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Science, Technology, Engineering, and Mathematics Student Persistence at a HBCU Community College

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This is to certify that the doctoral study by

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Walden University
2023

Abstract

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by

Terry Leachear Hughes

MS, Southern Wesleyan University, 2006

BS, Southern Wesleyan University, 2004

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

June 2023

Abstract

The problem addressed in this basic qualitative study was the persistence of science, technology, engineering, and mathematics (STEM) students at a historically Black community college (HBCC) in the southern United States. This problem is important because understanding the key successes and challenges STEM students face may enable faculty and administrators to support low-persisting students through degree completion. The purpose of this study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. Astin's theory of involvement and Reasons and Terenzini's synthesis of persistence were used as the conceptual framework for this study. The research questions were designed to develop an understanding of what students perceived as the keys to their success and the challenges that influenced their persistence. Eight, third-semester STEM students enrolled during the fall of 2021 and spring of 2022 volunteered to participate in the study. Data were collected using audio recorded, semistructured interviews and were analyzed thematically applying manual coding strategies to develop emergent themes. Participants perceived an engaging and supportive environment, specific course and content alignment, being academically determined, having adequate resources, and culture and opportunity as keys to their success towards degree attainment. The implications for positive social change include the potential for increased empowerment of HBCC students and how they will be represented in STEM fields after graduation, with added ability to promote social awareness and contribute to their communities.

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Dedication

This dissertation is dedicated to my Lord and Savior Jesus Christ. I can do nothing without him. This work is also dedicated to my loving husband, Timothy Hughes, who is my biggest fan. Words cannot express how blessed I am to have you in my life. Thank you for your prayers and support. Thank you to our daughter, Zacari, for being my cheerleader and so encouraging. “Mommy loves you.” To my mom for instilling in me hard work and perseverance. To my dad, I know you are looking down on me and smiling with great joy to see me complete this milestone. My siblings, you pushed me to never give up, thank you!

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Proverbs, 16:9:

“In their hearts, humans plan their course, but the *LORD* establishes their steps.”

I thank God for establishing my steps and giving me the strength to persevere to achieve this goal. I want to express my genuine gratitude to my committee members, Dr. Sydney Parent and Dr. Carole Pearce. Thank you, Dr. Parent for the positive energy you brought to this process. Thank you for your time and feedback, but most of all the motivation and support. Dr. Pearce, from day one you took the time to answer my questions. Thank you for your guidance and support. Dr. Moffett, thank you for your timely feedback. Thank you, Mrs. Richards, you answered every call and email, not one time you said no. Ms. Spells, you took time out of your schedule to help when asked upon, thank you!

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Chapter 1: Introduction to the Study

In this study, I explored science, technology, engineering, and mathematics (STEM) student persistence at a historically Black community college (HBCC) and how it could lead to positive social change. According to Talley (2022), there are currently 101 historically Black colleges and universities (HBCUs), of which 11 are HBCCs. To be designated as a HBCC, the institution must have been established prior to 1964, be accredited by a nationally recognized agency, and have the principal mission of educating African Americans (Stefon, 2023). There is little prior research on STEM student persistence at these institutions. Getting the students' perspectives of what caused them to succeed and their identified challenges could lead to the development of strategic approaches for administrators and faculty to help students with completing their academic journey. Completion rates and a decline in graduation rates is a growing concern among policy makers and university leaders for HBCUs (Montgomery & Montgomery, 2012). Due to the current competitive global market and rapidly changing trends, there is an increased demand for qualified individuals in STEM fields in the United States (Harris & Hodges, 2018). This study's implications for positive social change include the potential for increased empowerment of HBCC students and how they will represent STEM in the competitive market after graduation. The results of this study also support positive social change by improving persistence among STEM students who then become graduates and contribute to their communities. In this chapter, I discuss the background, problem statement, the purpose of the study, research questions, conceptual

framework, nature of the study, terms, assumptions, scope and delimitations, limitations, and significance.

Background

STEM education has been researched and explored on all levels at institutions across the United States (Balyk et al., 2022; López et al., 2022). However, HBCCs have received little attention compared to other institutions (Carter, 2018; Nelson & Baltes, 2019). I attempted to address the gap in practice in this study by exploring the number of students enrolled in STEM disciplines at one of the nation's 11 HBCCs and how few persist toward degree attainment. Dating back as far as World War II, the United States has benefited from the research in science and technology to maintain global competitiveness (National Academies of Sciences, Engineering, and Medicine, 2016). Nonetheless, since the start of the 21st century, government, educational, and industry leaders have expressed concerns about the shortage of STEM students and qualified STEM workers. The general problem is that educators and policymakers need to understand how to retain and raise the number of diverse students pursuing STEM in higher education (Dillon et al., 2016).

According to a telecommunications report, STEM initiatives continue to focus on innovative ways to attract and keep students engaged in STEM and increase active learning as well as ways to reduce bias about STEM professionals and STEM careers ("Budget Plan Offers," 2016). Additionally, the White House worked to increase a computer science initiative for computer training in schools (Breland, 2017). Recent reporting shows Congress backing research for the 2021 spending bill (Mervis, 2021).

Although agencies like the U.S. Department of Education and National Aeronautics and Space Administration have received a slight increase, the National Science Foundation budget has grown the least among the biggest four science agencies (Mervis, 2021). In addition, IBM (2020) announced committing $100 million to HBCUs investing in technology assets, resources, and skill development. Researchers found that the work of 4-year HBCUs contributed to the diversification of the STEM fields and addressed the shortage in the STEM workforce (Carter-Johnson et al., 2018; Gasman & Nguyen, 2016a). Additionally, since 2002, HBCUs have been the primary institutions for African American science and engineering recipients of baccalaureate degrees and are the only type of institutions that have shown an upward trend in producing STEM graduates (Fiegener & Proudfoot, 2013).

Since the beginning of the 1980s, educators and policymakers have continued to work on solutions to help improve persistence of underrepresented groups in STEM persistence in higher education (Collins, 2018; Estrada et al., 2016; Merolla & Serpe, 2013). Moreover, researchers have suggested that institutions implement STEM enrichment programs as well as provide students with access to research experience and faculty mentoring (Lane, 2016; Merolla & Serpe, 2013).

HBCCs have policies and practices in place to accommodate students who are less academically prepared in STEM disciplines (Gasman & Commodore, 2014; Toldson, 2018) as well as institutional structures and programs in place designed to address the academic challenges that may limit their students' success in STEM (Perna et al., 2009). Some institutions also implemented an early warning system designed to intervene to

assist students who experience academic difficulties (Perna et al., 2009). Scholars and practitioners noted that all HBCCs have a common mission, to provide an increased educational opportunity for underserved communities. HBCCs have an advantage because of their unique position within the African American community to attract underrepresented students (Toldson, 2018). HBCCs have addressed and filled the void of qualified STEM educators (Allen & Jewell, 2002). Therefore, these institutions have attracted more STEM teachers and increased their training (Kuenzi, 2008).

Research has indicated that mentoring contributed to underrepresented students' persistence in STEM (Lisberg & Woods, 2018). According to Ghosh-Dastidar and Liou-Mark (2014), the effectiveness of mentoring is one of the most significant factors that increase an underrepresented student's motivation and engagement in STEM. To increase diversity in STEM, some institutions developed a three-tiered mentoring program, including peer-led learning, research scholars, and graduate studies preparation (Ghosh-Dastidar & Liou-Mark, 2014). Researchers also found that mentoring had a significant impact on STEM students' academic performance (Harris & Nagle, 2022). These institutions have climates in which students support each other to have common success (Maton et al., 2000).

HBCCs provide an institutional environment supportive of the student's background and culture (Gasman & Commodore, 2014). Encouraging success by creating an atmosphere that celebrates STEM students' participation (Gasman & Nguyen, 2014) and carving out institutional niches that are STEM-focused (Hurtado et al., 2010) are important aspects of a supportive environment. Some scholar-practitioners substantiated

that those external inspirations, especially from faculty members and staff members, may lead to an environment of affirmation (Gross et al., 2019; McClain et al., 2018; Osborne & Orezzoli, 2022). Moreover, students who have attended HBCCs described the environment as a unique culture, mutually supportive, and collaborative, specifically in science (Hurtado et al., 2009).

HBCCs have implemented strategies to support a student's success in STEM (Gasman & Nguyen, 2016a). According to researchers, engagement focused learning and active learning specific for these settings could improve training and professional development (Buncick et al., 2001; Gasman & Nguyen, 2014; Lee et al., 2019). This type of approach is more effective for African American students because these students tend to respond better while engaging in exercises in which they have time to think about an idea (Gasman & Nguyen, 2014).

Another strategy HBCCs implemented included hosting science-related research days to give students exposure to a faculty member and student research (Gasman & Nguyen, 2014). These undergraduate research days allowed students to participate in research to create a passion for scholarship while acknowledging the exposure to the inspirational research of their peers (Gasman & Nguyen, 2014). HBCCs have also implemented institutional responsibilities, acknowledged the unique needs and challenges of their students, and continually worked with them to meet the standards of STEM (Gasman & Nguyen, 2016a). Additionally, some institutions implemented programs, such as foundations of mathematics and the fundamentals of engineering, intended to improve

the transition to college by front-loading STEM interventions as early as possible (Gasman & Nguyen, 2016a).

Researchers have asked if the school of choice is what affects students' persistence in STEM disciplines (Griffith, 2010). Studies have shown that underrepresented students who attend large institutions with research expenditures have lower persistence rates; however, students who choose colleges and universities with a focus on teaching and research have a higher likelihood of remaining in a STEM major versus attending an institution with less emphasis on STEM (Griffith, 2010). According to Fox et al. (2017), minority-serving community colleges, which include HBCCs, have been identified as being extremely important pathways for underrepresented students.

Effective leadership on a HBCC campus contributes to a student's persistence in STEM (Lockett et al., 2018). The interactions between senior-level administrators and students have an impact on student engagement and motivation to succeed (Lockett et al., 2018). Specifically, for HBCCs, engagement is evident as senior administrators interacting with students can directly or indirectly affect how students perceive their ability to succeed (Lockett et al., 2018). Along with their day-to-day responsibilities, senior administrators at HBCCs have multiple roles including overseeing the implementation of institutionalized student support systems (Lockett et al., 2018). Although they may not always be visible, HBCC presidents understand the importance of listening to students to get an understanding of their academic needs (Lockett et al., 2018). The current basic qualitative study was needed because there is an increased need in the workforce to fill STEM positions (see Cain, 2022). Graduates of HBCCs are

needed to fill the gap in current and future STEM positions, and filling these positions can help strengthen their families and communities.

Problem Statement

The problem under study was the idea that the persistence of STEM students at HBCCs is not fully understood by policymakers and educators (see Bray et al., 2018). Often, STEM students lack the support and encouragement needed to persist, which results in failing to complete their degree (Stavrianeas & Stewart, 2022). Consequently, these students will have less career opportunities and fewer chances for employment in the growing fields of STEM (Black et al., 2021; Cabell & Gnilka, 2021; Chen & Soldner, 2013). Nonetheless, 4-year HBCUs are instrumental in preparing students with different levels of academic backgrounds and are successful in producing STEM graduates who are career ready (Boncana et al., 2021; Huang et al., 2021; Toldson et al., 2021). A review of the literature revealed that little is known about HBCCs and the persistence of STEM student. Although HBCCs are an important part of their communities, there has been little research to date that directly discusses the persistence of STEM students (Elliott, et al., 2019; Nelson & Baltes, 2019; Strayhorn, 2021). My goal with the current study was to explore what students perceived as their keys to success and the challenges they faced when persisting in STEM disciplines to address this gap in the research.

Some of the most current literature on the topic has focused on understanding the persistence of students in other disciplines at HBCCs (Baker et al., 2020) and institutional factors related to persistence (Britton et al., 2022). However, more research is needed to understand persistence in STEM disciplines at HBCCs. The findings of this study may

inform HBCC leaders in how to further develop and implement practices to encourage student persistence in STEM disciplines.

Purpose of the Study

The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. In this study, I employed a basic qualitative approach, using open-ended interview questions to understand what STEM students perceived as keys or challenges to their academic success. It was important to identify students' key successes and challenges because of the impact those have on students' persistence. The need to increase workers in STEM fields, combined with the fact that underrepresented students, especially African Americans, remain underrepresented in higher education, makes the examination of student persistence in STEM fields crucial to growing the STEM workforce (see Adams et al., 2017).

The study's implications for potential for positive social change include the increased empowerment of HBCC students and their representation in STEM fields after graduation. The results of the study also support positive social change by improving persistence for STEM students who then become graduates and promote social awareness and contribute to their communities. Overall, academic successes lead to persistence, student graduation, and then employment. Additionally, an increase in STEM graduates has the potential to benefit employers, communities, and the economy.

Research Questions

The following research questions guided this study:

RQ1: What do STEM students who successfully persisted in their academic life at a HBCC perceive as the keys to their success?

RQ2: How do STEM students describe their challenges related to their progression toward degree attainment at a HBCC?

Conceptual Framework

In this study, I focused on STEM students' persistence and what they perceived as keys to their success and the challenges they faced. The conceptual framework for this study was based on combining two theories: Astin's (1984) student involvement theory and Reason's (2005) synthesis of persistence research that includes the persistence conceptual framework developed along with Terenzini in 2005. In this section, I provide an overview of the two theories as they relate to students' persistence in STEM disciplines.

In the theory of student involvement, Astin (1984) suggested that greater student involvement in the academic and social aspects of college will lead to greater learning. Astin's model is important to the current study because it demonstrates a link between students' academic involvement and their success in persisting towards degree attainment. Astin's theory is useful in understanding and embracing the unique experiences of African American students (Outcalt & Skewes-Cox, 2002). Given the unique challenges and experiences of HBCC STEM students, Astins' input, environment, and output (I-E-O) model can be useful for recognizing students' precollege STEM courses and the environmental factors that align with their persistence. The data analysis

results of this basic qualitative study show how previous STEM courses and environmental factors, such as faculty interactions, are instrumental in persistence.

Terenzini and Reason's 2005 framework organizes and synthesizes research on college student persistence and includes the researchers' own work as well as literature reviews conducted by Braxton et al. (2008), Pascarella and Terenzini (2005), Tinto (2001, 2017), and Reason (2005). Reason's framework was applicable to the study because it can be used to help explain students' persistence more clearly and connections to their success and/or challenges.

The conceptual framework for this study comprised two theories that are relevant to students' persistence in STEM disciplines. Both research questions were relevant to Astin's theory of student involvement and Reason and Terenzini's synthesis of persistence. I developed an interview protocol instrument that focused on gathering data in relation to students' academic involvement and how faculty have been instrumental in their persistence. A more thorough explanation of the framework is provided in Chapter 2.

Nature of the Study

In this basic qualitative study, I focused the perceived keys to success and challenges faced by a group of STEM students at a HBCC in the southern United States enrolled in their third semester and beyond. The qualitative approach has been and is still used in educational research (Merriam & Tisdell, 2016). According to Patton (2015), qualitative research is applicable to educational research and is a straightforward approach. Merriam and Tisdell (2016) stated that using basic qualitative research

originated from the belief that knowledge is constructed by people as they engage in and make meaning of an experience. A qualitative approach was necessary for understanding if prior STEM courses and the college environment contributed to students' persistence.

Data were collected from eight third-semester STEM students using semistructured interviews. After the interviews were transcribed using Nvivo transcription software and reviewed by the participants, I coded the data using the drag and drop method. Data were sorted, organized, and arranged into themes using Microsoft Word. The conceptual framework comprised the theory of student involvement and the synthesis of persistence. I analyzed the collected data through the lens of this conceptual framework, which provided the basis for understanding what students perceived as their successes and challenges to degree completion. To outline the importance of STEM student persistence, the naturalist paradigm was used for this study. To achieve this, I interviewed participants to hear their stories, perceptions, and experiences.

Definitions

The following terms were defined for use in this study:

Community colleges: Community-based institutions of higher education open to anyone with a desire to learn. Community colleges offer comprehensive educational programs and have open-access admission policies (American Association of Community Colleges, 2015).

HBCUs: Institutions that were the only higher education option for African Americans until the mid-1960s. HBCUs comprise 3% of the higher education institutions in the United States (Gasman, 2013; Lee & Keys, 2013).

HBCCs: Institutions whose origin was with private and religious organizations, many of which were founded after 1964. These institutions offer associate degrees and options to transfer to 4-year institutions. Their role was and is the same as the 4-year HBCU, which is the continued success and education of the African American community (Elliott et al., 2019; McClain et al., 2018).

Persistence: A student's postsecondary educational behavior in continuing to reach educational goals (Dwyer, 2017). In the context of this study, persistence was used to describe students who are continuing their enrollment in STEM disciplines.

Science, Technology, Engineering, and Mathematics: Although STEM fields may broadly include social and behavioral sciences (Chen, 2009), for this study, STEM fields aligned with the U.S. Department of Education's definition to include engineering technologies and computer/information sciences (Chen, 2009).

Assumptions

Assumptions are thoughts or conclusions that a researcher believes to be true without empirical evidence for verification (Ellis & Levy, 2009). The focus of this study was STEM student persistence. I assumed all participants would be persistent in their discipline. This study also included the assumption that HBCC STEM students would be open and honest in sharing their experiences and stories as they progress toward degree attainment. I also assumed all participants understood the interview questions. Other assumptions were that (a) participants were honest during the interviews, and (b) the participants provided concise information relevant to the topic of study. Nonetheless, participants answered the questions to the best of their ability.

Scope and Delimitations

The specific aspect of the research problem addressed in the study is what STEM students perceived as keys or challenges to their academic success. In researching STEM students at a HBCC, I found that there was very limited extant information on the topic. Because of limited research, I decided to conduct this study on HBCCs. The participants were learners who were persisting through STEM courses. Non-STEM degree seeking participants were not included in the study. A delimitation, or the intentional boundaries, established for this study included the focus on STEM students at only one of the 11 designated HBCC institutions. Because this study focused on STEM students only in the southern United States, STEM students from other HBCCs were excluded from this study. The conceptual framework of Milem and Berger's (1997) model of persistence, which proposed that student behaviors and perceptions interact to influence academic and social integration, was excluded from the study.

There is potential for transferability of the findings to other HBCC institution STEM programs. The results of this study could provide the underpinnings for other studies looking at STEM students' persistence at HBCCs. In addition, the findings of this study could be beneficial to college administrators seeking to increase persistence in their STEM disciplines.

Limitations

Limitations in research present a propensity towards weakness and concerns for the study (Ellis & Levy, 2009). With the identification of possible limitations in research, researchers must exercise patience while employing their research skills (Lodico et al.,

2010). Limitations I considered in this study were (a) participants' withdrawal from the study, (b) the inaccuracy of participants' stories relating to the phenomenon, (c) a small sample size, and (d) the lack of generalizability when doing a basic qualitative study because no statistical testing is done when using this research design (see Myers, 2000). I served as the primary instrument for data collection; consequently, there was a possibility of researcher bias in the study. A possible bias could have been assuming all participants were African American males during the interviews. Methods I used to avoid potential researcher bias included being clear and asking straightforward questions that could be answered by any gender or ethnic group.

Each limitation was carefully addressed. The data collection process began fall semester of 2021. The sample size was limited due to the availability of the participants. Approximately 65 invitations were sent out, and I received five responses from students expressing their interest in participating in the study. However, three participants withdrew from the study. The recruitment process being used was reevaluated and reapproved by Walden University Institutional Review Board (IRB). Over the course of 8 months, six additional participants were recruited, providing a total of eight participants. The next limitation addressed was the possible inaccuracy of participants' stories. Depending on how they may have interpreted the word persistence in their unique situations, participants may have answered vaguely. The last limitation was a lack of generalizability because the results can only be applied specifically to HBCC STEM students.

Significance

In conducting this study, I focused on students who were enrolled in STEM disciplines at a postsecondary HBCC. This study is unique because I addressed the significance of STEM student persistence at a HBCC in the southern United States and how graduates can contribute to STEM (see Nave et al., 2016). This research is needed because minimal studies on HBCC STEM student persistence exist compared to other areas in higher education (Bray et al., 2018; Elliott et al., 2019; McClain et al., 2018). Therefore, the results of this study may be valuable for higher education STEM educators and administrators, specifically at HBCCs.

Educators may use the results to further partner with elementary, middle, and high schools to influence students' STEM persistence earlier in their education. This study may also be significant to policymakers who grant resources to increase the number of underrepresented workers in the STEM pipeline (see Dillon et al., 2016). Understanding why students persist in STEM at HBCCs could be valuable in helping local and national government entities with appropriate funding for HBCCs. Presidential administrations have made STEM education a national priority (Breland, 2017). Recent projections show a growth from 2020 to 2023 with approximately 734,900 new jobs in computer technology and mathematics which calls for a STEM-capable workforce (Hira, 2022). The findings of this study advance knowledge in the field of education because of the focus on the persistence of STEM students at a HBCC. Likewise, there is potential for positive social change by providing other HBCCs with the results of this study, which

reflect how STEM students are empowered to persist, graduate, and contribute to their communities.

Summary

In Chapter 1, I provided an overview of the study. The purpose of this study was to explore STEM student persistence. The problem addressed was the idea that the persistence of STEM students at HBCCs was not fully understood by policymakers and educators (see Bray et al., 2018). There is little previous research on persistence of STEM students at HBCCs, while there are many studies available addressing students' persistence in STEM at other types of institutions.

In Chapter 2, I will provide a literature review regarding student persistence in STEM disciplines. The chapter also includes a description of the literature search strategies used and a more in-depth discussion of the conceptual framework as it relates to past and current research on student persistence. I synthesized the current literature related to students' persistence in STEM disciplines. The gap in literature is also discussed to establish why more research is needed on STEM students' persistence at HBCCs.

Chapter 2: Literature Review

The specific problem under study was that the persistence of continuing community college STEM students at HBCCs is not fully understood by policymakers and administrators. The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. In Chapter 2, I provide the literature search strategies, conceptual framework, and a review of the literature related to key concepts and variables. The chapter also includes a discussion on persistence in STEM fields at community colleges. In addition, I justify the selection of student persistence in STEM as the topic and current problem and synthesize studies as they relate to the research questions before concluding the chapter with a summary.

I conducted this study to add to the existing body of research and fill a gap in the literature that could encourage STEM students to persist to degree completion. According to Nelson and Baltes (2019), there is a gap in the literature when it comes to HBCCs, which are seemingly forgotten when it comes to research. There is little research focusing on persistence in HBCCs as these institutions continue to enroll and graduate students in the certificate and associate degree STEM disciplines (McClain et al., 2018; Stage et al., 2013). HBCCs are also instrumental in preparing academically underprepared students with pathways into STEM (McClain et al., 2018; Stage et al., 2013). If the gap in literature were to be filled, action could be taken to implement strategies that would reach more STEM students at these institutions.

Literature Search Strategy

To locate literature for this review, I searched for peer-reviewed references, scholarly journals, and books accessible through the public library and the Walden University Library, specifically the Business Source, ProQuest, EBSCO, ERIC, Document Delivery Services, and Thoreau databases. Keyword search terms included *persistence, STEM students, HBCUs, historically Black junior colleges,* and *historically Black community colleges.*

Most articles included in this study have publication dates between 2017 and 2021. In this review of the literature, I focused on STEM graduates who attend HBCUs and HBCCs. Results of the literature search are presented in topical order to advance the understanding of the role of persistence in students completing STEM disciplines to support the research questions. However, because of the nature and specificity of the topic, I expanded the publication dates searched to locate more relevant research related to the topic. Local, state, and national data on persistence in STEM at a HBCC was also searched. Additionally, I used the American Association of Community Colleges, the American Institutes for Research, the Frederick Patterson Research Institute Research and Reports, the U.S. Department of Education (i.e., National Center for Education Statistics), and the National Science Foundation websites extensively. There are few empirical studies on HBCCs, and the literature is limited. Much of the research and literature included HBCCs in a larger database without dissociation from 4-year HBCUs. Because there is only a small group of HBCCs, much of the research is older but was

needed to sustain the current research. After organizing and reviewing the sources, I concluded that adequate information had been collected to support this study.

Conceptual Framework

While other researchers studied persistence in college students, Astin's (1984) student involvement theory and Reason's (2010) synthesis of persistence research, which relied on the conceptual persistence framework developed alongside Terenzini (2005) provided an appropriate lens for this study. This framework was uniquely suited for this study because it relies on studies that are part of the extremely limited research on the persistence of students at HBCCs. Terenzini and Reason's (2005) framework included synthesized models integrating the work of Astin (1984, 1993), Tinto (1987, 2001, 2017), and Pascarella and Terenzini (2005) that drew the model for studying organizational effects of student outcomes proposed by Berger and Milem (2000). In the theory of involvement, Astin suggested that when students become involved academically and socially in college, the more they will learn, develop, and persist (Berger & Milem, 2000).

In their model of persistence, Berger and Milem (2000) proposed that student behaviors and perceptions interact to influence academic and social integration. However, the model was expanded and linked to Astin's (1993, as cited in Kuh et al., 2008) theory of involvement and persistence to suggest that students' psychosocial engagement directly influenced their persistence. In addition, Astin (1984) suggested students who frequently interacted with faculty members and peers and who were highly involved, which refers to the amount of physical and psychological energy exerted, time devoted to

study, time spent on campus, and active participation in student organizations were more likely to persist (Berger & Milem, 2000). However, students who are not involved neglected their studies, did not spend time on campus, did not participate in extracurricular activities, and had little interaction with faculty members and other students (Astin, 1984).

Astin (1984) concluded that five theory factors contribute to persistence: (a) involvement, which refers to the investment of physical and psychological energy in different objects; (b) involvement will continue with different students investing different amounts of energy in different objects at different times; (c) involvement has qualitative and quantitative features; (d) the amount of student learning and personal development is directly proportional to the quality and quantity of student involvement directly related to their program; and (e) the effectiveness of any educational practice is directly related to the capacity of that policy or practice to increase student involvement.

The theory provides basic, yet empirical, knowledge about environmental influences concerning student development that other researchers had learned; however, Astin (1984) did not find other theories to be adequate because of the dependency on human or educational resources that were difficult to implement or put into practice. Astin's (1984, 1993) theory of involvement focused on behaviors that promote student development by reiterating the student's active participation in their learning process. The more students are actively involved (i.e., participate) in college, the greater the learning and development. Astin's I-E-O model reflects how students interact in the process of adaptation (Renn & Reason, 2013). The theory attempts to explain what happens in the

environment segment of the model and what happens when a student's input characteristics interact with elements in the campus environment to produce specific outcomes (Astin, 1984; Renn & Reason, 2013).

To understand what predicts students' outcomes, researchers must understand what students bring with them to college (i.e., inputs) and the environment that leads to persistence in which they interact (Renn & Reason, 2013). Preparation and commitment fall within the input category as do student demographics and socioeconomic status (Renn & Reason, 2013). Environmental variables contribute to a host of factors within the organization, such as faculty members, peers to peers, and extracurricular activities (Ferrare & Miller, 2020). These factors make up involvement in addition to Astin's underlying principles, which are (a) students encounter environmental stimuli that reinforce specific traits and behaviors; (b) students may cause adaptations in the environment, and (c) outcomes, such as learning, development, and student success, are the product of interactions between individuals and their environment (Renn & Reason, 2013).

Terenzini and Reason's 2005 comprehensive framework guides student outcomes in research. Reason's framework included organization and synthesis of the extant research on college student persistence. The work of Reason included several reviews of other theorists, such as Braxton et al. (2008), Pascarella and Terenzini (2005), and Tinto (2007, as cited in Reason, 2009). According to Terenzini and Reason (2005), four areas that overlap and interact affecting how college students persist are (a) student precollege characteristics, (b) organizational factors, (c) student peer environments, and (d)

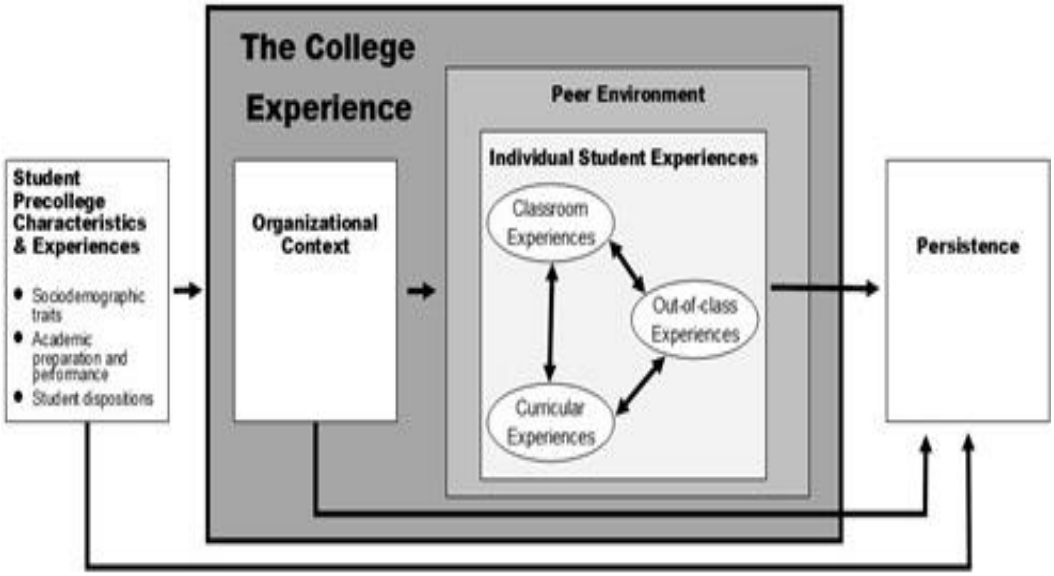
individual student experiences. Reflecting on this review, Reason synthesized several implications from the literature on persistence research. First, the higher education community recognized that students from diverse backgrounds, which include race and ethnicity, experience different college environments, which include efforts to improve persistence. A student's involvement with the environment also matters. Furthermore, more complex thinking is needed about persistence in research and practice (Reason, 2010). The decisions and behaviors proposed by Reason in the theory of student persistence are multidimensional. Reason's view illustrates the evolution of thinking about persistence, while the earlier theories of Astin (1984) and Tinto (1987) examined only student involvement and interaction in the college setting.

I considered Reason's (2010) implications in this study and utilized an integrated framework to examine student persistence based on Astin (1984) and other scholars' works which were reviewed by Reason for their connection to STEM persistence. An important link that connects the frameworks and enabled integration was the emphasis on behaviors as the main cause of student achievement outcomes, personal development, and persistence (Astin, 1984; Berger & Milem, 2000; Kuh et al., 2008; Renn & Reason, 2013). As described by Astin, student behaviors are related to their efforts spent studying, time spent on campus, and participation in student organizations. Additional behaviors were studied by Kuh et al., (2008), and students' precollege and college characteristics were studied by Reason. Faculty member behaviors are related to faculty member interactions with students (Astin, 1984), what the faculty members do (Kuh et al., 2008), and their influences on student persistence (Reason, 2010). Institutional behaviors

conveyed in Astin's work are policies and practices put in place to increase student involvement (Kuh et al., 2008) and all institutional influences (Reason, 2010). I integrated Reason's synthesis into the conceptual framework because of its focus on the impact of students' precollege characteristics and experiences. This study adopts (see Appendix A; permission from the author, Robert Reason,) a portion of Terenzini and Reason's (2005) conceptual framework, see Figure 1, that suggests that college effects on students' learning, and persistence begin with the characteristics and experiences undergraduate students bring with them to college and the college experience.

Figure 1

A Comprehensive Model of Influences on Student Learning and Persistence



Note. From*"* Parsing the First Year of College: Rethinking the Effects of College on Students," by P. T. Terenzini and R. D. Reason, 2005, presented at the Meeting of the Association for the Study of Higher Education, Philadelphia, PA.

Astin's (1993) theory of involvement indicated that the amount of energy undergraduate students put into their college experience, both academically and socially, would likely result in persistence. Astin suggested two forms of involvement: (a) academic, which includes spending time in labs, attending class, involvement with faculty members, studying, and doing homework and (b) social involvement, which includes involvement with peers, such as peer-to-peer mentoring, peer tutoring, working on a group project, socializing with friends, and student clubs.

Academic Involvement

A competitive nature remains in STEM programs in higher education and contributes to the persistence of STEM majors, specifically among underrepresented

students (Espinosa, 2011; Lancaster & Xu, 2017). Researchers have called attention to a range of reasons related to the persistence of underrepresented STEM students, such as academic preparation, social support, campus environment, and financial concerns, that are shown to influence the involvement of students in STEM fields (Figueroa & Hurtado, 2013; Lancaster & Xu, 2017; Strayhorn, 2017). The environment, which includes small class sizes, student-faculty member relationships, and having a family-like atmosphere, also influences student involvement that leads to STEM student persistence (Figueroa & Hurtado, 2013; Lancaster & Xu, 2017).

In their studies on STEM persistence among underrepresented groups, Garcia and Hurtado (2011) concluded that students who were involved in academic clubs or organizations, studied with others, or participated in undergraduate research programs had higher chances of persisting. Gayles and Ampaw (2014) agreed with Astin (1993) in suggesting that faculty member interaction, specifically outside of the classroom, positively impacts the persistence of STEM students. The connection between students' academic involvement and the institutions environment impacts students' persistence (Astin, 1984, 1993; Straus & Volkwein, 2004).

Griffith's (2010) study on the persistence of women and underrepresented students in STEM combined a restricted data set from the National Longitudinal Survey of Freshmen (1988) and the National Educational Longitudinal Study of 1988 to investigate institutional factors that contribute to persistence. Griffith found that an institution's environment has a strong impact on STEM students' persistence. According to Griffith, colleges, universities, and others interested in the increasing persistence of

students in STEM field majors should place some focus on the institutional environment because students are more likely to continue in a STEM major when more of a focus is placed on the undergraduate student experience.

Social Involvement

Student learning and cognitive development have been proven to shape what happens in the classroom, but, more extensively, it is the learning opportunities institutions provide outside of the classroom that promote student persistence at the postsecondary level (Astin, 1984; Gasman & Nguyen, 2014; Tinto, 1987). Astin (1993) found that social involvement factors, such as campus environment (like a residence hall) and involvement in extracurricular activities, impact student persistence. According to Astin (1984), students who are socially involved are more persistent:

> Students who live on campus in residence halls were positively related to persistence because they had more opportunities to be involved. The positive effect occurred at all types of institutions. Students who joined social fraternities or sororities or participated in extracurricular activities of almost any type are less likely to drop out. Participation in sports, particularly intercollegiate sports, has an especially pronounced positive effect on persistence. (p. 525)

Contrary to Astin's (1984) findings, other studies proposed that social involvement harms the persistence of college students in STEM (Bonous-Hammarth, 2000; Cole & Espinoza, 2008). Cole and Espinoza (2008) noted that underrepresented students' participation in social events, specifically diversity-related functions or activities, negatively affected students' grade point averages. Bonous-Hammarth (2000) also discovered that for the persistence of underrepresented groups in science,

mathematics, and engineering, social involvement had a negative influence on them. Litzler et al. (2014) agreed that some students, specifically underrepresented engineering students, found difficulty in participating in student organizations or activities because there was a notable distinction attributable to their racial and ethnic differences present, which caused a lack of persistence.

Literature Review Related to Key Concepts and Variables

Persistence

Evans and Baker (2016) defined persistence as a time of duration, in other words, movement over a certain amount of time, which mainly concerns individuals, and some people persist while others do not. Renn and Reason (2013) as well as Habley et al. (2012) indicated that a universal way of defining persistence does not exist because different perspectives have different definitions. Concurrently, Lohfink and Paulsen (2005) used data from a national survey to look at persistence for first-generation and continuing-generation students at predominately White institutions and at HBCCs, which concluded that a wide range of definitions for persistence was present in both situations. The findings from their study are beneficial to help scholar-practitioners better understand the persistence of first-year students. This study takes a unique approach from existing research by focusing on the persistence of HBCC students enrolled in STEM disciplines at their institution.

Conversely, Leppel's (2002) view of persistence offered a broader perspective that included how students are progressing from their first to their second year in college. Mortenson (2005) defined student persistence as a student who initiated the decision to

stay in college while Habley et al. (2012) defined a persistent student as one who continues to enroll at the institution. Lennings 1978 definition of student persistence is, students who continuously enroll without interruption (as cited in Habley et al., 2012). Astin (1993) concluded that student persistence is full-time status in the pursuit of a degree with the expectation of graduation in 2 to 4 years. (Habley et al., 2012). Therefore, I examined STEM students enrolled in a 2-year college setting and their persistence.

Historically, the research on persistence has focused more on attention to educational aspirations (Mau & Mau, 2006). The study of persistence builds on other scholars' work in college attrition and retention, including Astin (1984), Tinto (1987), and Reason (2010). Persistence has been a focus of study since 1975 (Habley et al., 2012). Numerous sources have been written to help understand persistence (Astin, 1993; Buonomo, 2018; Habley et al., 2012; Renn & Reason, 2013). Previous theories and models explored factors of persistence that focused on a students' perseverance instead of other factors that simply prevent departure (Graham et al., 2013; Lane, 2016).

As early as the 1930s, much research was conducted on why students failed to persist as opposed to why they succeeded (Demetriou & Schmitz-Sciborski, 2012). From the 1600s to the 1900s, the earlier institutions of higher education struggled to maintain enrollment (Berger & Lyon, 2005). However, researchers included more interest in recruiting and graduating students, with little concern about persistence (Berger & Lyon, 2005). Furthermore, in early U.S. society, a college degree was of little importance because colleges comprised a small entity, and persistence was not an issue (Berger &

Lyon, 2005). During this era, higher education institutions focused more on survival than on student persistence (Berger & Lyon, 2005).

During the 20th century, higher education institutions began to look at ways to improve persistence by emphasizing the importance of a college degree and monitored expansion, which created the need to persist because high school diplomas were less valuable for economic growth. However, previously, the focus of the 19th century was to encourage students of color and students from disadvantaged backgrounds to persist (Demetriou & Schmitz-Sciborski, 2012). Not until the 1990s did scholars and practitioners recognize students' ability to persist to degree completion as incredibly important.

While the 20th century began the emergence of persistence, the 21st century is when scholars and practitioners realized that student persistence was a concern in higher education (Astin & Helen, 1992; Berger & Lyon, 2005; Reason, 2010; Tinto, 2017). According to Baker et al. (2020), student persistence is still a significant problem for colleges and universities. Low persistence rates affect institutions' enrollments, budgets, and community perception (Baker et al., 2020). The study of persistence continues to build on the expertise of scholars and practitioners in college retention and attrition, including Astin (1984), Reason (2010), and Tinto (1987).

The issue of STEM student persistence received much attention, with most of the studies focusing on students who attend 4-year HBCUs (Fiegener & Proudfoot, 2013; Gasman & Nguyen, 2016a; Toldson, 2018). Researchers offered many views of persistence and provided several explanations relevant to the concept of persistence at the

HBCCs (Habley et al., 2012; Owens et al., 2012; Palmer et al., 2014; Tinto, 1987). In this study, the topic of student persistence included the identification of several factors that contribute to student persistence. However, one collective agreement does not yet exist (Astin, 1984; Pascarella & Terenzini, 2005).

Halpin (1990) investigated persistence from the viewpoint of a 2-year college. In this context, the students came from diverse backgrounds, different life experiences, and different academic achievement expectations when they entered the college setting, academically and socially (Halpin, 1990). These background experiences could result in persistence or commitments and stay in college (Halpin, 1990). Student persistence in higher education is a growing interest that has led researchers to view the works of other researchers and theorists as to why students persist (Hossler et al., 2008).

Similarly, educational sociologists Tinto (2001) as well as Bean and Metzner (1985) concluded that students should be academically and socially engaged in their college experience to successfully persist toward degree attainment (Bauer & Liang, 2003). Astin's (1984) model of involvement suggested that students, involved academically and socially, led to learning, personal growth, and persistence (Habley et al., 2012). The literature reviews of persistence research highlight varying theories of persistence. Kuh et al. (2008) proposed that students engaged in educationally purposeful activities would persist. Reason (2010) drew on studies by Tinto (2006-2007), Pascarella and Terenzini (2005), and many scholarly works by Astin (1993) that proposed a wide variety of influences on why students persist, focusing on interventions and involvement. Moreover, according to Tinto (2001), other studies on persistence are continuously

evolving and consistently adding information into the research that is reflective of the changes in American higher education.

The review of the literature regarding persistence underlines the various definitions of persistence and how the term has evolved in the context of higher education. Research indicated how the topic of persistence remains a growing area of interest for those who seek to understand student persistence. Because this study involved undergraduate first-year STEM students at a HBCC, Cabrera et al. (1993) model, along with Wei et al. (2011), helped in understanding students' attitudes toward persistence. Experts in the fields of social science maintain their stance that individuals' attitudes eventually lead to their behaviors (Chaiklin, 2011). Understanding students' persistence attitudes is vastly important because the students' views of their institutions are influences on their persistence behaviors (Ward et al., 2013).

Student Attitudes Toward Persistence

Students who successfully persist in college understand that remaining in college takes more than academic ability (Collier & Morgan, 2008). Their involvement is a common denominator to their success (Astin, 1984). In their seminal work, Astin (1984) explained the importance of student involvement and the effects on student persistence. This theory is that student involvement is determined by the amount of physical and psychological energy students exert in their educational endeavors (Astin, 1984). Students with a positive persistent attitude show a reflection of their desire to endure situations beyond their control (Allen, 1999). In addition, students who are aware of their self-confidence, have specific career goals, and those who are satisfied with their STEM

majors are more likely to persist toward graduation (Bauer & Liang, 2003; Gibson et al., 2019).

A study conducted by Gurer et al. (2019) found that student attitudes toward STEM programs have not received much attention. However, some correlational studies reveal a positive relationship between students' achievements and their attitudes towards STEM courses (Gurer et al., 2019). Using their expectancy-value theory, Ball et al. (2019) investigated the attitudes of students in STEM programs. The results revealed that contributing factors such as expectancies for success and intrinsic values potentially push students toward STEM careers (Ball et al., 2019). Also, when students believe in their academic success and value academic activities, they are more likely to express more positive attitudes toward STEM courses (Ball et al., 2019). Attitudes and beliefs of students are critical requirements for their persistence in STEM (Wu et al., 2018).

Behaviors and Persistence

Other researchers focused on student behaviors that consider the institution's commitment to the success of the student, as well as the student's commitment to the success of their educational goals and found that they are a predictor of the student's progression to graduation (Straus & Volkwein, 2004). Institutional commitment is a key component that maintains student enrollment, retention, and student persistence (Gansemer-Topf & Schuh, 2006; Schreiner et al., 2011; Straus & Volkwein, 2004). Moreover, a supportive college environment is a key factor in students' integration and involvement in college life that leads to their persistence (Astin, 1984; Schreiner et al., 2011; Tinto, 2017). Furthermore, Schreiner et al. (2011) articulated that the institution's

commitment to student success includes personnel (e.g., faculty members, staff members, and administration), and their genuine authenticity helps to connect with students to influence their success and persistence. Also, students identified faculty member support, encouragement, positive relationships, and interest in the learner as examples of institutional commitment (Schreiner et al., 2011). Moreover, some institutions incorporate research projects that involve faculty members and students, which helps students understand the critical and social needs of STEM (Bililign, 2019). Students' views and perceptions of the educational environment influence how they feel supported (Cabrera et al., 1993; Tinto, 2017).

Community Colleges

Community colleges are defined as community-based institutions of higher education and are open to anyone with a desire to learn. They offer comprehensive educational programs, have open-access admission policies, and are otherwise known as centers for educational opportunities (American Association of Community Colleges, 2015). A turning point in U.S. higher education was the period following the first Morrill Act in 1862, just before the Civil War (Drury, 2003; Neyland, 1990; Phillippe & Sullivan, 2005). This act granted all states 30,000 acres of federal land to establish universities. The purpose of these universities was to prepare students for engineering and science (Drury, 2003; Neyland, 1990). However, a gap needed to be bridged between high schools and universities (Drury, 2003; Phillippe & Sullivan, 2005).

To fill this gap, in 1901 the first junior college was founded in the United States and educators realized that the first 2 years of college were not an essential part of a

university-level education (Drury, 2003). According to Drury (2003), educators and researchers recognized the need and developed a rationale that emphasized the first 2 years of college should be an extension of high school. Although the junior college movement was slow to grow, other impactful forces contributed to the growth, such as the need for trained workers to operate in the expanding industries, which led to their substantial growth from 1929 to 1939 (Brit, 1989).

From the 1940s to the 1950s, significant events happened that helped shape the future of junior colleges, such as the passing of the GI Bill of Rights, which assisted World War II veterans. By 1947, junior colleges became the primary entry point in the U.S. higher education system (Phillippe & Sullivan, 2005). By the 1960s, more colleges were open, and more students began to enroll (Cohen & Brawer, 2003). By the late 1960s and 1970s, the schools became vocational institutions (Grubb, 1989). By 1988 the term *community* received a new meaning as a climate of learning and not a geographical location in the establishment of community colleges (Drury, 2003). Wang (2013) found that community colleges received recognition for their key role in providing relevant STEM education for underrepresented students. Therefore, this study will examine STEM student persistence from the community college perspective.

Community colleges have open access admission policies, reported in National Center for Education (NCES, 2008), which means students do not have to compete for admission at a set time of the year or demonstrate a level of academic proficiency to enroll (Planty et al.,). According to Planty et. al. (2008), between 2000 and 2016, undergraduate enrollment in postsecondary education institutions increased by 28% from

13.2 million to 16.9 million students with 29% of these at 2-year institutions. An increase to 17.4 million undergraduate students is projected by 2027, and from these percentages, community colleges are projected to increase by 12% (Juszkiewicz, 2019; McFarland, 2018). These institutions serve as a major credentialing function in the United States, offering certificates, diplomas, associate degrees, and vocational job training (Strayhorn et al., 2013). Throughout the United States, businesses, 4-year colleges, and other organizations collaborate with community colleges to offer STEM-focused programs and job training critical to their local areas (Strayhorn et al., 2013). Community colleges are unique because they expand educational access to nontraditional and underrepresented student populations, while providing engaging learning environments, which are key components in supporting student's choice of STEM majors (Evans et al., 2020). They also foster growth and development while exploring new ideas and interactions between diverse student populations (Wendt, 2018).

Community colleges are an important entity in a student's pathway to baccalaureate degrees in STEM, specifically for underrepresented students, and now serve as a pivotal role in STEM education (Wang, 2016). According to a report from the National Academies of Sciences, Engineering, and Medicine (2016), taking introductory science and mathematics courses at the community college level is beneficial for students due to the critical role they play in expanding the STEM pipeline. On the other hand, studies have explored relationships between coursework and student persistence, showing that mathematics course completion was a barrier to student persistence (Cohen & Kelly, 2019a). Moreover, the contribution of community colleges has been instrumental to the

resolution of demographic inequities in STEM (Bahr et al., 2017). Despite the disparities and barriers for STEM students, researchers contend that community colleges are an important avenue to relieve the problem (Bahr et al., 2017; Eddy, 2013; Stage et al.; 2013; Wang, 2013). Furthermore, community colleges are known for improving STEM participation by encouraging students to engage in activities that are educational while continuously providing counseling and guidance (Strayhorn et al., 2013). Likewise, community colleges educate almost half of all students who persist and complete post-secondary degrees in STEM disciplines (Cohen & Kelly, 2019b).

STEM Education

Most of the research focused on student experiences in STEM in general; however, Eddy (2013) suggested that limited literature exists on STEM education. Sheffield et al. (2018) wrote that STEM education has received recognition as being a powerful force in creating innovative thinkers with problem-solving skills to become informed and empowered citizens. To ensure students are being empowered, faculty members must engage students through active learning during STEM class time and adopt empirically validated teaching practices that enhance student learning and persistence (Frost et al., 2018). It is also important to understand STEM students' classroom experiences because these experiences can help policymakers and educators identify best practices that will support STEM students' success (Eddy, 2013). However, due to the COVD-19 pandemic, many faculty members had to adopt new teaching methods to engage STEM students, using deductive and inductive approaches (Felder, 2021). While students may have taken advanced STEM courses in high school, and these

precollege STEM courses are predictive of students' success (Bettencourt et al., 2020), this is still not enough. It is important for students to complete all high school courses in preparation for their academic journey, and to prepare for future employment (Glennie et al., 2019). Bottia et al., (2020) suggested students' prior academic achievement, school contexts, and interest in STEM during high school are factors that influence students to choose STEM education.

Furthermore, education, such as vocational and contract training, is an opportunity for discussion among policymakers and educators to learn what supports students in STEM environments (Eddy, 2013). In addition, Patel et al. (2019) indicated that STEM school and STEM program courses embrace 21st century skill development and adhere to the philosophical foundation of STEM education. Educational theorists, such as Lowell and Salzman (2007), Kuenzi (2008), and Maltese and Tai (2011) provided specific attention to education in community colleges with an emphasis on STEM. Undoubtedly, a great need for STEM education exists (Marrero et al., 2014). Due to the global economic crisis, educational theorists concur that everyone needs an understanding of STEM to make decisions for their families, the workforce, and communities (Marrero et al., 2014; Yull, 2013).

STEM Students

In the 21st century, community colleges have enrolled more than 10 million students annually with an increased underrepresented student population, over half of whom declared a STEM major (Drury, 2003; Jordan & Rideaux Jr., 2018; Snyder & Cudney, 2017). The undergraduate STEM student population is growing, these students

outnumber their humanities counterparts (Grimm & Vostral, 2019). A growing entry point for STEM students is community colleges (Snyder & Cudney, 2017). As a result, these institutions have an impact on incoming STEM students (Crosta, 2014; Noy & Zeidenberg, 2017; Shadduck, 2017; Urias et al., 2013; Wang, 2013). Scholars and practitioners alike define STEM students as those who have declared STEM to be their major (Chen, 2009; Noy & Zeidenberg, 2017). Noy and Zeidenberg (2017) found that compared to 4-year STEM college entrants, 2-year STEM college entrants were underprepared and required developmental education. Data from the 2009 Beginning Postsecondary Students Longitudinal Study, a national survey administered when students begin their college education, reported that 33.7% were White while only 25.5% were Black (Urias et al., 2013).

Other studies on STEM students found that underrepresented students who choose a STEM major face a variety of challenges such as, being a first-generation college student, lack of family support, perception of faculty disconnection, and finances (Flynn, 2016; McKim et al., 2017). These challenges faced by underrepresented students have been realized by scholars and practitioners to have an impact on STEM recruitment, retention, and lack of persistence (Kezar & Holcombe, 2020; McKim et al., 2017). Numerous strategies (i.e., mentoring, peer groups, and transition programs) are known to support underrepresented students in STEM persistence, notably, peer groups are more effective because they foster connections and help students learn the material (Green & Sanderson, 2018; Kendricks et al., 2013). However, these strategies do not have to stop with implementation, and more research and education can be conducted to ensure

strategies for student success and persistence toward STEM degree completion (McKim et al., 2017). Some institutions have implemented courses to promote the success and persistence of undergraduate science students by incorporating field trips, social media-based assignments and field-based research projects (Kamen & Leri, 2019).

STEM and Community Colleges

Reports, such as *Science in Community Colleges: Community Colleges and STEM Education* (2012), have captured ways to close the achievement gap in STEM education. The report recommends disaggregating student data by ethnicity, gender, and economic status to inform community colleges, employers, and high school administrators of areas for improvement. In more recent reports, such as *STEM Education in the U.S.: Where We Are and What We Can Do* (ACT 2017), policymakers of all levels of government emphasize the importance of educating students for STEM-related occupations. Current research suggests that 2-year colleges align with the focus on broadening access to higher earning fields like natural sciences and engineering (Perez-Felkner, et al., 2019). Additionally, 2-year STEM courses are more successful in helping students build confidence and perform well (Liu et al., 2020). Consequently, because not enough U.S. STEM students are equipped for the workforce (ACT, 2017; Chen, 2021), I will explore the persistence of STEM students at a HBCC.

Furthermore, data indicate that the underrepresented population is expected to increase to 54% of the U.S. population by 2050, and the underrepresented STEM student population remains increasingly diverse. There is an upward growth in STEM education and researchers have found that the number of students switching majors out of science

and engineering is now lower than the number of students entering science and engineering (Mau, 2016). Higher education institutions must have clear strategies for recruitment and retention of STEM students to assist in the national effort to produce quality students for the STEM workforce (Snyder & Cudney, 2017). Some community colleges have implemented the use of simulations as experiential learning to allow a student to apply courses to real-life situations (Lowell & Khatri, 2021). HBCCs remain instrumental in implementing components into the STEM campus environment, such as assessing students' prior academic performances, facilitating students' adjustment to college as well as academic and social involvement which supports STEM students' persistence (Toldson, 2018).

HBCUs/HBCCs

HBCUs are defined as those institutions established before 1964 and amended by the Higher Education Act of 1965 whose principal mission was, and is, the education of African Americans (Lane, 2016). Accordingly, the 2-year historically Black institutions are aligned with this definition and have met the criteria (Guyden, 1999; Lane, 2016). HBCCs uphold the same mission as HBCUs, to educate African Americans (Elliott et al., 2019; Guyden, 1999).

According to Merisotis and McCartthy (2005), the first HBCUs were established in the 1830s to provide religious education and training to African American youth. The second Morrill Land Grant Act of 1890 provided U.S. federal support for freed Black people (Neyland, 1990). A date given of 1895 was for the distinction of the first historically Black junior college taken from the Directory of Junior Colleges in 1933

however, the institution's catalog is unable to be authenticated (Guyden, 1999). The term *junior college* (interchangeable with community college) was almost unknown in 1895 (Guyden, 1999). Not until 1928 was the first junior college founded in Wesson, Mississippi from an established agricultural high school (Guyden, 1999).

The junior college movement evolved in the U.S. education system from 1895 to 1932 and offered junior college curriculum for underrepresented institutions (Guyden, 1999). By 1960, six years after the U.S. Supreme Court's decision in *Brown v. Board of Education*, HBCU enrollment dropped. Nonetheless, HBCUs continued to be leaders in higher education by providing access to low-income students (Johnson et. al., 2017). During the early 1960s, HBCUs played a major role in the civil rights movement (Thompson, 2004). By 1967, there were approximately 14 historically Black junior colleges throughout the south that were instrumental in the production of STEM students. Unfortunately, by the end of the year, there was a drastic decline (Guyden, 1999; McClain et al., 2018; Museus et al., 2011).

HBCUs make up only 3% of the nation's higher education institutions (Johnson et al., 2017). To date, only 12 are HBCCs, these 12 HBCCs also make up less than 1% of community colleges in the U.S. (Elliott et al., 2019). Little work and less attention is focused on the sciences and interventions at HBCCs versus HBCU 4-year colleges (Bray et al., 2018). This provides opportunities for more educational research to assist educators in determining what interventions are effective and necessary for students' persistence and pathways into STEM disciplines at HBCCs (Bray et al., 2018; Ghazzawi

et al., 2021)). Because there are few studies on HBCCs (Elliott et al., 2019), this study focused on the persistence of STEM students who attend a HBCC.

The Persistence of STEM Students at 4-year HBCUs

From the review of literature, no located study directly impacts the approach of the persistence of STEM students at a HBCC. However, there are four bodies of research that address concerns related to persistence in STEM at HBCUs: (a) persistence in STEM, (b) persistence at 4-year HBCUs, (c) persistence at community colleges, and (d) STEM at HBCUs/HBCCs. These areas are necessary for understanding STEM student persistence at a HBCC and are discussed as follows.

Persistence in STEM

In a 2013 statistical analysis report, Chen reported that STEM entrants either completed a degree in STEM or remained enrolled for over 6 years, while others chose a non-STEM major. Researchers have been working to understand patterns of persistence in undergraduate STEM majors. Most of the emphasis is grounded partially in the perception that some undergraduate STEM students depart because of the academic, social, and cultural condition conflicts encountered in these courses (Lee & Ferrare, 2019). Nonetheless, multiple factors are involved in students' persistence in STEM (Williams et al., 2019). According to Russell et al., (2018), identifying factors that promote STEM persistence can help diversify higher education and the STEM workforce. Persistence in STEM is a phenomenon studied and analyzed by many researchers at the 4-year institutions, as well as the community college level (Astin,1993; Reason, 2010; Shadduck, 2017; Tinto, 2017). Research on persistence in STEM indicated several

theories of persistence that enforce the importance of involvement, validation, integration, and financial assistance (Astin, 1985; Shadduck, 2017; Tinto, 2017).

According to the National Center for Education Statistics (NCES), a statistical analysis report, approximately 28% of bachelor's degree students and 20% of beginning associate degree students entered STEM disciplines between 2003 and 2009 (as cited in Chen & Soldner, 2013). However, of the associate degree-seeking students who entered STEM disciplines during that time, approximately 69% left the program (Chen & Soldner, 2013). Further understanding of STEM persistence is important to scholar-practitioners and policymakers because of a growing need to fill the gap in the STEM workforce (ACT, 2017). Increasing STEM persistence remains a national priority, especially for underrepresented students at community colleges (Wang, 2013).

The literature on STEM persistence extensively studies race/ethnicity and gender (Brown et al., 2005; Griffith, 2010; Hurtado et al., 2009, 2010; Jackson, 2013; Jordan & Rideaux, 2018; Lancaster & Xu, 2017; Stage et al., 2013). According to Lockhart et al. (2022), national data is being used extensively to study STEM persistence, with an emphasis on students who achieved STEM degrees. Maltese and Tai (2011) suggested that students who have an early interest in STEM are more likely to persist. Other research identified that coursework is a predictor of students who will persist in STEM (Maltese & Tai, 2011). Furthermore, goal-directed behaviors, prior academic achievement, and science-related experiences are other predictors of student's persistence in STEM (Park et al., 2019). Students who take more advanced courses in mathematics and science were more likely to persist in STEM degree completion (Maltese & Tai,

2011) than those who took fewer classes in science and mathematics (Lancaster & Xu, 2017). Considering the limited data, the importance of this study is to further investigate persistence from the vantage point of HBCCs.

Persistence at HBCCs

To identify and explain what makes students at HBCCs persist, Himelhoch et al. (1997) conducted a study to examine the predictive factors of HBCCs versus predominantly White institutions. The study was based on Bean and Metzner's (1985) synthetic model that included students' backgrounds, environments, and outcomes, which mirrored Astin's (1984) I-E-O model. The findings for both institutions suggested that faculty mentoring was an important predictor for student persistence (Himelhoch et al., 1997). Researchers identified that HBCUs have more supportive environments, recognize the need for more funding, and are in a unique position to encourage student persistence in STEM disciplines (Bray et al., 2018; Owens, et al., 2012; Palmer et al., 2010).

HBCCs' environments provide a place of encouragement and a sense of belonging, which allows students to feel comfortable with who they are and to explore areas of involvement within the institution (Hilton & Felder, 2014). Because they have a long history of producing STEM graduates, according to Owens et al. (2012), it is evident that HBCCs use effective strategies to enhance STEM student persistence (Palmer et al., 2010). Students who persisted at HBCCs, according to scholars like Brown et al. (2005), Gasman (2013), and Gasman and Nguyen (2014), agreed that HBCC students were favorable with the environment and had higher grade point averages.

Other researchers noted that HBCCs have positively affected human capital and degree attainment among students since the desegregation of the U.S. educational system (Wilson, 2007). A relationship with campus administrative staff and personnel is a key factor in student academic success and persistence (Arrington, 2015). The support and involvement from administration proved to show strong support for students on campus and their participation (Palmer et al., 2014). HBCCs allocate resources and organize learning opportunities to maximize students' involvement and impact their persistence (Palmer et al., 2014). As reported by Chance et al. (2011), Astin's (1993) study found that African American students were less likely to drop out of college if they were enrolled at a predominantly Black institution.

Similarly, other theorists such as Pascarella et al. (2005) reported that African American students performed better academically at HBCCs (Chance et al., 2011). Not only are institutional environments important to student persistence, but a student's perception of their chosen STEM discipline and how it is relevant to their lives increases their motivation to persist (McDaris et al., 2017). On the other hand, an area often overlooked in addressing the nation's goal for diversifying STEM graduates is persistence at the community college level (Snyder & Cudney, 2017). This is important as community colleges serve as an entry point to help address the topic of the persistence of underrepresented STEM students.

Persistence at Community Colleges

Although a plethora of research published on student persistence at 4-year colleges exists (Astin, 1993; Tinto, 2001), few studies include the 2-year setting (Wang,

2013, 2016). Increased demand for community colleges to prepare more students for a 4-year college and to enter the workforce exists (Reyes et al., 2019). The persistence of community college students is at the forefront of the U.S. discussion of economic competitiveness, as leaders are committed to ensuring social mobility that characterizes The United States of America (Reyes et al., 2019). The 2012 President's Council of Advisors on Science and Technology issued a call to build relationships between community college students and faculty members to increase persistence for ease of transfer to 4-year institutions (Shadduck, 2017).

Prior research conducted by Voorhees (1986) claimed that studies of student persistence at community colleges are overwhelmingly descriptive. Conceptual models are tested to explain the complex interactions of the unique influences of students at community colleges (Voorhees, 1986). In this study, Voorhees found measures of academic integrations such as hours studying and faculty member interactions to be independent of persistence in the community college setting. Pascarella and Terenzini (2005), in their post-1990 research, gave a more positive outlook on the differences in educational and occupational outcomes between 2-year and 4-year colleges. For example, attending and persisting at a community college still led to employment. According to Pascarella and Terenzini (2005), community college students benefited more during the first year of college and such gains are essential to their subsequent persistence and academic performance. In addition, according to Nakajima et al. (2012), the study of student persistence at community colleges revealed that students who are more likely to

remain enrolled are students who earn good grades and those who attend on a full-time basis.

The more recent literature concurs with the previous studies, suggesting that the study of persistence at community colleges remains extremely challenging. In other words, there are not enough data sets available to provide sufficient information about experiences of students at all levels, and persistence data do not mean a lot without corresponding information relating to student goals (Hatch & Garcia, 2017). According to Jordan and Rideaux (2018), a developing body of research exists documenting the problem of persistence among community college students in general, but, more specifically for African American male students. The concern is that researchers remain more focused on the "how" questions of quantitative research with less emphasis on the qualitative research to understand "why" community college students persist (Jordan & Rideaux, 2018). Despite any challenges, community colleges are instrumental in bridging the gap in STEM for underrepresented students (Wood & Williams, 2013).

STEM at HBCCs

The focus of STEM persistence at HBCCs sparked the attention of scholars and practitioners to investigate why these institutions graduate more students in STEM than the predominantly White institutions (Bray et al., 2018; Brown et al., 2005). HBCUs educate a large population of students entering from the community colleges (PR Newswire, 2021), while helping close the achievement gap and providing educational opportunities (McClain et al., 2018). Hicks and Wood's (2016) metasynthesis analysis of first-generation college students in STEM at HBCCs included discussion of the

importance of academic and social interventions to support students' persistence in STEM.

The findings indicated that previous academic performance influences persistence, the importance of how and why these students can remain in the pipeline, and the in-STEM disciplines for HBCCs' students (Hicks & Wood, 2016). According to the Helmsley Report published by Gasman and Nguyen (2016b), HBCCs continue to lead the nation in graduating more STEM students. The success of persistent students starts from the time they enroll, which begins with advising, includes a supportive learning environment and small class sizes, and enlists the involvement of faculty members until students graduate (Allen, 1999b; Roberts & Louis, 2018).

Similarly, Gasman and Nguyen (2016b) and Lancaster and Xu (2017) found that HBCC STEM students involved in peer-led activities, faculty member interactions, and supplemental instruction programs are more likely to persist to degree attainment. Also, HBCUs exemplify a family-like atmosphere, which includes faculty members, staff members, and students associated with the institution to help empower and motivate each other (Lockett et al., 2018). The administrative support system brings together deans, provosts, vice-presidents, and presidents to encourage students' academic involvement (Lockett et al., 2018). Not surprisingly, a 2004-2005 report revealed, of the 15 top producing institutions graduating African American students in biological and biomedical studies, only two were not HBCCs (Hurtado et al., 2009). Moreover, HBCCs have vital roles in providing academic and social educational opportunities for students enrolled in STEM disciplines (Hicks & Wood, 2016). To keep up with the growing need for STEM

workers, research suggests that HBCCs invest in infrastructure that supports access to technology to attract and retain tech-savvy students as well as investing in more Wi-Fi bandwidth on their campuses (Johnson et al., 2017).

According to Museus et al. (2011), the effectiveness of HBCCs at producing underrepresented graduates in STEM could be the result of the racial backgrounds represented by students on campus and may be correlated with the validation of their ethnic backgrounds. Moreover, studies reported that some faculty members at HBCCs go out of their way to teach and work directly with students, spend time with them outside of the classroom, and take time to know students personally (Museus et al., 2011). Likewise, educators encourage other faculty to draw more connections between the classroom and students' personal experiences in STEM (Glancy & Moore, 2013). Previous research and data reported that nationally, 30% of undergraduate engineering degrees and 44% of natural science degrees are awarded to African American students who attended HBCCs (Chance et al., 2011). A unique qualitative study on academically gifted, millennial students in STEM disciplines at HBCCs reported that students attribute their success of matriculation to their precollegiate experiences, self-motivation, attitudes, and the impact of their gender and race (Rice et al., 2016).

Summary

This review of literature focused on persistence, community colleges, STEM education, STEM students, STEM and community colleges, HBCCS, HBCUs/HBCCs, the persistence of STEM students at 4-year HBCUs, persistence of STEM students at HBCCs, persistence in STEM, persistence at HBCCs, persistence at community colleges,

and STEM at HBCCs. Using Astin's (1984) framework of involvement, along with Reasons' (2005) and Terenzini's (2005) synthesis of persistence, several factors are noted that contribute to STEM students' persistence. Astin's I- E-O model includes identification of what students bring with them to college, how the environment affects their persistence, and the outcome of being persistent. The review includes an outline of social and academic involvement as an important aspect of student persistence.

What is known in the literature is that researchers are continually trying to understand persistence in STEM disciplines. What is not known is what STEM students at HBCCs perceive as keys to their success and their challenges to degree completion. The present study fills a gap in the literature because there are limited studies looking at persistence of STEM students within the context of HBCCs. In addition, much of the current literature on STEM persistence has been conducted at HBCUs and other higher education institutions, however, not many studies have been done at HBCCs. Therefore, this study filled the gap by providing a current study with a focus on STEM students persistence at a HBCC.

In Chapter 1 of this study, I discussed the purpose of the study, identified research questions to guide the study, and discussed the significance of the study. In chapter 3, I provide a review of the methodology used in the study, along with the role of the researcher and a description of how I selected the participants. In addition, I outline (a) the data collection process, (b) data analysis, and (c) procedures for the ethical protection of participants.

Chapter 3: Research Methodology

The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. In deciding on a research design, the researcher must be familiar with different designs to make the best decision concerning their research questions and hypotheses (Creswell & Plano Clark, 2018; Merriam, 2009). In Chapter 3, I discuss the research design and rationale, role of the researcher, methodology, trustworthiness, and ethical procedures.

Research Design and Rationale

To address the purpose of the study, I used the following research questions:

RQ1: What do STEM students who successfully persisted in their academic life at a HBCC perceive as the keys to success?

RQ2: How do STEM students describe their challenges related to their progression toward degree attainment at a HBCC?

The phenomenon studied was the persistence of STEM students at a HBCC. The STEM participants had to be enrolled in their third semester or beyond. I employed a basic qualitative design in which participants were from one HBCC. I chose a basic qualitative design because it is used to capture stories of the participants while gaining an understanding of how they interpret their experiences (see Merriam & Tisdell, 2016). This approach provided insight on what students perceived as their keys to success or challenges they faced. A basic qualitative design was suitable for this study because it helped me understand limitations in the information or any findings that justified the need for further research. During the study, the researcher should remain aware and interested

in understanding the meaning and phenomenon for the participants involved in the study (Merriam & Tisdell, 2016). When employing a basic qualitative design, the researcher is focused on how meaning was constructed as well as how people make sense of their lives and their worlds (Merriam & Tisdell, 2016). In addition, basic qualitative research allows the researcher to inquire and document what happens among real people in the real world using their own words (Patton, 2015). This includes gathering their perspectives within their own context (Patton, 2015).

Numerous qualitative research designs exist (i.e., case study, ethnographic study, grounded study, narrative analysis, and phenomenological study) and were considered for this study. A case study design was not used because case study research seeks to explore events or phenomena in a real-world context (see Lodico et al., 2010; Merriam, 2009; Merriam & Tisdell, 2016). Case studies can focus on a program or programs to make needed decisions (Stake, 1995; Yin, 2003). I did not choose an ethnographic research design because an ethnography is useful when the researcher wants to study the behaviors of a culture-sharing group, and some interactions may exist between participants within a large set from multiple perspectives (Creswell, 2013; Lodico et al., 2010). No consideration was given to grounded theory because it results in the formulation of a theory, which was not aligned with the purpose of this study. Although as part of a grounded theory study, the researcher conducts interviews, a systematic procedure is used to analyze and develop a theory (Creswell, 2013). Finally, I did not select a phenomenological study because it involves the researcher developing an understanding of the lived experiences of people around a specific phenomenon (Creswell, 2013). The

quantitative method enables the researcher to make a hypothesis and test theories using numerical data or statistical correlations (Creswell & Plano Clark, 2018; Park & Park, 2016). In discovery-oriented research, qualitative researchers inquire about topics through exploratory examination to develop an understanding of a phenomenon (Cairney & St. Denny, 2015; Creswell, 2013; Park & Park, 2016).

Role of the Researcher

The role of the qualitative researcher begins with posing a question of how or what and then expanding the question to understand a person, personal experience, or a phenomenon (Merriam, 2009; Merriam & Tisdell, 2016). The researcher is the primary instrument of data collection and analysis in qualitative case studies (Cohen, 2016). Sherry (2013) mentioned that the role of the researcher is to recognize the sensitivity of research and use that to their advantage in building a relationship with participants. As such, the researcher's responsibility is to be respectful, nonjudgmental, and nonthreatening. Opinions, perspectives, and biases did not influence the study (see Yin, 2014). I served an objective role as the interviewer in the study. Other roles of the researcher included that of the data collector, data analyst, and presenter of the findings (see Cohen, 2016; Sherry, 2013; Yin, 2014).

My role as the researcher was that of an interviewer and data analyst. I spoke with participants and asked the interview questions about prior STEM courses, college resources, faculty, and the college environment. The participants' answers were gathered as the data for the study. I used NVivo transcription software to transcribe the data. I did not have any personal or professional relationships with any participants; however, the

participants and I have similar cultural backgrounds, but I do not have a background in STEM.

Because I was the researcher and the only one analyzing the data, there was the potential for bias. To stay aware of potential bias, I documented using my journal notes. My notes included ideas between initial codes, categories, and themes. In this study, my responsibility as the researcher was to act ethically and abide by principles set forth by the Walden University IRB guidelines and the ethical requirements of the study site. The chosen research site was one that I did not have any affiliations with.

Methodology

The methodology section includes a description of the study participants and the criteria used for their selection. An explanation of the instruments used for this study, procedures for recruitment and participation, data collection, and data analysis are also explained in this section.

Participant Selection

I selected the participants for this study from one of the 11 designated HBCCs enrolled in STEM disciplines. Participants were considered homogeneous because they were a subgroup of undergraduate college students who had similar social and educational demographics. According to Patton (2015), homogeneous groups consist of people who have similar backgrounds and experiences and who share a common issue.

I used a stratified purposeful sampling strategy to select participants for this study. Patton (2015) defined stratified purposeful sampling as a method for cases that have samples within samples and suggested that purposeful samples can be stratified by

selecting particular units. According to Merriam and Tisdell (2016), purposeful sampling is used when the researcher chooses research samples that generate the most understanding of what is being studied. I employed stratified purposeful sampling for this study because it allowed me to select participants with experiences related to the purpose of the study and who could provide answers that supported my research questions.

I identified the participants with the help of the study site's administration department. Students considered were identified from a 2-year higher education institution and were enrolled in STEM disciplines. I sent an email with my recruitment flier attached to administration. The institution's administration department contacted potential participants by sending out a mass email of my recruitment flier.

I recruited participants from STEM disciplines offered at the institution. Students who were interested in participating contacted me via the email listed on my flier. From the recruitment process, eight participants who met the inclusion criteria were confirmed. The participants in this study were students who were 18 years old and older and enrolled in a STEM discipline at the HBCC study site. The two main criteria for participant selection for this study were (a) students who were actively enrolled in the STEM disciplines (as shown in Table 1) and (b) students who had been enrolled for three or more semesters.

Table 1

Sample Representation from Four Disciplines

	Associate in science	Electro-mechanical engineering	Computer technology	Cybersecurity
Number of students	41	10	10	4

In determining the sample size for the study, I considered the number of students enrolled in each discipline and that the interviews would be conducted virtually. The number of participants was not determined to be too large or too small, but one that could provide an understanding of student persistence. The sample size was sufficient because I collected data until saturation was met. According to Lodico et al. (2010), saturation is met when a researcher decides if more participants are needed or when data are repeated.

Instrumentation

The interview protocol was the primary instrument for data collection in this qualitative study and was developed by me. The basis for the development of the instrument was literature published on STEM students and persistence. I designed the interview questions to align with the two research questions and be relevant to STEM students' successes and challenges. Two content experts who both are in the fields of community colleges and STEM reviewed the protocol before I put it into use in the study.

The interview questions had high content validity because I used an inductive approach that assessed participants' perceptions of persistence (see Merriam & Tisdell, 2016). In addition, the literature review was used to help develop the interview questions.

The questions were constructed to reflect the responsive interviewing model that captures the experience of each participant (see Rubin & Rubin, 2012). The open-ended interview questions were intended to provoke answers that revealed participants' perspectives (see Patton, 2015). It was my intent to encourage participants to share their thoughts freely when answering the questions.

Procedures for Recruitment, Participation, and Data Collection

Procedures for Recruitment

To recruit participants for this study, I needed to identify a 2-year higher education institution that had STEM students. Next, I contacted the registrar office at the study site and had them locate students who fit the criteria for participation. Written permission from the vice president of Academic Affairs was granted to conduct this research. I also received IRB approval (Approval No. 06-11-21-0111167) from Walden University before invitations were sent out to potential participants. After receiving permission from the study site and approval from Walden University IRB, my recruitment flier was emailed to potential participants from the institution administration department and distributed on campus. The participants for my study were recruited from the Associate in Science program with concentrations in computer technology, electrotechnical engineering, and cybersecurity. The vice president of Academic Affairs of the program was made aware of the nature of the study and the voluntary participation of the students. No students under the age of 18 years old were included in the study because they are not adults.

Due to not initially generating enough participant responses, I had to develop a follow-up recruitment plan. I suggested offering an Amazon e-gift card for $10 and submitted an updated IRB application. Approval was granted by Walden University IRB to give participants a $10 Amazon e-gift card.

Procedures for Participation

Before beginning data collection, I had already notified the institution of my intent to use them as a study site. They agreed on allowing me to conduct my research after I obtained approval from the Walden University IRB. Once approval was obtained from Walden University IRB, I obtained formal written permission to use the institution as the study site. The students were identified by the registrar office as potential participants. Those students who were interested in participating emailed me with a "yes" response to participate. After receiving their agreement email response, I contacted them via email to provide the informed consent form that described the research study, potential risks and benefits of being in the study, payment, and privacy. Participants were also notified of the purpose of the study, the type of data being collected, and the length of the sessions. Participants were informed that the information would be used for educational purposes only and their personal information would not be shared. I asked participants to carefully read the form, and if they were still willing to participate in the study, to respond to my email with the words, "I CONSENT." After I received the consent email back, individual meetings were scheduled using online conferencing software or via cell phone at the time agreed upon by the participant to ensure

confidentiality. My contact information was made available to participants so they could reach me if they had any questions or concerns.

Data Collection Procedures

I sent out reminders a day before the interviews to confirm the participants' participation in the study. There was only one data collection session per participant. Each session was allotted 25 to 45 minutes. The data for this study were collected through open-ended interview questions using online conferencing software or via conference call (due to the COVID-19 pandemic) after receiving Walden University's IRB approval. At the beginning of the interviews, I informed the participants about the reason for the study and that the information they provided would be kept confidential. The participants' names were replaced with an alphanumeric code to preserve confidentiality. The interviews were conducted using the developed interview protocol and were audio recorded on my personal audio recording device. At the end of the interviews, I reminded participants that the data would be kept confidential, then thanked them for taking a part in the study before stopping the recording and ending the call. There were not any follow-up interviews.

I downloaded the data to a password-protected hard drive and purged the audio recorder. All study data were de-identified such that respondents' names and contact information were not included. The alphanumeric code used for the interviewing process was used for all data collection documents, both digital and hard copies, to preserve participant confidentiality.

Data Analysis Plan

Data analysis involved reviewing the answers to interview questions. Data organization is necessary for qualitative studies because a lot of data are collected during the research process. I used the NVivo transcription service to auto transcribe the data for this study. As part of the transcription process, I purchased a bank of minutes from NVivo transcription. The interview files were uploaded from my computer into NVivo, allowing the automated service to transcribe the audio files. The process created a written transcript that was uploaded to the project in NVivo. After the transcript file was uploaded, I reviewed each transcript and assigned it an alpha numeric code. NVivo was used to organize the data, generate codes, and assist in the development of themes.

As recommended by Adu (2019), along with the NVivo software, I used six stages when coding, which are: (a) preparing qualitative data, (b) exploring data, (c) coding potentially relevant information, (d) developing categories and themes, (e) visualizing outcomes, and (f) exporting outcomes. I thoroughly went back and forth among the stages, as necessary. The process of data analysis in qualitative research is nonlinear, reiterative, and ends when the collection and data analysis is complete or when no new data emerge (Merriam, 2009). There was one discrepant case, a student majoring in STEM was attending the institution not for the STEM degree but because of the athletic opportunities. Although a discrepant case occurred, I recognized it and committed to including all data.

Stage 1: Preparing Qualitative Data

First, I made sure all interview transcript files were labeled accordingly using identifiers (ID) that were generated for each participant. For example, participant one was identified as participant PA1. These IDs are stated on the transcript documents. During this stage, participant's demographic information was organized by the participant IDs and was developed using an excel spreadsheet. Next, the interview transcripts within NVivo were used to create cases for each participant. Then the excel classification spreadsheet was sent to NVivo from my desktop because NVivo has been integrated into my Microsoft excel. NVivo provided a password-protected secure platform where the data was stored, and I am the only one who has access. After 5 years, all data will be destroyed (deleted from my hard drive by me).

Stage 2: Exploring Data

In the second stage, I spent time learning about the data by reviewing the transcripts. This allowed me to see how many times participants used a specific word. I ran the text search command, and the word frequency command, however, there were not enough frequently used words or similar word usage to create a word cloud or a word tree for visualization.

Stage 3: Coding Empirical Indicators/Potentially Relevant Information

I used the drag and drop method to code participant's exact words, along with narrative coding because my study was highly exploratory (Saldaña, 2016). In this stage, with the research questions on hand, I went through each transcript and coded relevant segments under their respective research question. New codes were created. I assigned

codes to the explicit potentially relevant information and created memos associated with this stage of the coding process.

Stage 4: Developing Categories/Themes

In this stage, I began sorting and then theming the data (Saldaña, 2016; Williams & Moser, 2019). After the codes were developed, using the individual-based sorting strategy, I created a table in Microsoft Word and manually sorted the codes and created labels. Each code was assessed and put into clusters with the research question. After the codes were sorted and labeled, they were arranged and entered in NVivo to create categories and themes (Adu, 2019).

Stage 5: Visualizing Outcomes

In this stage, I created a table using Microsoft Word to show the participant's demographics. This shows readers a visualization of how many participants were from each of the four disciplines.

Stage 6: Exporting Outcomes

This final stage was critical when it comes to thinking about how the outcomes were communicated to my audience. Tables were developed representing each research question, initial codes, and themes developed.

Trustworthiness

According to Braun and Clark (2013), being a qualitative researcher requires the highest ethical standards. In addition, Yin (2014) indicated that the integrity of the researcher is essential to the credibility of the study design. The necessary steps were taken to ensure that the findings and interpretations were accurate (Cohen, 2016).

Strategies were applied for trustworthiness as described by Merriam (2009). There are four constructs, according to Shenton (2004), that trustworthiness depends on in qualitative research: "credibility, transferability, dependability, and confirmability" (p. 64). The qualitative researcher's goal is to collect and interpret accurate data that are understood by the reader (Merriam & Tisdell, 2016). I kept notes to help me notice and account for any potential bias.

Credibility

For this study, credibility was addressed in several ways: I kept reflexivity notes. Next member checking was used to make sure the participants' responses reflect what they wanted to say. Member checking is a method of checking for the credibility and accuracy of the results (Merriam & Tisdell, 2016). For member checking, the verbatim transcriptions from the auto-recorded interviews were returned to each participant in a Microsoft Word document by email to check for accuracy with what they meant to say. Each participant was asked to check the transcript for completeness, the accuracy of what they intended to say, and for fairness.

To further establish the credibility of the findings, a colleague with a doctoral degree assisted with reviewing both the collected data from the study and my findings from the analysis of the data. That is, the peer review examiner examined my transcripts and findings. During this process, I made sure that the information provided did not contain any of the participants' names or any other identities. I provided an overview and explained the basic qualitative study by outlining the research questions, the framework, the chosen methodology, as well as the data collection method.

Transferability

Transferability relates to qualitative research, which describes the setting and participants of the study. The research can be replicated because it contains evidence from quotations and notes (Merriam & Tisdell, 2016). A data table was developed to show the codes and any themes as they emerged from the participants' interviews. Although transferability may be a challenge to prove, details were shared without breaking confidentiality. By providing details of student perceptions to their success and challenges, other institutions may find likeness. Moreover, STEM persistence is not a new theory, it would transfer to other institutions. I cannot prove the findings can be relevant to all populations, however, I can provide viewpoints of this population of STEM students.

Dependability

According to Patton (2015), dependability relies on the process of inquiry and the inquirer's responsibility for making sure the process is logical, traceable, and documented (p. 685). To show my findings were consistent my audit trail is reflective of the research steps taken from start of the study, the development of the study, and lastly reporting the findings. This study utilized the two research questions tied to persistence as its conceptual framework. This study provides a transparent report of the research, which includes the processes used in data collection as well as the analysis and results.

Confirmability

According to Patton (2015), confirmability establishes the fact that data collections are true and not of the inquirer's imagination (p. 685). The data collection and

analysis were presented in a clear and sequential order. Confirmability was established by using reflexivity notes to keep track of any potential viewpoints or biases that I may have had (Lodico et al., 2010). I used my notes to make sure I did not have any personal expectations about what the participants experienced or what the data revealed. All interviews have been audio recorded, transcribed, analyzed, and coded. All data have been reviewed for accuracy.

Ethical Procedures

According to Merriam and Tisdell (2016), the most significant part of ethical research is found in the ethical procedures and is embodied in the ethical stance of the researcher and not just in the procedures. This basic qualitative study was conducted in accordance with Walden University IRB rules and regulations regarding the use of study participants as required by the federal government. Permission was obtained from the Walden University IRB to begin the data collection process on June 11, 2021, with approval # 06-11-21-0111167. The importance of the participants was not ignored during my study. The informed consent process served to protect participants from harm and to respect their privacy (Tam et al., 2015). According to Creswell (2013), a researcher must be free of deceptive practices and respectful of the research site. I was aware of ethical issues that could have occurred during the study and made sure to protect the integrity and confidentiality of the participants. To ensure the confidentiality and safety of the participants as well as the trustworthiness of the data, precautions were made with the site and the data.

To ensure the ethical protection of participants, I am certified by the Collaborative Institutional Training Initiative Office of Extramural Research to protect human research participants (Certificate Number 35512096). Data collections did not begin until IRB approval was granted for this study. The name of the school and participants will remain confidential. The university has approved this study for publishing, and a summary of the results has been given to the participants. Strategies were used to ensure participants were aware of the interview process. Participants were given the opportunity to carefully read the informed consent form and respond by email. Questions for myself were asked directly before deciding to participate in the data collection process.

Treatment of Data

To protect the participants' confidentiality, data were downloaded into protected computer files. Identities were removed and destroyed, names were changed using pseudonyms, and no email addresses were kept. All data collected have been stored electronically on a personal computer and backed up on a password-encrypted external hard drive, in my home, with access by me only. Participants who terminated their participation from the study will not be included in the study and their data was purged. The written data of participants will be kept secured and confidential and remain in a locked file drawer, and all transcribed data and themes will stay there to protect participants and will be destroyed after 5 years.

Summary

This chapter included the research design, which is a basic qualitative study. I discussed purposeful sampling of the participants' as well as the selection criteria. This

study will add to the body of existing knowledge on HBCC STEM students' persistence. A basic qualitative study method was used to expand understanding of the phenomenon of the HBCC student community and its relationship to persistence. Qualitative interview data have been collected and analyzed using a conceptual framework of student involvement and persistence theories. In chapter 4, I include data collection, the demographic table, data analysis, codes, themes, and the summary.

Chapter 4: Results

The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. I gathered an in-depth understanding of STEM student persistence through the data collection process. Study participants were STEM students who were in their third semester and beyond. The results of the study may be used to inform stakeholders, educators, and community leaders of the importance of persistence in STEM disciplines. In this chapter, I present the findings of the study, a discussion of the setting, data collection, data analysis, results, and evidence of trustworthiness before concluding with a summary.

The research questions that guided the study of STEM student persistence were:

RQ1: What do STEM students who successfully persisted in their academic life at a HBCC perceive as the keys to their success?

RQ2: How do STEM students describe their challenges related to their progression toward degree attainment at a HBCC?

Setting

Organization

The primary setting for this study was a HBCC in the southern United States that specializes in STEM disciplines. The sample consisted of eight participants. For this study, I was not made aware of any organizational conditions, such as budget cuts or personnel changes, that would have influenced the participants or their experience at the

time of the study. I did not experience any changes at the time of the study that would have influenced my interpretation of the study results.

Demographics

Participants had to meet certain requirements to participate in this study. Each student had to have been in a STEM discipline for at least three semesters. To protect participants' confidentiality, I did not include any identifiable information pertaining to the interviews. Participants were issued an alphanumerical identification code, as listed in Table 2.

Table 2

Demographics of STEM Students

Coded name	Race/ethnicity	Age	STEM (major)	Gender	Semester
PA1	Black	25	AS	M	3
PA2	Black	42	AS	F	3
PA3	Black	20	Computer technology	M	Last semester
PA4	Black	20	Electrical engineering	M	3
PA5	Black	20	AS	M	4
PA6	Other	19	Cybersecurity	M	4
PA7	Black	20	Electrical engineering	M	4
PA8	Black	20	Electrical engineering	M	4

Note. AS = Associate in Science.

Data Collection

Participants

Invitations and fliers with an explanation of the study were emailed to the registrar for distribution to STEM classes. The eight participants represented several disciplines, including cyber security, electro-mechanical engineering, and associate in science, and they each met the selection criteria and consented to be interviewed. I sent out a request to participants individually to inform me of dates and times they were available for interviews. The interview process involved using open-ended interview questions designed to explore STEM student persistence at a HBCC. Participants were required to respond to the informed consent email, "I Consent," to participate in the study. Each participant then received an email with the agreed upon date, time, Microsoft Teams link, cell phone number, and/or Zoom reservation. The allotted time for each interview was 25 to 45 minutes. I used the interview protocol as a guide for the interviews. Each participant was reminded that the interviews would be audio recorded, as stated in the consent form.

I collected data primarily via Zoom, Microsoft Teams, and my cell phone for the study to adhere to the COVID-19 restrictions except for one interview, which was conducted in a face-to-face meeting while adhering to COVID-19 protocols. All participants took part in individual, semistructured interviews. Prior to beginning each interview, I thanked participants for their willingness to participate in the study. I also explained the interview process and let them know that they could pass on answering any question or stop the interview if they felt uncomfortable. I encouraged them to answer

freely because the final research report would not include any individual names. The data collection process involved audio recording, which each participant was informed of before starting the interview. Each interview was transcribed using NVivo transcription. I also used my journal notes to make sure I had the participants' accurate words to avoid unintentionally conveying my own biases.

Variations in Data Collection

There were variations in the collection methods. Some participants preferred meeting via Zoom, others in Microsoft Teams, and others using the telephone. After the interviews were conducted, the data were transcribed and reviewed for correctness. I used thematic coding to analyze the data and made sure my personal biases did not interfere with the collecting, coding, sorting, or theming of the data (Williams & Moser, 2019).

Data Analysis

After the data collection process, I began data analysis, which involved listening to the audio recordings and transcribing the interviews using NVivo transcription software. I auto transcribed the eight interviews and saved them in the New NVivo software, which is password protected. This process also involved assigning de-identifier IDs at the top of the transcripts to make sure that no identifiable information was revealed. I reviewed the transcripts to understand the data and to determine the most suitable method for analysis (see Adu, 2019). I formatted the data and loaded them into NVivo for qualitative data analysis. I coded using the drag and drop method in NVivo for the initial codes (see Table 3). Next, I sorted using a Microsoft Word table to organize and arrange the data collections into categories and themes (see Table 3). Thematic

analysis was used to analyze the data. Corresponding answers were organized into specific codes and themes for each research question (see Tables 4 and 5). After the data analysis, I conducted member checks by emailing the preliminary findings to participants in a Microsoft Word document and asking for their feedback. No participant feedback was received.

Table 3

Initial Codes, Categories, and Themes

Initial codes	Categories	Themes
Classrooms and meeting areas Experimented with wires	Small class sizes Engaging environment	Structured and engaging environment
Electrical circuits, digital circuits Introduction to CAD	Specific course content Prior STEM courses	Specific course content alignment
The provide classrooms and meeting areas which are very helpful Biggest source are my professors	Supportive faculty Positive environment Creating a supportive environment	Positive and supportive environment
You have to work hard for yourself I had to stay focused on school	Being self-motivated Being proactive academically	Academically determined and motivated
The tutoring they have for the students When we are in the computer lab	Attending an institution with adequate resources	Adequate resources
There is a lot of rich history and more of motivation for you This HBCU has given me a bunch of opportunities	Culturally rich institution Institution known for basketball Institution that provides opportunity	Culture and opportunity
Taking online classes is kind of difficult Just didn't understand the lesson	High online course workload Difficulty understanding lessons	Academic struggles
My son got sick; I just couldn't stop school I'm at a standstill, I plan on my future being basketball	Difficulty balancing academics and sports Balancing academics and family	Balancing school, sports, and family
Crippling debt Terrible financial consequences	Debt Finances	Worried about financial challenges

Table 4

Research Question 1: Codes and Themes

Research Question	Codes	Themes
RQ1: What do STEM students who successfully persisted in their academic life at a HBCC perceive as the keys to their success?	Small class sizes	Structured and engaging environment
	Engaging environment	Positive and supportive environment
	Institutional structure	Specific courses and content alignment
	Specific courses	Academically determined and motivated
	Transfer programs	Adequate resources
	Supportive faculty	Culture and opportunity
	Positive environment	
	Known for basketball	
	Provides opportunity	
	Culturally rich	
	Resources	
	Self-motivated	

Table 5

Research Question 2: Codes and Themes

Research Question	Codes	Themes
RQ2: How do STEM students describe their challenges related to their progression toward degree attainment at an HBCC?	Difficulty balancing academics and sports Balancing academics and family Adjusting to a new environment Understanding the lessons High online course load Crippling debt	Academic struggles Balancing school, sports, and family Worried about financial challenges

Results

I conducted this basic qualitative study to address what students perceived as their keys to success and their challenges related to their progression toward degree attainment at a HBCC. After careful analysis of the data, the results showed that STEM students have varying perceptions on what their key successes are in persisting toward their degree. Six themes as to what STEM students perceive as their keys to success emerged from the data analysis: structured and engaging environment, positive and supportive environment, specific course content alignment, academically determined and motivated, adequate resources, and culture and opportunity. On the other hand, students faced challenges when progressing toward their degree attainment. Three themes emerged from the analysis regarding their challenges: academic struggles; worried about financial challenges; and balancing school, sports, and family.

RQ1

Theme 1: Structured and Engaging Environment

All participants offered insight into what they perceived as their keys to success as they persist in their academics at a HBCC. The theme with the highest number of references was a structured and engaging environment, which participants found to be a key factor contributing to their success. All participants offered different responses leading to their success at a HBCC. Participant 1 (PA1) indicated, "If I'm able to afford structure and was on task and put in the work behind it, I think that's going to give me the resources to be successful." Likewise, participants mentioned small class sizes and hands-on experiences. In addition, an environment conducive for learning was important. PA8 explained,

> The size of the classes has made it better as well because we had.... it was the fact that we do have not so many students in the class, and we can get hands-on and one-on-one training with the teachers as well. It makes it a lot easier to learn and understand. They had on-campus dorms and that was better. So, I can get the college experience as well.

Theme 2: Positive and Supportive Environment

Prior research concluded that institutions that provide consistent support are more favorable for students and their persistence in STEM (Morton, 2021). The findings of the current study also showed that students could relate to positivity and support in their environment. They also perceived that support from faculty members contributed to their success. PA4 shared, "There was something that happened to one of our teachers last semesters in an engineering class and the dean actually came into the class and helped us out."

While every student will not have the same experience, student-to-student relationships are valuable to some. Some students found that creating a community of togetherness is helpful when striving toward degree attainment. PA6 expressed,

> I knew all my classmates, they actually helped me like when we don't understand something, we worked together in the study group, and we just talk about what we needed help on. And we just talk about on how to make things easier for us to understand by getting together and study groups.

Theme 3: Specific Courses and Content Alignment

The findings showed that prior STEM courses, specific course content, and transfer program alignment are keys to the success of student persistence. Participant PA6 shared,

> Besides cyber security I actually took some mechatronics classes. I took mechatronics courses, which taught me a lot about what I wanted to do. It actually helped me even get more in-depth on why I wanted to extend me, extend my, learning to this school, and to this subject.

The participants provided varying responses on what influenced their persistence and challenges. Some of the participants indicated that specific course content and prior STEM courses contributed to their persistence.

Theme 4: Academically Determined and Motivated

Five of the eight participants expressed that being self-motivated, proactive, having consistency, and determination are all significant keys that contribute to their success. Self-motivation and one's attitude toward their academics play a role in their success (Rice et al., 2016). PA1 noted that, "You have to work hard for yourself to get to

where you want to be." While PA2 said, "I had to balance it all out, I had to stay focused on school and maintain the home. It was hard. It was very. It was very challenging, but I didn't give up. I stayed, I stayed with it." As a STEM student, PA5 responded that,

"My personal persistence has allowed me to get closer to my goals as I've become more aware that college is a serious deal, and you have to be ready." PA8 stated, "being here to help me realize that you have to be proactive to do anything that, and anywhere you go. You have to be proactive and on time consistent with everything."

Theme 5: Adequate Resources

Resources are fundamental to produce HBCC STEM students. Such resources may include, but are not limited to, educational programs, labs, or facility resources (Zacher, 2018). The availability of resources impacts learning and influences students' persistence (Palmer et al., 2014). PA1 shared,

> It was the school that was probably in terms of resources that I needed at that time basically a school that I wanted to go to. The tutoring they have for the students is very good. Not just resources but having hands-on experiences give students the opportunity to transform their thoughts and ideas into practice.

PA6 shared a similar response about the benefit of resources:

> I'd probably have to say the labs, take my mechatronics classes at the lab and we are currently in my cybersecurity class, we're in the computer lab and we're just working on different structures, other computers, and things like the OSI model and how those functions.

Theme 6: Culture and Opportunity

Culture plays a role in students' drive to succeed. In addition, a culturally rich institution and an institution that provides opportunities are other elements affecting the persistence of STEM students who attend a HBCC. PA1 elaborated on the culture by saying,

> Because I understand the history that you would know and a lot of richer that you know, if you didn't come here, there is a lot of rich history and more of motivation for you to help you understand your Black history about colleges and HBCU background. I think that's the motivation for someone that is determined.

Likewise, PA8 shared thoughts about the opportunities at the institution, saying,

> I was able to go to a bunch of events that helped me down here as well with getting internships and whatnot. So as far as being at this HBCU, has given me a bunch of opportunities, and I'm glad to be graduating from here.

RQ2

The second research question sought to understand what STEM students perceived as their challenges toward degree progression. The data show that some students were challenged understanding difficult lessons, some struggled with their course work, while others faced challenges with online learning.

Theme 1: Academic Struggles

As noted by McKim et al. (2017) and Smith et al. (2019), STEM students do face unique challenges. PA2 shared:

> Struggles the most. I just say sometimes I just don't understand the lesson completely. I mean, it seems like it's very simple. going back to school after so many years, and I didn't fully understand the process of what I was supposed to do.

In addition, this is what PA6 had to say: “I’d probably have to say when I'm taking online classes kind of difficult because it's the cyber security class, so you have to do a lot, a lot of studying, a lot of reading.”

Theme 2: Balancing School, Sports, and Family

Outside of academic work, some students must maintain their family while others have to balance sports activities. Experiencing such challenges, some students do not find giving up an option. Indicated by PA3*:* “well, I'm going to use COVID for this example recently, right after school started COVID hit my home, my son got really sick severely, and I had to take care of him. So, I just couldn't stop.”

Theme 3: Worried About Financial Challenges

Prior research revealed that students enrolled in STEM disciplines are also presented with the challenges of paying tuition and what the financial outcome will be after graduation. PA5 noted: “But it also something that's obviously a double-edged sword that can help me by crippling debt or terrible financial consequences in the long run.”

Discrepant Case

Most of the participants seemed eager to discuss the successes and challenges of being a STEM major; however, one was not. PA4 was not interested in pursuing a STEM

degree although found the courses to be helpful. The participant did not plan on being an engineer, but rather planned on pursuing an opportunity in athletics.

Evidence of Trustworthiness

I rigorously structured specific words or phrases within each participant's response to come up with specific codes and themes. Because of the sample size, I expected that some participants would have similar words or phrases. I specifically picked out words or a combination of words for coding using the drag and drop method. To protect the identity of the participants, de-identifiers were used to maintain confidentiality. I documented step-by-step processes of this research to make it simple for future researchers to review and conduct similar research. To further assist with trustworthiness, my interview protocol was reviewed by two experts with advanced degrees, who are experts in STEM in community colleges. Trustworthiness was established by making certain there was credibility, transferability, dependability, and confirmability. Some of the methods I used were reflexivity, member checking, and peer debriefing.

Credibility

There were several methods to establish credibility, which included reflexivity, member checks, and peer debriefing. For reflexivity, I kept reflective notes of the research process. To conduct member checks I sent the preliminary findings to the participants and asked for their feedback. For peer debriefing, I asked a colleague with a doctoral degree to review my data and share relevant comments. There were no adjustments made to how credibility was stated in Chapter 3.

Transferability

There were no adjustments made to how transferability was presented in Chapter 3. The findings may be transferred to other HBCC institutions. I established transferability by providing as many details as possible about STEM student persistence and HBCCs in my research. These details were provided without disclosing the confidentiality of the participants. Although I cannot prove the findings to be applicable to all populations of students at HBCCs, I was able to provide the experiences of STEM students in this study. The documented themes will also help in the transferability to other HBCCs. The coding and data collections discussed in Chapter 4 also enhance transferability in this study.

Dependability

The strategies implemented in Chapter 3 were not adjusted. The audit trail is reflected in the research steps taken from the start of the study to the development and to reporting the findings.

Confirmability

As discussed in Chapter 3, no adjustments were made to confirmability. I kept reflexive notes to document any potential biases or personal viewpoints.

Summary

In this chapter I presented an overview of the basic qualitative study on eight STEM students at a HBCC. This chapter was divided into four sections: data collection, data analysis, evidence of trustworthiness, and summary. The findings of this study focused on what students perceive as their keys to success and their challenges. Through

my research findings I learned that faculty interactions were instrumental in student persistence. Research Question 1 was answered when it was revealed that supportive faculty, small class sizes, an engaging environment, and instructional structure were instrumental to student persistence. Six themes emerged from Research Question 1 which are: structured and engaging environment, positive and supportive environment, specific course content alignment, academically determined and motivated, adequate resources, culture and opportunity.

Maintaining balance academically had an impact on students' persistence. Difficulty balancing schoolwork, sports, family, and understanding the lessons answered Research Question 2. The major themes for challenges to degree attainment are academic struggles; adjusting to a new environment and commuting to school; balancing school, sports, and family; and worried about financial challenges.

In Chapter 5 I will introduce the chapter and the purpose will be stated. Next, the interpretation of the findings will be discussed followed by the study's limitations, recommendations, and implications. Finally, I will discuss the conclusion of the study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. For the conceptual framework of this study, I combined (a) Astin's (1984) student involvement theory and (b) Terenzini and Reason's (2005) synthesis of persistence research that included the persistence conceptual framework developed along with Terenzini in 2005. Because this research was exploratory (Saldaña, 2016), I employed a basic qualitative approach (see Merriam & Tisdell, 2016). There was very little prior research on STEM students' persistence at a HBCC; however, previous researchers had found that these institutions are instrumental in preparing students with pathways into STEM (McClain et al., 2018). To facilitate a better understanding of STEM students' persistence, I developed the following research questions:

RQ1: What do STEM students who successfully persisted in their academic life at a HBCC perceive as the keys to their success?

RQ2: How do STEM students describe their challenges related to their progression toward degree attainment at a HBCC?

The findings reported in Chapter 4 helped answer the research questions used to guide this study. I did not intend for this study to be a generalization of STEM students at all HBCCs. Rather, it provides an overview to understand what STEM students perceive as key to their persistence and their challenges towards their progression at one of the 11 federally funded HBCCs.

The findings reveal that students perceive the following keys to their success: structured and engaging environment, positive and supportive environment, specific course content alignment, academically determined and motivated, adequate resources, and culture and opportunity. They also perceive the following academic struggles as challenges to their progression: adjusting to new environments and commuting to school; balancing school, sports, and family; and being worried about financial challenges.

Interpretation of the Findings

The findings of this study are aligned with Astin's (1984) student involvement theory and Reason's (2005) synthesis of persistence to include the I-E-O model. The findings also extend knowledge to the peer-reviewed literature in Chapter 2. The students in this study shared what they perceived as key to their success and some of their challenges. Of the eight interviews, seven participants attributed prior STEM courses as a key to their success. Although there is very little research on STEM students' persistence at HBCCs, results related to the first research question reveal that an environment of structure that is engaging, positive, and supportive were significant factors for persistence. Participants perceived that their HBCC offering an environment conducive for learning, meeting their expectations, and having small class sizes were important to their success, which agreed with Astin's (1993) findings. The persistence of HBCC STEM students can be notably attributed to faculty support and adequate resources (Berger & Milem, 2000; Ferrare & Miller, 2020; Gasman & Nguyen, 2014). Congruently, not one theme in the data alone affects or causes a student to persist in their STEM degree program. Rather, it is a combination of all seven themes that guides a student to success.

Limitations of the Study

The findings of this study cannot be generalized to all HBCUs or community college STEM students. The criteria for participant selection of this basic qualitative study limited participants to only one of the 11 federally funded HBCCs. I did not explore the persistence of STEM students at any of the other HBCCs, which resulted in a small sample size. In addition, I did not conduct a complete examination of all factors that may contribute to STEM students' persistence at a HBCC or challenges they may face.

Recommendations

With a competitive global industry that is heavily motivated by STEM, the educational systems must continually develop and implement methods to support students (Gasman et al., 2017). There is an increased demand for STEM graduates to fill positions within the United States (Magnuson, 2018). If HBCCs expect to graduate STEM students to fill current and future positions, they may want to research new ways to assist students in their educational journey. Further research could be conducted to look at the persistence of STEM students from other HBCCs and could include choosing a larger sample size. The results of this study suggest that a population of students perceive that an engaging and supportive environment, resources, and the offering of specific courses contributed to their persistence. Students also faced challenges such as balancing school, work, and family.

This study could be duplicated to gather more responses and expand on the challenges students face. Another study could be conducted to interview HBCC STEM alumni to gain an understanding of what they perceived as the keys to their success and/or their challenges to see if there is a connection with the current study findings. Additionally, I recommend conducting a qualitative study that explores how faculty interactions impact student persistence. Some potential research questions could be: What are the effects of faculty interactions on STEM students? Why is it important to have faculty-student interactions in STEM disciplines?

Implications

The implications of this study for positive social change include that graduating students will be equipped, empowered, and more employable to meet the current labor demands. The results of this study showed that faculty support can impact students' persistence. Within the study site, the administration may want to continue to encourage positive interactions between faculty and students, which could develop into mentorship opportunities for faculty and ultimately lead to positive social change within the institution. For further positive social change, this study may serve as foundational research to bring about new ideas for HBCCs and STEM student persistence in higher education. Although the sample size was small in this study, the results incorporate information from students regarding their successes and challenges while persisting in STEM disciplines. This study can contribute to the existing literature by drawing attention to student persistence in STEM at HBCCs. This study revealed what students

perceived as the keys to their success and their challenges regarding persistence, a subject on which there is little prior research.

Due to growing demands in the STEM workforce, more businesses may see a greater need to partner with the study site to bring about STEM awareness, teamwork, and collaboration, which could result in positive social change in the community. The study also revealed that specific courses contributed to students' success; therefore, this research could be built upon to enhance training in specific content areas to increase student persistence. Greater persistence leads to greater graduation rates, which could possibly lead to more employment opportunities.

Conclusion

Students' persistence in STEM is critical for all HBCCs and the expansion of the local workforce (Bray et al., 2018; McClain et al., 2018; Reyes et al., 2019; Russell et al., 2018). The purpose of this basic qualitative study was to explore the perceptions of STEM students at a HBCC regarding their persistence toward degree completion. The conceptual framework used as the lens for this study comprised Astin's (1984) student involvement theory and Reason's (2005) synthesis of persistence research, including the conceptual persistence framework that was developed along with Terenzini (i.e., Terenzini & Reason, 2005).

Most of the extant literature focused on the 4-year HBCUs. There continues to be little scholarly research on HBCCs, especially concerning STEM students' persistence (McClain et al., 2018). It is important to continue to add to the limited amount of knowledge in support of HBCCs. Overall, the results of this study helped to understand

what HBCC STEM students perceive as the keys to their success and their challenges towards degree progression. Because there is limited scholarly research on STEM students' persistence at a HBCC, this study contributes to the narrative of the importance of supportive environments at HBCCs (see Gasman & Commodore, 2014).

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Appendix A

Permission to adopt figure.

From: Terry Hughes
Sent: Monday, May 11, 2020 7:55 PM
To: rreason@iastate.edu <rreason@iastate.edu>
Subject: Request to adopt a figure from your work

Good evening,

My name is Terry Hughes a Doctoral Candidate at Walden University. While working on my conceptual framework I found that your FIG. 1. Comprehensive model of influence on student learning and persistence will work well with my study. I would like to ask permission to adopt this model as part of my framework for my dissertation.

I look forward to hearing from you.

Kindly,

Terry Hughes

From: Reason, Robert D [HS AD] <rreason@iastate.edu>
Sent: Tuesday, May 12, 2020 8:48 AM
To: Terry Hughes <terry.hughes@waldenu.edu>
Subject: Re: Request to adopt a figure from your work

Terry,

I'm happy to hear of your interest in the conceptual framework. You certainly have my permission to use it in your research and dissertation.

All my best,

Bob