ABSTRACT

WALDIE, ALEXANDER LEE. Through the Early College Pipeline: Three Essays of the Early College High School Model and its Influence on Decision-Making and Transitional Processes of ECHS Graduates as Degree Seeking Students (Under the direction of Dr. Paul D. Umbach and Dr. Tuere Bowles).

To better understand the Early College High School (ECHS) movement in modern American educational culture and the impact that these programs have had on students that graduate from them and go on to pursue a bachelor’s degree, this study produced three essays that addressed various aspects of ECHS programming and provide future insights for administrators and policymakers alike. The first manuscript offers a comprehensive history of the development of the national ECHS movement and their early impact on the students and educational environments where these programs have existed. This essay serves as a foundational starting point for policymakers and other academics to learn more about ECHS programs and benefits and limitations that student participants have faced. A second narrative study supplements this history by providing rich insights into the decision-making process of students that attended and graduated from a science, technology, engineering, and math (STEM) based ECHS program, but decided to pivot away from STEM based majors or careers. This study offers insights into the types of resources and supports that students continued to need after they had shifted away from STEM and considers an alternative type of curriculum that proposes more intentional inclusion of liberal arts alongside STEM programming. The last study explored an imbedded caseload of underrepresented students in STEM majors attending the same STEM based ECHS program, reviewing the transitional experiences these students faced as they graduated from their ECHS and continued to pursue a STEM based bachelor’s degree. Findings indicated that these students felt academically prepared to transition to college but faced some challenges in their social transition.
Through the Early College Pipeline: Three Essays of the Early College High School Model and its Influence on Decision-Making and Transitional Processes of ECHS Graduates as Degree Seeking Students

by

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DEDICATION

For Caitlin and James, who have been my source of ongoing encouragement and support, and who have given up so much, for so long, to ensure that I reached this milestone.
Alexander Lee Waldie is a native son of Winchester, Virginia, but has lived in North Carolina for almost a decade, and as such, has successfully adopted the use of terms such as “folks” and “y’all.” He received a Bachelor of Science in Psychology at James Madison University and returned to that institution for a Master of Education in Counseling Psychology with a concentration in College Student Personnel Administration. While completing his Ph.D. in Educational Research and Policy Analysis at North Carolina State University, he has worked professionally in higher education settings including advising, Early College High School administration, and assessment. After graduation, he plans to continue working as a scholar-practitioner in a higher education administration environment.
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# TABLE OF CONTENTS

LIST OF TABLES ........................................................................................................... xiii
LIST OF FIGURES ........................................................................................................ xiv
INTRODUCTION ............................................................................................................. 1
   Definition of Terms..................................................................................................... 1
   References................................................................................................................... 6

CHAPTER ONE: A COMPREHENSIVE REVIEW OF EARLY COLLEGE HIGH SCHOOL
PROGRAMS FROM 2002 TO 2018 .............................................................................. 8
   College Readiness..................................................................................................... 11
   Student Transition and Integration to College ....................................................... 15
   Underrepresented Populations in College ............................................................. 19
   Touted Benefits of ECHS Enrollment for Students .............................................. 24
       College Readiness............................................................................................... 25
       Increasing Underrepresented Student Success.................................................. 26
       Environmental and Financial Benefits ............................................................ 30
   Potential Limitations of ECHS Programs on Students ....................................... 32
       Reduced Extracurricular Activities ................................................................... 33
       Increased Financial Burden on Students, Families and Schools ..................... 35
   Unforeseen Academic Challenges ....................................................................... 39
   References................................................................................................................. 44

CHAPTER TWO: A NARRATIVE STUDY OF THE DECISION-MAKING PROCESSES FOR
NON-STEM DEGREE-SEEKING STUDENTS AT A STEM BASED EARLY COLLEGE
HIGH SCHOOL ........................................................................................................... 54
   Statement of the Problem......................................................................................... 54
   Purpose of the Study ............................................................................................... 56
   Review of the Literature ......................................................................................... 57
       Career Decision Making ...................................................................................... 58
       Leaving the STEM Pipeline .............................................................................. 60
       Social Cognitive Career Theory ....................................................................... 62
   Methodology ............................................................................................................ 63
       Narrative Research ............................................................................................. 64
       Sample Selection ................................................................................................. 65
       Data Collection ................................................................................................... 66
       Data Analysis ....................................................................................................... 67
       Trustworthiness .................................................................................................... 68
       Reflexive Statement ............................................................................................ 69
   Limitations of the Study ......................................................................................... 70
   Participant Profiles ................................................................................................. 71
       Beth ....................................................................................................................... 73
       Elizabeth ............................................................................................................... 74
       Lily ......................................................................................................................... 76
       Lisa ......................................................................................................................... 77
       Michael .................................................................................................................. 79
CHAPTER THREE: EARLY COLLEGE HIGH SCHOOL GRADUATES’ TRANSITIONS AS DEGREE SEEKING STUDENTS UNDERREPRESENTED IN STEM MAJORS: A CASE STUDY .........................................................113

Statement of the Problem .........................................................114
Purpose of the Study ...............................................................115

Review of the Literature ..........................................................117
Underrepresented Students Transitioning to and Through College ........118
Underrepresented Students in STEM Programs of Study ..................122
Conceptual Framework ............................................................125
Limitations and Delimitations of the Study ..................................127
Methodology .................................................................128
Case Study Methods ..............................................................130
Sample Selection .................................................................131
Data Collection .................................................................132
Data Analysis .................................................................133
Validity and Reliability ........................................................135
Researcher Bias and Assumptions ...........................................136

Individual Cases .......................................................................137
Inez .................................................................139
Ogechi .................................................................140
Jordan .................................................................141
Jacob .................................................................142
Ken .................................................................143
Natalia .................................................................144
Gabriella ..............................................................145
Steve .................................................................147
Stephanie ..............................................................148

Parents Play an Active Role in Early College and Career Decision-Making ........88
In a STEM Environment, Exposure to non-STEM Disciplines is Critical for Exploration .................92
STEM Departure was Driven by Either Few Seismic Experiences or Many Smaller Factors ..........................................................95
Uncoupling the STEM Program from STEM Curricula and Careers can be Challenging ..........98
Discussion and Implications ....................................................99
Policy .................................................................100
Practice .................................................................101

Future Research .................................................................102
References .................................................................104

Nina.................................................................80
Quintin.................................................................82
Ruth.................................................................83
Sarah.................................................................85
Seth.................................................................86
LIST OF TABLES

Table 2.1 *Demographics of STEM ECHS Participants in non-STEM Programs of Study* ..........72

Table 3.1 *Individual Case Details for the STEM Based ECHS Bounded Case* .........................138
LIST OF FIGURES

Figure 2.1 Lent, Brown, and Hackett’s (1994) Person, contextual, and experiential factors affecting career-related choice behavior. .................................................................63

Figure 3.1 The relationship of college transitional experience types for early college high school students moving through the process from enrolled high school student through their first and/or second year of enrollment at a four-year institution........127
INTRODUCTION

This dissertation consists of three manuscripts woven together across the theme of Early College High School (ECHS) programs and their intended purpose of preparing students for college success, including those from underrepresented populations. Due to the hybrid nature of ECHS programs combining components of a high school curriculum and presence in college level courses, these small schools of choice also accelerate the decision-making process that students go through regarding their college majors and future career aspirations. The first manuscript is a comprehensive review of ECHS programs nationally from their inception in 2002 and the role they have come to play in secondary and post-secondary educational environments where they exist. The second manuscript, a narrative study of students that graduated from a science, technology, engineering, and math (STEM) ECHS program, explores the decision-making processes that participants experienced as they decided to pivot away from STEM majors and careers, even as they attended a STEM themed school. The third manuscript is a case study of STEM based ECHS graduates and the transitional experiences that they have had as students underrepresented in STEM majors as they continue to pursue bachelor’s degrees in STEM based programs.

The site selected for manuscripts two and three is a STEM based ECHS program located on the campus of a more selective, public, four-year, very high research based doctoral institution. Students were selected to participate in this public ECHS program through a lottery operated by the local school district. Each year, 50 students were selected to attend, with half of each incoming class prioritized as first-generation college going students (see definition below). This context is important for a few reasons. One example is that most ECHS programs operate on a community college campus, which places ECHS students in an environment that is more
accustomed to serving commuter and transfer student populations. Community college-based programs also allow for the opportunity to earn an associate’s degree or some portion thereof (e.g. the 44-hour general education diploma in North Carolina), which provides additional benefits to transfer students via articulation agreements with various four-year institutions (Edmunds et al., 2017). The college transfer-based curriculum of community colleges also limits the types of courses students can take to those that are generally considered appropriate for first- and second year students. Conversely, the four-year institution that serves as the partner to the ECHS site for this study presented challenges unique to this type of setup. For example, these students did not have the opportunity to earn a guaranteed credential such as an associate’s degree, which required more advocacy and college knowledge to navigate their own credit transfer process. The four-year college environment was larger and presented students with a wider variety of degree programs to explore, which brought both opportunities and challenges. On one hand, these students had an on-campus experience more representative of a large college environment, had more freedom in the types of course options they could choose from, and could explore degree options on campus by taking classes and interacting with faculty from various academic departments. On the other hand, this large environment was sometimes overwhelming, and the large course sizes for gateway science and math courses made seeking out individualized assistance more difficult. The ECHS program was also in competition with competing strategic priorities at the institutional level, which sometimes limited access to resources for this student population.

Across all three chapters, common terminology related to the operation of ECHS programs are used; thus, definitions for some of these terms is provided below for additional context.
Definition of Terms

**College Readiness:** “College readiness can be defined as the level of preparation a student needs in order to enroll and succeed, without remediation, in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program” (Conley, 2008, p. 4). ECHS programs frequently tout college readiness as one of the foundational aspects of their programs.

**College Transition:** A transition is deemed to be “any event or non-event that results in changed relationships, routines, assumptions, and roles” (Goodman, Schlossberg, & Anderson, 2006, p. 33). Transitions can originate from larger life events like high school graduation or smaller changes such as a change in career aspiration, but is only recognized as a transition if it is deemed as such by the person experiencing it (Goodman et al., 2006). Originated out of Schlossberg’s (1981, 1984) transition framework for adults in a counseling setting, transition theory has been expanded upon as a student development theory that addresses the transition of college students (L. D. Patton et al., 2016).

**Early College High School (ECHS):** The most common manifestation of the CIHS program in North Carolina has been the formation of ECHS programs. An initiative of the Bill and Melinda Gates Foundation, ECHS programs began in 2002 with an emphasis in two key areas: increasing the number of students graduating from high school with the skills necessary for college success, and focusing on the success of traditionally underrepresented populations in post-secondary education, including those from low socioeconomic backgrounds, and minority and first-generation college students (Berger, Adelman, & Cole, 2010; Bill and Melinda Gates Foundation, 2009; Edmunds, 2012).
**First-Generation College Students (First-gen):** A student who is of the first generation in their family to attend college (Chen, 2005). There is some variation in definition as to how much education a parent can have before the student is no longer considered first-generation, and that variation can impact how these students are counted and benchmarked against their peers with parents who have attended college (Smith, 2015b). Some organizations, such as the Center for Community College Student Engagement, allow for a student to be classified as first-generation only if both parents have not pursued education beyond high school (Center for Community College Student Engagement, 2017). Other definitions, such as the one from a National Center for Education Statistics report of the National Education Longitudinal Study of 1988, classify a student as first-generation if one, but not both, of the parents has some college experience, but cannot have earned a bachelor’s degree (Chen, 2005). In all cases, the defining component is that neither parent has obtained a bachelor’s degree.

**STEM or STEM Based Programs of Study:** STEM stands for science, technology, engineering, and math, and is typically used as a placeholder to discuss programs of study often considered “hard sciences.” Definitions for the term vary slightly depending on the research being conducted, and most often the variations exist around the inclusion of social and behavioral sciences. For example, the American Council on Education (Anderson & Kim, 2006) defines STEM as “mathematics, statistics, computer/information science, computer programming, electrical, chemical, mechanical, civil, or other engineering; engineering technology; electronics. Natural resources, forestry, biological science (including zoology), biophysics, geography, interdisciplinary studies including biopsychology, environmental studies, physical sciences including chemistry, and physics,” while the National Science Foundation (National Science Board, 2016) also includes behavioral and social sciences and health-related
fields. Oftentimes, social and behavioral sciences do not require the same level of rigorous math and science courses in their programs of study as other STEM based programs, and so in order to streamline the experiences of STEM students in their first year, this research study will omit social and behavioral sciences for the purposes of identifying students underrepresented in STEM based majors.

**STEAM, STE@M, or STEAM Based Programs of Study:** Whereas STEM based programs only focus on science, technology, engineering, and math, STEAM programs incorporate the liberal arts in the curriculum as a means to further integrate interdisciplinary approaches and develop a holistic educational method for students (Yakman, 2010). The STEAM model rejects the traditional ways in which science, technology, engineering, and math are siloed as academic subjects in favor of a more cross-curricular methodology.
References


CHAPTER ONE: A COMPREHENSIVE REVIEW OF EARLY COLLEGE HIGH SCHOOL PROGRAMS FROM 2002 TO 2018

The Early College High School Initiative was the driving force behind the rapid growth of the Early College High School (ECHS) movement in America since its inception in 2002 in partnership with 13 educational organizations and with funding from the Bill and Melinda Gates Foundation, the Carnegie Corporation of New York, the Ford Foundation, the W.K. Kellogg Foundation, the Dell Foundation, the Lumina Foundation for Education the Walton Family Foundation, along with other local foundations (Jobs for the Future, 2017a). The motivation for this movement emphasized two key areas: ensuring that students were graduating from high school with the skills necessary for college success, and focusing on the success of traditionally underrepresented populations in post-secondary education, including those from low socioeconomic backgrounds, minority students, and first generation college students (Berger, Adelman, & Cole, 2010; Bill and Melinda Gates Foundation [Gates Foundation], 2009; Edmunds, 2012; Kaniuka & Vickers, 2010). The ECHS Initiative has established five core principles that were fundamental to advancing their mission and that all ECHSs were expected to adhere to, though the individual schools had flexibility for how they chose to pursue these goals. These core principles include (Jobs for the Future, 2009):

- Serving students traditionally underrepresented in higher education;
- Establishing the high school program through a collaborative partnership between the local education agency, a higher education institution, and the community;
- The development of an integrated academic program that allows students to earn up to two years of college credit;
The creation of a comprehensive support system that helps students to develop the academic and non-academic skills necessary for college completion;

The utilization of all partners to establish conditions and advocate for policies that favor the advancement of the ECHS movement

Since 2002, the movement has produced over 280 high schools across 31 states and the District of Columbia, serving more than 80,000 students across the country (Jobs for the Future, 2017b). Compared to a traditional high school, ECHS programs have offered a college preparatory curriculum with non-selective enrollment that condensed and expedited the high school courses in order for students to earn significant portions of college credit throughout their high school career (Kaniuka & Vickers, 2010; Berger et al, 2010). Content has been delivered either in person or through distance education, with decisions to utilize distance education methods based on funding or proximity of the partner institution (Hill, 2011). The operation of an ECHS has been generally smaller than a traditional high school, with student populations no more than 400-500 students, and they have required more high school faculty per pupil in order to provide a smaller classroom experience (Kaniuka & Vickers, 2010).

ECHS programs are also different from other dual credit type programs (e.g. dual enrollment or concurrent enrollment) that might offer a student both high school and college credit for taking a course without the need for standardized test credits via Advanced Placement or International Baccalaureate (Tobolowsky & Allen, 2016). Dual credit courses are usually taught by the students’ qualified high school faculty or at local colleges (community and four-year), are typically offered piecemeal to students who choose to sign up for them (i.e. not built into a specific curriculum), and most often, they don’t offer comprehensive systems of support outside of what’s readily available to any student (Tobolowsky & Allen, 2016). Though more
commonly available than ECHS programs, dual credit offerings “differ by rigor, content, instruction, structure, and design within and between states” (Tobolowsky & Allen, 2016 p.9). All of these programs are different from Advance Placement or International Baccalaureate courses which are rigorous high school courses taught by high school instructors and require students to pass an optional exam with a high enough score to earn college credit. Because these courses are taught in a high school setting, they do not expose students to the college environment, and African American, Hispanic, American Indian and Alaskan Natives have been historically under-enrolled in these programs (College Board, 2014; Tobolowsky & Allen, 2016).

The ECHS movement is relatively young and has relied on the buy-in from many stakeholders in a loosely organized system that have fully committed to the mission. Although the ECHS Initiative, and now the ECHS movement operated by Jobs for the Future, has existed on a national level, there has been no countrywide enforcement power over the individual schools, and most states that operate ECHS have done so within the parameters of their own educational systems. Some ECHS programs have also operated with additional guidelines provided by nonprofit entities such as the recently defunct North Carolina New Schools (Neff, 2016) or Jobs for the Future, established to support the growth of the ECHS movement. The five core principles of the ECHS Initiative have been undoubtedly lofty, and even as they have been referred to as standards for improving secondary education and college readiness for marginalized populations across the country, the reform that they have attempted to inspire across multiple state educational systems have required deep consideration of politics, resources, and environments known for being complex and slow to change.
College Readiness

ECHS programs have been underpinned by a philosophy of providing a comprehensive high school experience built around high academic expectations and extensive supports, with the goal of preparing students to be ready for college in a way that allows them to persist and graduate with a bachelor’s degree (Berger et al., 2010; Julie A Edmunds, 2012). The ECHS movement has been intrinsically tied to the concept of college readiness from the beginning, seeing comprehensive college preparation as the primary tool to disrupt traditional educational settings that marginalize underrepresented populations. Therefore, understanding how ECHS programs have approached school and curricular design first requires a brief review of college readiness.

College readiness has become such an important part of the national mission and culture of secondary education that college and career readiness standards have now been codified into the most recent reauthorization of the federal education law, the Every Student Succeeds Act (ESSA) (US Department of Education, 2017a). The focus on college readiness as a primary mission of high schools has aligned with the changing demographics associated with college attendance and the workforce, and the cultural shift away from an economy that functions primarily on graduates of high school. Conley (2005) reported that approximately 90 percent of entering freshmen in high school looked towards attending college as their goal, and close to two-thirds of high school graduates have made the jump directly from high school graduation to college enrollment. And yet, college aspiration and enrollment rates have been lower, both for students who are minorities or come from low socioeconomic backgrounds (Klasik, 2012). And while there has been growing demand for college graduates in the larger economy, a trend that seems unlikely to reverse, those who make up the future workforce are the ones that have been
most left behind in terms of preparation for college degree attainment. The Bureau of Labor Statistics indicated that the overall workforce will slow in growth over the next 35 years, but the rate of growth for minority workers will continue to expand while non-Hispanic Whites will decrease by 20 percent as a portion of the total workforce (Toossi, 2002). As of 2009, only 58% of Hispanic and 55% of African American students earned a high school diploma, compared to a national average of 71% and only about one-fifth of African American and Hispanic students were prepared to succeed at a four-year institution (Bill and Melinda Gates Foundation, 2009).

Despite this growing focus on college readiness as an integral part of the secondary experience, the concept has taken on different meanings and encompassed multiple components, making a single definition of the term difficult to pin down. Traditionally, the strongest measures of college readiness have come in the form of a student’s high school grade point average, the rigor of their academic schedule (i.e. how many honors, AP or IB, or dual enrolled college courses the student has taken), class ranking among their peers, and their scores on standardized college entry tests such as the ACT, SAT, or SAT II (Adelman, 2006; Sawyer, 2013; Sternberg, 2010). Other supplemental information such as extracurricular involvement in high school clubs, community service, and employment history has also indicated a level of student engagement, and been typically treated as secondary information in the college application process (Sternberg, 2010). Recently, however, more complex models of college readiness have been explored that consider how academic factors interact with non-academic behaviors and the environment to impact the readiness of students to enter a collegiate environment. This has also come at a time when some college admissions programs have chosen to look beyond the traditional measures of readiness. Many colleges have now opted for ACT or SAT scores to be optional in the admission process (Syverson, 2007), and others have allowed
students to submit a more holistic portfolio to represent their preparation and past achievements (Jaschik, 2015). Even with these changes taking place, however, students still have had a need for college preparation that is comprehensive and intentionally designed into their secondary education in order to have the best chance of succeeding.

Conley’s (2010) seminal research surrounding college readiness has illuminated a more comprehensive understanding of the subject, interpreting readiness as a function of the high school experience, stating that “high schools should be considered successful in proportion to the degree to which they prepare their students to continue to learn beyond high school” (p. 9), as opposed to a function primarily left to the responsibility of a student’s individual performance. He has also indicated that college readiness implies enrolling and succeeding without the need for remediation in credit-bearing general education courses (Conley, 2008). His four-dimension model has taken a comprehensive view of the “capabilities, skills, knowledge, and behaviors students need to demonstrate to be ready to pursue learning beyond high school” (p.19) and has demonstrated that a student’s acquisition of specific content knowledge is only a piece of the wider skills necessary for college preparation. Conley’s (2010) Four Dimensions of College and Career Readiness include

- key cognitive strategies, or “patterns of thinking that lead to the development of a variety of specific ways to approach and attack challenging learning situations;” (p. 33)
- key content knowledge, or a strong command of subject based knowledge required in order to understand academic disciplines, including not only content knowledge in topics such as English, math, science, social sciences, and the arts, but also a strong command of the overarching academic skills of critical reading and writing;
• academic behaviors such as those that hone a greater level of self-awareness, self-monitoring, and self-control; and

• contextual skills and awareness, also understood as college knowledge, or the primary knowledge base concerned with the operation of college as a system and culture. (Conley, 2010, p. 35-41)

The first two components of Conley’s (2010) model addressed the more traditional measures of college readiness, as students who are well prepared via key cognitive strategies and key content knowledge could reasonably be expected to perform well on measures such as high school GPA, standardized tests such as the SAT or ACT, or the academic rigor of their high school curriculum. Conley’s model is more comprehensive, however, in that it has also considered the development of a college going culture and knowledge of college systems as being paramount to a student’s collegiate success. More recent efforts to adopt this holistic approach to college readiness has led to efforts such as those in Macdonald and Dorr’s (2006) Creating a College Going Culture resource guide for K-12 administrators that included nine critical principles such as active involvement of high school faculty and parents, establishing partnerships with colleges, communicating to students about college on a daily basis as early as elementary school, and providing college information and resources including comprehensive college counseling. Additional recommendations have included raising standards at the secondary level and developing data systems that share information across secondary and post-secondary institutions to help administrators continue to refine transitional processes and make adjustments based on post-secondary feedback (Roderick, Nagaoka, & Coca, 2009).

Similar to Conley’s model, Edmunds and her colleagues (2016) have found multifaceted and complex factors in determining college readiness in high school students, especially for those
who have participated in ECHS programs. Again, there has been a focus on academic preparation, but it was holistic and encompasses areas such as content knowledge, critical cognitive strategies and appropriate written and oral academic communication skills. They also considered the academic adjacent behaviors and attitudes that successful students demonstrate to manage their lives, including appropriate time management and goal setting strategies, the development of key in-and-out of class studying habits, and appropriate social and relationship tactics that assist students to self-advocate, collaborate with others, and generally excel in social settings with peers. Lastly, they addressed the importance of understanding the complex processes related to navigating the college environment, including those that have taken place prior to landing on campus (such as navigating the admissions and financial aid applications or understanding the transitional impact that attending college will have on the student and their family), as well as those that have taken place once a student is on campus full time (such as physically navigating campus, understanding the class registration process, and understanding the cultural and normative campus environment) (J. A. Edmunds et al., 2016).

**Student Transition and Integration to College**

Ensuring that high school students are college ready has been a popular focus of literature related to the transition between high school graduation and college attendance, but it is also critical to understand the phenomenon of the transition itself. The impact of a transition can take place prior to beginning the first college semester, as happens with the phenomenon of “summer melt” (Castleman & Page, 2014), or once a student has been on campus for a period of time, but in either instance, the transitional challenge concerns not only the academic adjustments, but the personal and social adjustments as well (Gerdes & Mallinckrodt, 1994). Chickering and Schlossberg (2002) note that the transition to college requires “new – or modified – roles,
relationships, routines and assumptions” and that identifying the magnitude of these changes is crucial to understanding how big of a transition a student may be facing (p.17). Students who move from one academic environment to another can also experience “transfer shock,” which is a slight dip in academic performance as they adjust to the academic and social settings of their new institution (Thurmond, 2007). This culture shock in their transition to college is more pronounced for students from first-generation backgrounds (Inman & Mayes, 1999).

A transition then, is “any event, or non-event that results in changed relationships, routines, assumptions, and roles” (Schlossberg, Waters, & Goodman, 1995, p. 27). Schlossberg’s (1989) process of transition is useful to better understand how students adjust to a series of phases in which they approach a transition,

- first by engaging from afar or through initial assessment of the situation by “moving in,” to the transition;
- then by “moving through” the transition, addressing or engaging with the transition in order to incorporate the change; and
- finally, by “moving out” or moving past the transition from a point of contention to a full integration of the transition that has taken place (L. D. Patton et al., 2016).

An adult development theorist by trade, Schlossberg’s theory was originally developed to help adults cope with life transitions, and has since found influential status as a college student development theory regarding student transitional experiences (Goodman et al., 2006). She states that a student’s ability to deal with transition is dependent on four S’s: Situation, Self, Support, and Strategies. Especially as it relates to supports and strategies, students either successfully adopt to their new environment or not by the strategies and supports they establish (N K Schlossberg et al., 1995). It was a combination of these factors, which were non-static in
nature and existed in differing levels for each student, that determined the ability for students to transition or adapt to the challenges that arise in their pursuit of graduation (Chickering & Schlossberg, 2002).

Another part of the transition to college includes students’ ability to socially and academically integrate into the institution once on campus. Tinto’s Interactionalist Theory of Student Departure (1975, 1987, 1993) stands out as the seminal research in this area and has reached near paradigmatic status, despite critiques of his original work. In some ways similar to the thoughts underpinning Schlossberg’s (1989) process of transition, Tinto postulated that both social and academic integration took place when students were able to successfully work through processes of separation, transition, and incorporation (Milem & Berger, 1997). He saw students as entering college with a set of preordained entry characteristics and skills (such as student demographics, academic abilities, and financial abilities) that impacted the student’s initial commitment to their educational goals and to the institution, and those initial commitments were what determined the consequent levels of social and academic interactions, which in turn impacted subsequent ongoing commitments to the institution and the commitment to graduate (Braxton et al., 2013; Milem & Berger, 1997; Tinto, 1975, 1993, 2006). Although having been widely accepted as foundational to research around undergraduate student integration and retention, Tinto’s work has not gone without its criticisms throughout the past 35 years, and his theories regarding social and academic integration have been built upon and updated by others to account for additional considerations such as motivational and other psychological theories, students’ decision making and goal setting processes, and students’ transition into and through college (Demetriou & Schmitz-Sciborski, 2011).
Building off of Tinto’s revised Interactionalist Theory of Student Departure (1993) and the previous work of Braxton, Hirschy, and McClendon (2004), Braxton, et al. (2013) offered a revised theory of student persistence in residential colleges and universities that critiqued Tinto’s earlier work for not standing up to empirical testing, and for over-representing the impact of academic integration. Braxton, et al.’s (2013) model suggested that student persistence is the result of a student’s ability to socially integrate at the institution, and that greater social integration resulted in a student’s greater subsequent commitment to their college, which led directly to increased persistence (Braxton, et al., 2013, p. 165). Both social integration and subsequent ongoing commitment to the institution were the result of multiple input factors that a student either brought with them prior to enrollment, or experienced during their initial time at their new institution. Such factors included a student’s entry characteristics (including race, gender, family SES, highest level of parental education, academic ability, academic achievement in high school, ability to pay and cultural capital), students’ initial commitment to the institution, the institution’s commitment to student welfare, institutional integrity, and psychosocial engagement (Braxton, et al., 2013). Kuh and Love (2000) also noted that Tinto’s overrepresentation of academic integration may have stemmed from his engineered separation of student experiences when in reality, students perceive their experiences as being more fluid and interconnected. Other recent efforts to address previous shortcomings of Tinto’s earlier work have focused on improving the predictability of retention and integration models, integrating more complex variables (e.g. financial and cost considerations, familial relationships), and more accurately capturing the experiences of student populations that face unique obstacles or have additional barriers to their social and academic integration (Borglum & Kubala, 2000; Flowers,
More recently, Tinto has reaffirmed that while student involvement and engagement is at the heart of integration efforts, the issue of student retention is complex and vastly intertwined with institutional policies and program implementation, instructional techniques and faculty interaction, and economic inequities (Tinto, 2006). He has also critiqued his earlier work for not being comprehensive enough, acknowledging the need for a range of models to address the complexity of retention from sociological, psychological, and economic frames (Tinto, 2006).

Great consideration must still be given to the complex variety of student backgrounds (social, cultural, economic, and institutional) that impacts their experiences before and during college, the influence of collegiate environment (community college, four-year institution, residential, commuter, etc.) on students’ experiences, and the development of enduring multifaceted institutional models that better align resources across the campus to address retention for all students (Tinto, 2006).

Underrepresented Populations in College

The other key focus of the ECHS movement has been to improve the experiences of traditionally underrepresented populations in college, including those from low socioeconomic backgrounds, minority students, and first generation college students (Berger, Adelman, & Cole, 2010; Gates Foundation, 2009;). Increasing the college enrollment and achievement rates of traditionally underrepresented students has been a notoriously stubborn challenge for educators and requires careful consideration of additional factors that impact college readiness, transition, and integration to the institution. Students from low socioeconomic backgrounds, first generation college students, and underrepresented racial minorities (URMs) have faced
additional obstacles on their journey as they plan for, transition to, and persist through college. In many cases, underrepresented students have identified with more than one of these populations (e.g. students who have both identified as being from a minority group and from a family in the lowest quintile of earners in the United States), potentially compounding the challenges that they have faced as they navigate college (Malcom, 2010; Owens, Lacey, Rawls, & Holbert-Quince, 2010). For instance, students from both Latino and low socioeconomic backgrounds have had to not only work through any potential differences between their familial culture and the dominant culture on campus, they have also faced the complex world of financial aid, part-time work, and other financial decision-making processes, all while working through the transitional processes that all college students navigate. Understanding the challenges of recruiting and retaining underrepresented students in rigorously designed ECHS programs (and propelling them to continue their education at the collegiate level) requires an analysis of how these student populations have been marginalized in their traditional primary and secondary education settings.

The arduous process getting to college for these students has often started in their place of birth and upbringing. Racial and socioeconomic discrepancies and patterns of racial segregation in America have reinforced that minority and low-income students are at a disadvantage in preparing for college from an early age. These factors, along with parental educational level, were most correlated with achievement gaps between White students and their Black and Latino counterparts in a comprehensive national study of approximately 200 million standardized reading and math tests from students in 3rd through 8th grade (Shores, Reardon, & Kalagrides, 2017). This study accounted for school districts that enrolled over 90% of all Black and Latino students in the United States, and found that while achievement gaps varied between
and within school districts in each state, there was but a handful of districts where the achievement gap was zero, and that the larger gaps existed in districts where racial segregation and differences in White-Black socioeconomic status were more prominent (Shores et al., 2017). For those districts where the gap was near zero, they typically either enrolled few minority students or were poor districts where minority and White scores were equally low (Shores et al., 2017). The patterns that initially set underrepresented students at a disadvantage are further complicated by the college preparation and application processes that take place during a student’s secondary education.

From 1980 to 2002, the number of high school students who identified as having aspirations to attend college essentially doubled, from 40% to 80%, and while this growth occurred across all racial and socioeconomic groups to some extent, challenges have remained in terms of converting student aspirations to degree attainment due in large part to long-standing structural issues in the college preparation, application, and transition processes (Roderick et al., 2009). Metrics that have typically carried the most weight in the college admissions process, including high school GPA, academic rigor of high school course schedule, Advanced Placement (AP) and International Baccalaureate (IB) course enrollment, and SAT and ACT test scores, are measures for which some minority and low-income students have been less equipped, due to a lack of rigorous academic preparation, a dearth of appropriate resources, and/or missing contextual knowledge for the college application process (Elliott, Christopher Strenta, Adair, Matier, & Scott, 1996; Owens et al., 2010; Rosenbaum & Becker, 2011; Sternberg, 2010). AP and IB programs are designed to provide college preparatory levels of academic rigor to high school students, but Black and Latino students have been under-enrolled in these programs, in part because they have been less likely to be identified as gifted students at a younger age and
have not been offered academically stimulating classes at appropriate rates that would have
prepared them for the rigor of AP and/or IB courses once they reached high school (Gándara,
2004; Nguyen, Callahan, & Stevenson, 2010). Disproportionately low numbers of Hispanic and
African-American students, and less than one percent of students from low socioeconomic
backgrounds (defined as eligible for free or reduced lunch) took AP courses when they were
offered in the student’s high school, and when these students did take the courses, they were
much less likely to score at least a three (the minimum score accepted for college credit)
(Handwerk, Tognatta, Coley, & Gitomer, 2008).

In considering the academic rigor of the high school curriculum, while there has been no
nationally mandated curriculum, the typical credit system for a year of instruction in a particular
subject is a Carnegie unit (Martinez & Bray, 2002), and the standard measure for intensity has
been based on the number of Carnegie units a student has earned during their time in high school
in core subjects such as English, mathematics natural sciences (ideally with labs), history and
social sciences, and foreign language (Adelman, 2006). Typically, higher levels of academic
rigor have been associated with increased numbers of courses that a student has taken in these
core areas, and there have also been specific courses that have served as benchmarks for rigor,
including levels of math beyond Algebra II (i.e. calculus, trigonometry, and statistics) and
increased levels of lab based natural science courses, and yet African-American and Latino
students have attended high schools at a higher rate than their White and Asian peers for which
calculus, trigonometry, and statistics are not available for students to take (Adelman, 2006).

Colleges have reinforced this method of determining college readiness via academic rigor,
as minimum requirements for admission have often required that students take a threshold of
courses. In California, for example, only a third of graduates from the 2003-2004 academic year
had completed the requirements to enter a public California four-year institution, with lower rates being reported for African American, Hispanic/Latino, and American Indian/Alaskan Native students (Macdonald & Dorr, 2006). Criticisms of this system for determining rigor through an accumulation of high school credits has included that it has not accounted for content or performance standards within courses (Barth & Haycock, 2004), that high school transcripts, typically the vehicle of communication of rigor to entities such as college admissions, have been inconsistent in listing subject specific testing scores for cross validation purposes (Adelman, 2006), and that differences in numbers of Carnegie units earned has been as much a product of a student’s socioeconomic status, geographical location, and disparities in available resources in the school system rather than students’ ability to perform academically (Altonji, 1995). More recently, some colleges have attempted to address issues of inequality in their admissions standards, with some institutions opting for a “test optional” application process that has deemphasized standardized scores such as the ACT and SAT (Rooney & Schaeffer, 1998), while other institutions have experimented with comprehensive portfolio based applications that allow students to interact with colleges and receive feedback as early as ninth-grade (Jaschik, 2015).

A comprehensive study of college students by the National Bureau of Economic Research demonstrated frustratingly persistent challenges to access for students from lower socioeconomic family backgrounds from 1999 to 2013. For example, students of parents in the top one percent of income levels were 77 times more likely to have attended an Ivy League college. At the same time, the small number of low-income students that attended elite private institutions remained approximately constant and overall access to institutions that best addressed income mobility (from the lowest quintile to the highest) dropped off significantly (Chetty, Friedman, Saez, Turner, & Yagen, 2017). Despite that students from low and high-
income families were determined to produce similar earnings outcomes relevant to the institution attended, low income mobility is still impacted by access to college in the first place (Chetty et al., 2017). Adelman's (2006) study cited above regarding availability of post-Algebra II math courses for minority students also found that the percentage of high schools that offered upper level math courses dropped based on students' socioeconomic quintile for family income, ranging from 71.6% of availability to 43.5% availability in calculus, from 83.1% to 63.7% in trigonometry, and from 34% to 18.5% in statistics (p. 32).

The result of these challenges has been that Black and Latino students have been graduating from high school less prepared for college than their White and Asian peers. Data from the National Assessment of Educational Progress (2015) showed that only 17% of Black students and 25% of Latino students graduated with at least proficiency in reading, and those numbers drop to 7% and 12% respectively for proficiency in math, reflecting numbers that have been consistently low and relatively unchanged since the early 1990s (Greene & Forster, 2003; Greene & Winters, 2005). Students from low socioeconomic backgrounds have faced similar situations regarding a lack of college readiness, and even when these students do make it to college, many of them face taking remedial courses due to the lack of adequate preparation they received at their high school (Roderick et al., 2009).

**Touted Benefits of ECHS Enrollment for Students**

ECHS programs were intentionally designed to help students from underrepresented backgrounds participate in a program that introduced them to a college environment, prepared them for college level academic work via a rigorous high school curriculum and the ability to earn upwards of 60 college credits, and gave them the non-academic skills often overlooked for these populations but essential for transition to the university and persistence towards a
bachelor’s degree. In the 15 years since the ECHS Initiative first introduced ECHSs, the programs have demonstrated higher high school graduation rates than their traditional high school peers, and the students who have participated in these programs have taken more college preparatory coursework than their peers (Edmunds et al., 2017). ECHS students and their faculty have also reported that the students have benefited from learning other academic behavioral skills such as time management and study skills, self-advocacy, knowledge about the college selection and application process (Edmunds et al., 2017). These programs have not been without their challenges, however, and the students and their families that have participated in them did so at the expense of other tradeoffs such as reduced extracurricular activities and additional financial costs. An in-depth analysis of the benefits and potential limitations of ECHS programs is provided in the following sections.

**College Readiness**

As previously indicated, preparing students to build the skills necessary to transition into college has been one of the foundational aspects of an ECHS program. Preparing for post-secondary success is a comprehensive process that involves the development of essential cognitive skills, fundamental academic knowledge, strong academic (e.g. time management and effective study habits) and non-academic (e.g. effective communication and social skills) behaviors, and a command of the processes and culture of college (Conley, 2008). Through their research, Martinez & Klopott (2005) found that especially for minority and low-income students, college entry and persistence was best predicted by “academic preparation, social support, access to information, parental involvement and knowledge about college, and financial aid” (p. 5). In order to prepare students so broadly, ECHS programs have operated in drastically different ways from traditional high schools. A study of North Carolina’s comprehensive model to recreate the
high school experience for its 70 ECHS programs demonstrated that the schools are expected to create an environment that “supports college readiness, including changing course-taking requirements, improving teaching and learning, building high-quality staff-student relationships, and providing academic and affective supports to students” (Julie A Edmunds, 2012).

One study found that the ECHS students gained from built in support structures such as participation in a learning community model, enrollment in a college success seminar course, and an early alert system that informed parents of falling grades (Leonard, 2013). Additionally, these students spoke with their parents earlier and more often about financing college and he found that parents of the ECHS students were more engaged with the high school faculty than the traditional high school parents (Leonard, 2013). Another study demonstrated that students in an ECHS program defined their success in college preparation “either by the earning of college credit or the academic expectations that prepared them to be successful in the college courses they took” (Kaniuka & Vickers, 2010, p. 172-173). The students at this ECHS took ownership over their academic rigor, in part, because they felt invested in by high school faculty who were caring, supportive, and invested in their general well-being (Kaniuka & Vickers, 2010). This type of relationship building has been important to college readiness, as interactions with faculty at the collegiate level have also impacted student success (Graunke & Woosley, 2005; Ullah & Wilson, 2007).

**Increasing Underrepresented Student Success.** Another foundational aspect of ECHS programs has been their focus on increasing success for traditionally underrepresented populations in higher education, such as those from minority or low economic backgrounds, or those who were first in their family to attend college. The Bill and Melinda Gates Foundation, one of the primary financial supporters of the ECHS Initiative, looked to educational reform as a
crucial way to reduce inequality and increase access for these populations (Gates Foundation, 2009). One major way to encourage economic growth for underrepresented populations has been to ensure that they participate in educational opportunities that increase the likelihood of graduating from high school with the skills necessary for college success. In 2009, only 71 percent of American students were earning a high school diploma, with fewer Hispanic (58 percent) and African American (55 percent) students persisting to high school graduation, and even smaller numbers completing high school college ready (Gates Foundation, 2009). This has been especially concerning in a market where all future growth in the workforce is projected to come from minority populations (Gates Foundation, 2009). The ECHS Initiative was established in part to disrupt this trend of continuous low performance and, as is made clear by the ECHS Initiative’s first core principle, to create a strong commitment to the success of students underrepresented in higher education.

In order to serve underrepresented populations, ECHS programs have had to first get these students enrolled in their schools. Most ECHS programs have designed their student selection process through a lottery based system to help ensure fair selection of enrollees (Berger et al., 2013; DiMaria, 2013; Julie A Edmunds, 2012; Fischetti, MacKain, & Smith, 2011; Webb, 2004). While this process has better promoted equality in the selection process, it has done so with some potential challenges to the underrepresented populations. Funded by the Gates foundation and carried out by American Institutes of Research and SRI International, the largest ongoing research on the impact of the ECHS Initiative has indicated that it is likely that ECHS programs “attracted academically prepared and ambitious students to their lotteries” and therefore may have still missed targeting less prepared students who had a greater need for support (Berger et al., 2013, p. vi). In the same study, they found that lottery applicants
performed better than the average for all students on the English, language arts, and mathematics state level assessments (Berger et al., 2013, p. vi). The challenge with this type of lottery system has been that unless schools recruit heavily from communities that reflect the targeted characteristics sought after by the ECHS Initiative, they are less likely to enroll high levels of students from those populations (Webb, 2004). Despite potential limitations in using a lottery system to recruit underrepresented students, as of 2009, ECHS programs were successful in enrolling 67 percent of their students from racial or ethnic minorities and 59 percent from economically disadvantaged families (Julie A Edmunds, 2012).

For underrepresented populations that found their way into enrollment in ECHS programs, the results have been promising. A study of one ECHS in Fayetteville, North Carolina that has a minority-majority population, and where over 56 percent of the students are on free or reduced lunch services, indicated that the ECHS students outperformed traditional high school students on five academic state tests, including in English, math, science, and social science (Kaniuka & Vickers, 2010). These results held true for all Black students, as well as a majority of White, Hispanic, and multiracial subgroups (Kaniuka & Vickers, 2010). Students at this school indicated that the opportunity to excel in an academically rigorous environment and the supportive and caring environment were beneficial to their motivation to succeed (Kaniuka & Vickers, 2010). Another ECHS in Texas graduated its entire senior class in 2012, where 86 percent of the students are on free or reduced lunch and 84 percent of the students are Hispanic (DiMaria, 2013). Additionally, 46 of the 86 graduates earned an associate’s degree, and the graduating class as a whole earned an average of 30 credit hours (DiMaria, 2013). In both of these instances, the success of students was dependent on many formal support structures offered from the ECHS program that most likely do not exist in a traditional high school, including small
class sizes, intentionally designed in-school and afterschool tutoring, and increased faculty interactions with students in a mentor or advisor capacity (DiMaria, 2013; Kaniuka & Vickers, 2010). In a 2007-2008 survey of ECHS programs, 89 percent of programs reported offering some form of academic or social support class (e.g. college life-skills course, introduction to university studies, etc.) and 84 percent offered a formal tutoring program of some sort, although only 66 percent of students reported using the formal tutoring services (Berger et al., 2010).

The most recent research has shown that ECHS students graduated at higher rates than comparison students (86 percent versus 81 percent, respectively), and were more likely to enroll in both two-year and four-year institutions (80 percent versus 71 percent, respectively) (Berger et al., 2013, p. v). The ability to earn a significant portion of college credit was also important for these students as it helped to motivate students to move from high school graduation directly into enrolling in a postsecondary institution. In a study of graduates from 64 ECHS programs in 2009, Webb & Mayka (2011) found that 24 percent of students earned either an associate’s degree or an equivalent two years of college credit, and 44 percent had earned at least one year of credit. Another national evaluation found that ECHS graduates had earned an average of 23 college credits upon completion of their program (Julie A Edmunds, 2012).

Initial reports on college degree attainment have also appeared hopeful, especially for traditionally underrepresented populations. Recent research has indicated that attending an ECHS has a statistically significant, positive impact on degree attainment when compared to traditional high school peers, and this positive effect has held true even after allowing for a fifth year of study for traditional students (Berger et al., 2013). As it relates to the populations that the ECHS Initiative has sought to serve, minority students were 29 times more likely to earn a degree than the comparison group, and low-income students were right behind them, being 25
times more likely to earn a degree, though there was no observable effect between first
generation students and non-first-generation students (Berger et al., 2013). The majority of
ECHS students who earned a degree did so while enrolled in their ECHS program and the most
common degree that was attained during this time was the associate’s degree (Berger et al.,
2013). It is important to keep in mind that research in this area has been relatively limited as
most of the ECHS programs in operation have had student populations that have not yet reached
the age at which they could potentially earn a bachelor’s degree. More attention to this area will
be needed as these programs mature.

**Environmental and Financial Benefits**

One of the touted benefits of attending an ECHS has been the opportunity to interact with
the college environment in a facilitated and supportive manner. Fifty percent of ECHS programs
have been located on a college campus, allowing students to engage with the college
environment in a way that is absent from dual enrollment or other college credit earning
programs (DiMaria, 2013). Early interaction with a college campus has been shown to increase
students’ access to information about various college resources (e.g. application process,
financial aid, academic support) and has left them feeling better prepared to handle life in college
(Martinez & Klopott, 2005; Edmunds, 2012). Students at one ECHS program in Texas have
reported that interacting with the faculty and attending classes with traditional college students
has helped them to “demystify the college experience” (DiMaria, 2013). An analysis of data
from a national survey of the ECHS Initiative has found that ECHSs were mostly successful in
providing information that was critical to the successful transition from high school to college,
including in areas such as “supports for college entrance exam preparation (63%), college tours
A prompt transition from high school to college has often been vital to determining if students will persist to a degree. Using a representative longitudinal sample of the Texas high school class of 2002, Niu & Tienda (2013) found that students who delay entry into post-secondary education, especially more than a year after graduating high school, have shown a significantly lower rate of completing a bachelor’s degree than those who enrolled immediately after high school. This was especially true for students who were from lower socioeconomic or minority backgrounds, had lower academic profiles, and started their collegiate careers at a community college (Niu & Tienda, 2013). Although most ECHSs in the country have been aligned with a community college partner, and therefore most ECHS students are automatically starting their college experience at a community college, when they graduate from high school, the amount of credits they have accumulated has further encouraged their enrollment in both two-year and four-year institutions. In an impact study of the ECHS Initiative, it was reported that ECHS students were more likely to enroll in college than students from a traditional high school program by a margin of 80 percent versus 71 percent, respectively (Berger et al., 2013). For the 2010-2011 academic year, 93 percent of ECHS graduates nationally earned at least some portion of college credits, with 56 percent earning two or more years (DiMaria, 2013). For those who have earned a substantial amount of credits or an associate’s degree through their ECHS program, it makes sense that they would have seen the four-year institution as their next step in the pursuit of their degree.

Long-term financial savings for students and their families receive a great deal of attention in the ECHS literature. As was mentioned earlier, the ability for ECHS students to earn
up to 60 college credits before graduation has been one of the core principles of the ECHS Initiative (JFF, 2009). One of the motivating factors behind this principle was that it would enable long-term savings for remaining higher educational costs. Typically most, if not all, costs associated with taking college courses while enrolled in an ECHS program have been covered by the program (Berger et al., 2013), though this is not always the case (see below). This has been one of the ways in which families have saved money over participating in other accelerated programs such as dual enrollment (which have typically required the family to pay for course credit at reduced rates) or Advanced Placement courses (which have required a fee in order to take the test for potential college credit, unless a family has applied for, and been granted, a waiver based on family income). Even after having paid for other credit earning methods such as dual enrollment or Advanced Placement exams, students have found that not all credits transfer to a college, forcing them to retake the course in order to receive credit at their new institution (DiMaria, 2013). By one principal’s estimate, students who have completed an associate’s degree while enrolled in her ECHS program save about $6,000 after calculating savings on tuition and textbook purchases (DiMaria, 2013). Students could also realize lifetime savings beyond the time in which they are enrolled in ECHS programs. For example, students who complete degrees at younger ages could potentially enter the workforce sooner, minimalizing opportunity costs and potentially increasing lifetime earnings (Berger et al., 2013).

**Potential Limitations of ECHS Programs on Students**

While there have been many noted potential benefits for students who have participated in an ECHS program, there have also been certain shortcomings that have impacted the experience of the students and their families as a result of enrolling in this type of experience. Much of the literature produced by the ECHS Initiative and partner organizations, such as Jobs
for the Future, has focused on the merits and successes of ECHS programs as well as efforts to expand their operations. Nowhere has this been made more clear than in the ECHS Initiative’s fifth core principle: “Early college schools and their higher education and community partners work with intermediaries to create conditions and advocate for supportive policies that advance the early college movement” (JFF, 2009). Undoubtedly, those behind the ECHS movement have believed in their mission and sought to create a more equitable educational system by expanding their operations. Critical analysis of ECHS programs, however, including the investigation of potential limitations, is essential in determining if the schools have been meeting their mission, and if the target populations have been better served than they would have been in a traditional high school program.

**Reduced Extracurricular Activities**

Extracurricular activities have been an essential component of the traditional high school experience, and have encompassed many activities (e.g. sports, clubs, band, electives, homecoming, prom) that contribute to the development of self-identity and effective social skills (DiMaria, 2013; Woodcock & Olson Beal, 2013). Many ECHS programs, however, have offered very limited extracurricular activities, or have sacrificed them altogether due to limited time and resource allocations. Often, the academic rigor of ECHS programs has taken precedent over social development and this has severely limited the amount of time that students have to participate in extracurricular activities (Fischetti et al., 2011; Thompson & Ongaga, 2011; Woodcock & Olson Beal, 2013). In essence, these students were trading the opportunity to participate in extracurricular activities for the “benefits of a small personalized environment (400 or fewer students) that offer schoolwork aligned with college preparation and degree plans”
(McDonald & Farrell, 2012). One graduate of an ECHS in Texas reported his feelings in this way:

I believe the experience of attending (and succeeding in) an ECHS is tailored to a very specific subset of students who are strongly academically capable, who are willing to abandon their extracurricular activities at the normal high school, and that don’t see school as a social hang out environment, but one that is for learning and excelling.

(Woodcock & Olson Beal, 2013, p. 68)

A common theme has been that students do miss opportunities to participate in a wide range of extracurricular activities and have felt that by entering an ECHS program, there is potential to sacrifice potential high school friendships (Woodcock & Olson Beal, 2013; Noble & Drummond, 1992). For some students and their parents, this was more than an inconsequential trade off. The traditional components of high school have been strongly tied to the American cultural identity of teenagers and hold great value among parents, community members, and academics (Fischetti et al., 2011; Woodcock & Olson Beal, 2013). This could have been more pronounced for students that come from families in which high school represented the pinnacle of formalized education, and for which a great emphasis has been placed on participating in a traditional experience that includes athletics, certain social events, and the achievement of graduation. At the at the same time, students have felt anxiety about having fewer social experiences, and felt more socially immature when comparing themselves to the traditionally aged college students (Noble & Drummond, 1992; Thompson & Ongaga, 2011; Woodcock & Olson Beal, 2013).

Some programs have made efforts to provide other non-academic opportunities for development. One ECHS in southeastern North Carolina required that their students participate
in ongoing service learning opportunities until they graduated (Thompson & Ongaga, 2011). In an effort to provide some aspects of the traditional high school experience, Trini Garza ECHS in Dallas, Texas offered the opportunity for their students to participate in spirit week type activities that led up to a homecoming dance, but they held the events during the week before winter break when the traditional college students were off campus for assigned study days (DiMaria, 2013). Additionally, most of the other extracurricular activities that these students participated in were more directly related to their academic mission, such as the creation of a robotics team and an urban debate team (DiMaria, 2013).

**Increased Financial Burden on Students, Families and Schools**

Despite the potential financial savings often focused on by those involved in the ECHS movement, there have been substantial economic challenges that come from participation in these programs, especially for students from lower socioeconomic backgrounds for whom these programs are in large part designed. In some states in which ECHS programs operate, programs have required that the student (or their family) paid for college tuition in any college level course they took, even when that cost was mitigated by the high school and partnering higher education institution (Griffith, 2008). Costs such as transportation, non-subsidized food, and technology have also added to a family’s burden for enrollees of ECHS programs. This has presented a potential challenge to families from lower socioeconomic backgrounds, and when students have underperformed, it has felt like a “serious financial blow” for the families (Leonard, 2013, p. 195). Additionally, the lost costs of underperforming have motivated some parents to remove their students from their ECHS program, so as not to risk any additional funding for poor college grades (Leonard, 2013). Financial considerations beyond a student’s time in the ECHS program has also been a concern for students and their families.
Oftentimes, ECHS programs have emphasized either the ability to earn an associate’s degree or a high number of credits before the student graduates from high school, but a study of 3,000 ECHS graduates in 2009 found that less than half (44%) of students earned the equivalent of one year’s worth of college credits, and only a quarter of students earned two years of credit (Hoffman & Vargas, 2010). In cases where a student had earned a large portion of college credits through their ECHS program, those credits were not always transferrable to their intended four-year institution. Similar to challenges faced by traditional transfer students, even in instances where a guaranteed transfer credit agreement has been in place for students who complete a core of general education courses, as is the case in Georgia, North Carolina and Texas (Creech & Lord, 2007), ECHS graduates have sometimes found that they have requirements specific to their intended degree program at their new institution that required them to extend the amount of time they needed to stay to complete their bachelor’s degree (Smith, 2015a). In these situations, students and their families would need to plan to pay for more than the remaining two years of college that is often assumed remains in order to earn a bachelor’s degree. To date, most research in this area has focused on how ECHS programs assist students from low socioeconomic backgrounds, who might not otherwise have the opportunity to pursue college, but it is also important to determine if there have been significant financial burdens that caused students to either leave ECHS programs early or decide not to enroll in them at all.

In addition to the potential financial burden for students and their families, challenges in funding ECHS programs have also existed for school districts and the partnering higher education institutions that operate these programs. In the first years of operation, financial support for ECHS programs was strong, due in part to an $107 million-dollar investment from the Bill and Melinda Gates Foundation that also encouraged state subsidies for these programs.
State level policies also attempted to reduce the financial burdens for school districts operating ECHS programs by encouraging the shared use of resources and buildings with the ECHS’s post-secondary partners (though this comes at the cost of the higher education partner), and by allowing ECHS programs to cooperate with other private business entities to secure additional external funding, rent-free space, and other resources (Zinth, 2016). Of the seven initial states that operated ECHS programs, all provided equivalent funding amounts to both ECHS and traditional high school programs, although Pennsylvania only did so when the high school covered the cost of tuition for college courses taken by their students; otherwise, schools not sharing the cost received reduced funding from the state (Griffith, 2008).

Initial research of the financial viability of these programs showed that these programs were strong investments over the course of time. A study of the return on investment of early operating ECHS programs estimated that as long as operating costs for ECHS programs were kept relatively similar to traditional high school programs, the return-on-investment for school districts and the states in which they operate in was positive (Palaich, Augenblick, Foster, Anderson, & Rose, 2006). The authors reviewed the costs and benefits of operating traditional schools versus ECHS programs in California, and using data from the National Educational Longitudinal Study, found that while the initial operation of an ECHS program costs approximately two million more dollars than a traditional high school program per year, the estimated difference in student benefits over a 15 and 25 year time period were $25 million and $50 million, respectively (Palaich et al., 2006). While a local school district may feel the initial squeeze of the increased costs in operating ECHS programs in the short term, states should also consider that any investment in supporting and increasing the operation of these programs could lead to windfalls down the road.
Quickly after the initial ECHS programs began, it became clear that they would cost more to operate per pupil. An early analysis of the costs to plan and implement a variety of ECHS types (operated at a high school base, a community college, a university, and through a charter) demonstrated that in all situations, the initial start-up costs were more than the funding allocated from the district, requiring grant funding to support anywhere from 12.4% to 90% of the initial costs (Webb, 2004). This makes sense, as funding to operate public schools has almost always been allocated based on how many pupils were enrolled in the school, and prior to operation, there is no per-pupil funding. Even after ECHS programs were fully implemented and had full student enrollment, however, they all operated at a deficit, ranging from 4.5% to 12% of the total budget, requiring additional revenue streams (Webb, 2004). While different types of ECHS programs operated at similar levels of per-pupil cost (ranging from $4,918 to $12,250) to varying state averages (ranging from $4,907 to $11,588), gaps in funding remained for these smaller schools, in large part due to college costs, including tuition and fees, books, and supplemental salaries for faculty (Webb, 2004).

Initially, the large amounts of grant funding from the Bill and Melinda Gates Foundation helped to offset the increased costs of operating ECHS programs, but that funding ended in 2009, and without increased financial allocations from the states in which these programs operate or other large funding partners, increased participation and scalability of ECHS programs has been less likely to happen, even as these programs continue to demonstrate successes in high school graduation and college enrollment rates of traditionally underrepresented student populations (Zinth, 2016). After grant funding ended, a few schools in Georgia, Ohio, and Washington D.C. have either cut or scaled back their ECHS programs (Zehr, 2010).
Unforeseen Academic Challenges

There has certainly been some promising research regarding the success of ECHS programs and their ability to narrow the gap between high school and college academic performance. It has also been important to remain critical of this movement to ensure that traditionally underrepresented or at-risk student populations do not remain marginalized in an effort to report positive results. Academic rigor has been seen as one of the areas in which a student, especially one who was not a high achiever prior to enrolling in the ECHS program, could find significant challenge. Woodcock & Olson Beal (2013) questioned whether condensing the high school curriculum into two years and pushing high school students into college courses early was appropriate when research suggests that traditional students were not generally ready for college after four years of high school courses. They have also questioned the wisdom of placing at-risk students who enter into ECHS programs academically behind their peers into such an accelerated program (Woodcock & Olson Beal, 2013). An important consideration along this line of questioning regards what happens to underperforming students when they can no longer continue taking courses at the college level. Have they been required to stay at the ECHS to complete their high school courses, or were they forced to socially integrate back into a traditional high school? The literature has not yet addressed these questions.

Navigating through two separate but partnered educational organizations has also posed academic challenges for students. Once an ECHS student has begun taking college courses, it has been sometimes difficult for the ECHS program to keep track of academic progress and student attendance because of the lack of a streamlined system that works for both the high school and the college data systems (Berger et al., 2010). In these instances, the ECHS has had to rely on student self-reporting, which has been sometimes challenging for students who are
struggling, or wait until the end of the semester for final grades, when it has been too late to intervene for the past semester. Another potential pitfall has regarded the transferability of credits. Although a student’s credits taken at the college institution have counted if the student remained at that institution to complete their degree, similar to dual enrollment or Advanced Placement programs, students’ credits have not always to another institution (DiMaria, 2013). In Woodcock & Olson Beal’s (2013) study of ECHS graduates, one student reported not transferring his accumulated credits from his ECHS program because it would have severely limited his ability to earn financial aid, causing him to choose between an academic or financial benefit.

With such limitations, it is understandable that some underrepresented student populations have chosen to forgo participating in ECHS programs or have raised concerns about the programs that they have been enrolled in, even when these programs were specifically designed to increase their likelihood for collegiate success. Potential alternatives for ECHS programs have remained in traditional high school settings, such as dual enrollment opportunities, registration in Advanced Placement or International Baccalaureate coursework, or accelerated graduation with the intention to enroll in college earlier. However, these programs have historically targeted academically accelerated students and have not appealed to traditionally underrepresented student populations that perform academically in the second or third quartile (Howley, Howley, Howley, & Duncan, 2013; Leonard, 2013).

With the growth in ECHSs, researchers have worked to understand initial impacts that these programs have had on high school student success and the experiences students have while enrolled, but less is known about how graduates of ECHS fair once they leave the high impact environment and enroll at college with mostly traditional high school peers. As Howley, Howley,
Howley, & Duncan (2013) have pointed out, the challenge in examining the long-term success of ECHS programs for their ability to increase bachelor degree attainment is that the ECHS movement has not yet produced large numbers of students who have graduated from college. While some research has come out regarding the college graduation rates of ECHS populations, it has primarily captured two-year graduation rates, as most ECHS programs have not been established long enough to have alumni that have completed bachelor’s degree (Berger et al., 2013). The fact that ECHS graduates have increased attainment rates of associates degrees is not surprising, as most ECHS programs have been partnered with community colleges that provided students with an opportunity to earn enough credits for the associate’s degree while they were actively participating in the program and receiving the additional supports. Understanding what happens to ECHS graduates once they have enrolled in bachelor’s degree seeking programs and the experiences that they have in their transition to their new institution is a question that needs exploring. This is especially true for underrepresented students; if the ECHS Initiative promotes the success of underrepresented students as a core tenet of ECHS programs, then there is an obligation to follow up with those students to understand their post-ECHS college experience. Similarly, those that promote STEM themed ECHS programs as methods of improving the STEM pipeline for underrepresented students must exercise due diligence to ensure that these programs support traditionally marginalized populations in meaningful ways.

Similarly, STEM based ECHS programs emphasize the importance of selecting majors and careers that enhance science, technology, engineering, and math, but is this the right approach? Should students who are still developing concepts of self, exploring interests, and making early decisions about career pathways be limited in their exposure to non-STEM based curricula in favor of STEM? Currently, it is unknown how students’ major and career decisions
are impacted by participation in a program that specifically emphasizes accelerated decision-making related to majors and careers. Certainly, parents and students can understand benefits associated with earning upwards of 60 college credits, but has anyone considered the potential tradeoffs that are required to operate in an environment that pushes earning two years of credit into an already full high school curriculum? When students participate in ECHS programs, are they better served by the expedited major and career selection process if they are also provided with the additional resources to explore, or does that create unintended consequences?

At its core, the ECHS movement as designed originally by the ECHS Initiative, has been predicated upon the idea that these programs can provide “ways to educate young people to be prepared to contribute to our knowledge-based economy and to improve their overall quality of life” (ECHSI, 2013a). This need is especially prudent in a market where all future growth in the workforce has been projected to come from minority populations, despite that these populations have traditionally been the worst served by higher education (Bill and Melinda Gates Foundation, 2009). As the movement is now well into its second decade of operation and the populations of ECHS programs have continued to grow, analyzing their long-term impact is obligatory. Due to the large amount of attention and resources that have been devoted to the mission of these programs in serving underrepresented student populations, and the ongoing financial support that will be required if this movement is to continue to grow and be supported, it is paramount to ensure that underrepresented students have been served in alignment with the original mission of the ECHS Initiative, and that resources to support these programs have been used responsibly.

The following two chapters will examine the experiences of STEM based ECHS graduates as they consider their readiness for college, their transition from high school graduate to full-time degree seeking student, their feelings of integration into their new college environment, their past
decision-making processes in regards to pursuing STEM and non-STEM programs of study, and where applicable, the intersectionality between their identity as an ECHS graduate and that of a student traditionally underrepresented in STEM majors.
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CHAPTER TWO: A NARRATIVE STUDY OF THE DECISION-MAKING PROCESSES FOR NON-STEM DEGREE-SEEKING STUDENTS AT A STEM BASED EARLY COLLEGE HIGH SCHOOL

Reflecting a concern that students underrepresented in postsecondary education were not making sufficient gains in college readiness and completion, and that changing demographics in the United States could mean severe economic consequences if growing minority populations earning postsecondary degree or certificate “with genuine economic value” were not improved, the Early College High School Initiative was developed in 2002 (Bill and Melinda Gates Foundation, 2009; Edmunds, 2012). This movement, funded by the Bill and Melinda Gates Foundation and spearheaded by Jobs for the Future, was founded on the principles of serving traditionally underrepresented students by providing a model of college readiness through participation in small public schools located on college campuses that blended rigorous high school and college level courses, and provided comprehensive systems of academic and social support (Berger et al., 2010; Edmunds, 2012). In the 16 years since the movement first started, these programs have also expanded to address challenges in education that continue to stymie traditional high schools, including addressing the collegiate needs of English language learners, tackling the shortage of minority and women students in the STEM pipeline, reengaging with students that leave high school, and developing partnerships with STEM based industries to develop career pathways upon graduation (Webb & Gerwin, 2014).

Statement of the Problem

Literature has informed us of the behaviors and processes that traditional high school students take, especially in the secondary school setting, as they begin to make decisions about future careers, develop a sense of career identity and awareness, explore potential vocational
options and behaviors via work or volunteer experience, engage in conversation with parents and other working professionals about careers, and begin to plan or map career and associated educational pathways (Greenberger & Steinberg, 1986; Holland, 1997; Johnson & Mortimer, 2002; W. Patton & McMahon, 2014; Super, 1980). Their decisions are also influenced by a variety of contextual and social cognitive factors such as demographic and familial background, support systems and barriers, perceptions of self-efficacy, and individual predispositions (Holland, 1997; R. Lent, Brown, & Hackett, 1999; R. Lent, Ireland, Penn, Morris, & Sappington, 2017; Rogers & Creed, 2011).

Challenges remain in understanding how the major and career decision-making processes of ECHS students might differ from traditional high school programs or the impact that these programs have had on their bachelor’s degree selection and long-term career plans. Literature regarding ECHS programs (see Chapter One) demonstrates that these students are exposed to collegiate environmental factors from an earlier age, enroll in college level courses as early as their sophomore year of high school, and have access to enhanced support structures in their high school and on their college campus; and yet, it is unknown if these additional factors contribute to students’ decision-making processes, especially in programs with targeted curricula such as STEM or STEAM based programs. A review of the ECHS Initiative’s original five core principals shows a focus on academic support, integration between high school and college academics, and college completion, but makes no mention of preparation for careers that are inevitable post-bachelor’s degree (Jobs for the Future, 2009). Despite this lack of inclusion, career and major exploration is likely to be integrated into ECHS programs where other academic and collegiate supports are offered. In a time of increased scrutiny regarding the value of a bachelor’s degree, preparation of college graduates for entry-level careers, and the gap
between college training and workforce skills, understanding how specialized programs like ECHSs prepare students to make decisions about majors and careers is paramount.

**Purpose of the Study**

This study sought to understand how ECHS programs impact students’ decision-making processes surrounding their college major and potential career aspirations. In an environment that expedites the high school and college timeline, it is important to consider if there are adverse consequences to narrowing the curricular focus to heavily emphasize STEM – do these programs work as intended? This is especially important to understand as it relates to students that are in such a developmental stage of life where they are still exploring self-identity, interests, and aspirations. This research offers an opportunity for policymakers and practitioners to consider if there is value in expanding STEM based education to also include exposure to liberal arts. This is not to say that STEM does not remain an important area of study, but rather that program leaders should understand the connections that students make between STEM and other curricular areas essential to functioning in a global society. This study also investigated how ECHS programs with a specific curricular focus might have impacted a students’ decision to either move towards completion of a bachelor’s degree in that tracked field or away from that field entirely. The purpose of this narrative case study was two-fold: to understand how ECHS students make decisions about their college majors and careers at an earlier age than traditional high school students, and to explore the role that a STEM based ECHS program and its curriculum had on the decision-making processes of students who decided not to continue pursuing a bachelor’s degree in a STEM related field.

The following research questions were proposed:
1. What are the personal and familial experiences that impact students’ decisions to attend a STEM based ECHS program?

2. What are the thoughts, processes, actions and other experiences that students go through as participants in a STEM based ECHS program as they make decisions about their majors and careers?

3. What experiences ultimately lead students away from STEM based majors and careers as they actively participate in a STEM based ECHS program?

4. How do students’ scholastic experiences change after they have decided not to pursue STEM majors or careers in an environment and culture that actively promotes STEM education?

**Review of the Literature**

Early College High School programs are small public high schools of choice located on college campuses (typically, but not limited to, community colleges) that emphasize preparing students from traditionally underrepresented postsecondary populations for college by blending the high school and college experience, promoting academic rigorous coursework in preparation for college, providing additional systems of support, and allowing students to earn up to two years of college transferrable credit at no cost to the student (Edmunds et al., 2017). Because these schools are smaller, they have provided opportunities to promote strong and meaningful relationships between students and faculty while fostering cultures of leadership (North Carolina New Schools, 2013). The ultimate goal for these programs has been to ensure that students are prepared for college in a comprehensive manner, building off of the multifaced model of college readiness established by Conley (2005, 2008, 2010) that has included cognitive strategies for processing and consuming learning, developing a strong command of academic content
knowledge, establishing and practicing key learning behaviors and techniques that reinforce learning, and gaining an awareness of the contextual knowledge of college environments and cultures.

**Career Decision Making**

Around the turn of the 20th century, a movement began in the United States that emphasized better aligning people to careers by comparing the attributes of people to the knowledge and requirements of various jobs (Brown, 2002). Starting with the work of Frank Parsons (1909), there was a focus on scientifically measuring personal “aptitudes, abilities, ambitions, resources, and limitations, and the relation of these elements to the conditions of success in different industries” (p. 3). Herein was the argument that work did not have to be merely a means to an end, and that people actively engaged in vocation selection increases work satisfaction while reducing costs and labor inefficiencies versus people who opt into careers as a product of their environment or for other non-personal reasons. For these reasons, Parsons advocated that there was a strong need for vocational counselors to help young people through this process of discovery and his work gave way to the development of the trait-and-factor theory (Parsons, 1909). Building off of this work, and with the influence of major world events such as the Great Depression and World War II that required a more precise way to align people with appropriate careers, psychological instruments such as the military’s Army General Classification Test (precursor to the modern day Armed Services Vocational Aptitude Battery) and the Myers Briggs Type Indicator (MBTI) were developed to measure people’s intelligence, skills, abilities, personalities, and other attributes (Brown, 2002; Emre, 2018; Maier, 1993). By 1950s, theorists such as Donald Super, Anne Roe, and John Holland moved away from trait-and-factor theory in favor of more dynamic theories considered environmental and lifelong
developmental factors, and that viewed people as complex and active participants in their
decision-making processes (Brown, 2002).

Although the field of career development and exploration draws heavily from psychology
in its earliest years, it has become more interdisciplinary in the second half of the 20th century as sociological research also began to explore issues related to work and careers. Whereas psychologists focus on the relationship between career, individual traits, and fit with the career environment, sociologists seek to understand social status attainment (including socioeconomic, racial, and gender) and how work intersect with issues such as inequality, mobility, earnings, lifestyles, and community (Brown, 2002; Johnson & Mortimer, 2002). Sociologists of the 1960s through 1990s explored links between family, social, or other demographic factors and status stratification (Blau & Duncan, 1967; Cocran, Duncan, & Ponza, 1984; Duncan, Featherman, & Duncan, 1972; Hauser, 1971), the impact of structural systems of education in shaping educational and career outcomes via organizational characteristics within and between schools, tracking or grouping students, and differences in resource allocation (Alexander, Entwisle, & Horsey, 1997; Dauber, Alexander, & Entwisle, 1996; Entwisle & Alexander, 1993; Johnson & Mortimer, 2002; Kubitschek & Hallinan, 1996; Lee & Bryk, 1988; Lee, Bryk, & Smith, 1993), and how practical experiences with work have impacted subsequent career, family, and other life decisions (Greenberger & Steinberg, 1986; Johnson & Mortimer, 2002; Marini, Shin, & Raymond, 1989; Schoenhals, Tienda, & Schneider, 1998). As sociological theories and concepts rose in prominence alongside psychological concepts, these fields have converged in their acknowledgment that career decision-making is impacted by a variety of factors across disciplines. In understanding the world of work, there has been room for multiple theoretical approaches, including person-environment theories (Holland, 1997; Lofquist & Dawis, 1991),
developmental constructivist theories (Gottfredson, 2002; Savickas, 2005), and social cognitive theories (Lent, Brown, & Hackett, 2002; Reardon, Lenz, Peterson, & Sampson, 2012). Lent, Brown, and Hackett’s (1994, 2002) work has since become a major theoretical framework with which to study STEM based major and career exploration, especially among underrepresented students in secondary and post-secondary settings (Adedokun, et al., 2013; Gibbons & Shoffner, 2004; Gushue, Scanlan, Pantzer, & Clarke, 2006; Gushue & Whitson, 2005; Hardin & Longhurst, 2016; Kier, Blanchard, Osborne, & Albert, 2014; Lent, et al., 2005; Lent, Lopez Jr, Lopez, & Sheu, 2008). Despite the ubiquity of this theory, it hasn’t yet been used to explore the career decision-making that takes place in the smaller targeted ECHS programs, especially those which are themed around a STEM curriculum. Social Cognitive Career Theory (Lent, Brown, & Hackett, 1994; 2002) was also used to frame this study and is expanded upon below in a section below, but first it is important to understand why it is that students, especially those from underrepresented populations, leave the STEM pipeline in the first place.

**Leaving the STEM Pipeline**

Across all student demographic types, students who have chosen to leave STEM programs of study for non-STEM based programs have done so for a variety of reasons, but some of the strongest predictors of attrition at both two-year and four-year institutions have included the level of academic rigor of STEM courses taken, the type of math courses taken during the first-year, and the performance in STEM based courses relative to non-STEM based courses (Chen & Soldner, 2013). At the four-year level, an increase in the number of failed or withdrawn STEM courses has also been correlated with switching to a non-STEM based program of study, and overall college performance has been correlated with whether students change to a non-STEM major or leaves college all together. Students who earn a cumulative
GPA below 2.5 are more likely to exit college altogether, while students who earn a 3.5 or higher cumulative GPA are more likely to remain in college but switch to a non-STEM program of study (Chen & Soldner, 2013).

For minority students, the above reasons for leaving STEM based majors have been exacerbated by other complicating factors, including lower levels of preparation in STEM fields prior to college (Elliott et al., 1996), selective STEM admissions standards that prioritize ability and achievement via standardized scoring and high school performance over other mitigating factors (Elliott et al., 1996), faculty beliefs and attitudes about minority students’ abilities to be successful in STEM based programs (Hubbard & Stage, 2010), encountering racial stereotypes, discriminatory practices, and high levels of isolation on campus (Allen-Ramdial & Campbell, 2014; Griffin, Pérez, Holmes, & Mayo, 2010; Hurtado, Newman, Tran, & Chang, 2010; Owens et al., 2010), and the lack of a sense of belonging for minority students that arise out of differences between students’ culture of upbringing and the dominant culture of college (Griffin et al., 2010; Hurtado et al., 2010; Museus & Liverman, 2010; Owens et al., 2010). Additionally, the majority of Latino students have entered higher education through community colleges, but for those interested in STEM, they are less likely to persist to a bachelor’s degree than Latinos who begin directly at a four-year institution (Malcom, 2010). Unwelcoming climates have also limited the success of women in STEM programs of study, as has selectivity of the institution (Espinosa, 2011; Nixon, Meikle, & Borman, 2007). Institutional selectivity impacted women of color in STEM more than White women; the more selective an institution was, the greater the disparity between women of color and White women that finish a bachelor’s degree in a STEM field, though this did not hold true at HBCUs (Chang, Sharkness, Hurtado, & Newman, 2014; Espinosa, 2011).
Social Cognitive Career Theory

In order to better understand the comprehensive processes that students in a STEM based curriculum undergo and how those experiences shaped their decisions to turn away from STEM based majors and careers, Lent, Brown, & Hackett’s (2002) Social Cognitive Career Theory (SCCT) was used to frame this study. SCCT was built upon the general social cognitive theory of Albert Bandura (1986) that emphasized the interdependence between acquisition of knowledge, personal agency (the capacity for intentional action, influenced by such things as self-efficacy, personal belief systems, and actual skill sets) and social structures (such as culture, race and gender, genetic predispositions, and other human created social structures) (Bandura, 1986, 1999; Lent, Brown, & Hackett, 2002). Combining Bandura’s theory with a convergence of previous work career development theories in vocational, trait and factor, personality and developmental psychology (Hackett & Betz, 1981; Holland, 1997; Krumboltz, Mitchell, & Jones, 1976; Lofquist & Dawis, 1991; Super, 1980), SCCT offers a single comprehensive framework that considers the intersectionality of a variety of factors in impacting career choices and emphasizes the direct and indirect experiential learning in shaping occupational interests and choices, recognizes that genetic predispositions and the environment play a significant role in career selection, and adopts a social cognitive lens that distinguishes self-agency, motivation, metacognition, and self-regulation as being important factors for complex learning beyond simple conditioning (Lent, Brown, & Hackett, 2002).

As seen in Figure 2.1, a person’s attitudes about their ability to perform specific tasks (self-efficacy), coupled with their beliefs (or outcome expectations) about completing these tasks, informs nascent interests that drive goal-setting, which in turn encourages participation in activities that further increase their performance in such tasks and leads to learning experiences
(Lent, Brown, & Hackett, 2002). This creates a feedback loop in which individuals are reinforced in their beliefs, attitudes, and confidence (as reflected in their self-efficacy) about the career related tasks that they have chosen to pursue. In this sense, self-efficacy, outcome expectations, and goals constantly play off of one another as people develop and refine career related interests throughout their lifetime (Lent, Brown, & Hackett, 2002). At the same time, people are influenced by their personal history, sociostructural variables, and other contextual background factors that can be both biological and socially constructed (Lent, Brown, & Hackett, 2002). These factors are always at play and impact not only the experiences that are available to individuals and how they come to see and understand their learning experiences in personal and societal contexts, but also how they view perceptions of the environment in shaping the opportunities available to them (Lent, Brown, & Hackett, 2002).

![Diagram](image)


**Methodology**

Hesse-Biber and Leavy (2011) note that qualitative researchers seek to understand “the social meaning people attribute to their experiences, circumstances, and situations, as well as the
meaning people embed into texts and other objects” (p. 4). Merriam (1998) similarly notes that “the key philosophical assumption upon which all types of qualitative research are based is the view that reality is constructed by individuals interacting with their social world” (p. 6). This social constructivist framework, which relies on the participants’ subjective interpretation of their experiences, allows the researcher to find a variety of complex views from the participants constructing their own meanings regarding the situations for which they are found (Creswell, 2013).

Currently, not much is known regarding the decision-making process of ECHS students and how they select their major and potential career path, especially when deciding to move away from the tracked curricular focus of their school. For this study, understanding the decision-making processes of each individual student and parsing out their unique stories, even as they participated in the same ECHS curriculum, requires searching for meaning as it is created, perceived, and retold by the students. Of particular interest is how these students, when exposed to a STEM based curriculum, made decisions that led them away from STEM majors and career interests. Specifically, a narrative inquiry approach provides an avenue to collect detailed stories about the contexts of these students’ lives and their career aspirations, and to understand the intersectionality between their lived experiences and other important factors such as their culture, their world of work, and home life (Creswell, 2013).

**Narrative Research**

People are natural storytellers, sharing the stories of their life, deciding who to invite in and what to share (Bernard & Ryan, 2009). Narrative research is a method rooted in various humanities and social sciences and concerns itself with rich experiences of individuals or small groups as understood through “stories lived and told” (Creswell, 2013). As a qualitative
approach, it is centered around the collection of stories from and about individuals and their experiences and contains elements such as the potential for co-constructed realities with the researcher, the discovery of individual (and small group) identities, and the realization of tensions, turning-points, aha moments and other subtle patterns across stories (Creswell, 2013). The stories are contextually bound in space and time, and though not always told in chronological order by the participants, are untangled and reorganized into an overarching story that captures the essence of what’s being studied (Creswell, 2013).

Oral histories, the narrative approach used for this research, consists of the collection of individual memories of events, how those events came to be, and the impact they had on the participant (Plummer, 1983). It is a collaborative process that invites the storyteller to share deeply, and in doing so, they also share a larger historical context with insights beyond their own experiences (Hesse-Biber & Leavy, 2011). Oral history is framed around the participant as storyteller and the interviewer as engaged listener.

Sample Selection

In considering the population for this study, purposeful sampling was used by the researcher as a means to strategically capture the experiences of ECHS students enrolled in the same STEM based program (M. Q. Patton, 2002). Specifically, this study sought to understand how students that came to be enrolled in a STEM based ECHS program made decisions about their majors and careers, especially in instances where they experienced a phenomenon that altered their career trajectory away from STEM. This population represented a critical case; that is, this group of students had experiences that could be representative of other high school students who intend to pursue some major or career trajectory, but are then impacted by life events that change their motivation (Miles, Huberman, & Saldana, 2014; M. Q. Patton, 2002).
Even though the students selected for this study participated in a unique high school experience with additional resources and guidance in pursuing STEM based careers, it is likely that at least some of their lived experiences as adolescents in a high school setting are also true for students in traditional high school settings.

The site for this study was an ECHS program with a STEM based curriculum located on a four-year university campus in North Carolina. The ECHS site allowed for an extreme sampling strategy to be used in selecting participants, as it is only one of three STEM based ECHS programs in North Carolina out of 84 total ECHS programs in the state, and allowed the researcher to “learn from unusual manifestations of the phenomenon of interest” (M. Q. Patton, 2002). Whereas all ECHS students are exposed to resources related to college readiness and the option to take academically rigorous courses that culminate in college course enrollment, not all ECHS students are tracked for a specific set of fields. At the same time, even if students go into high school with preconceived notions of their intended career trajectory, the experiences of changing course away from those original plans might be radically different for those in a non-tracked environment. This study allows the researcher to find out how much a tracked environment impacts students’ decision-making around majors and careers.

Data Collection

The primary method of data collection for this research was loosely structured individual interviews conducted with former STEM based ECHS students. A copy of the interview protocol can be seen in Appendix A. The students selected for these interviews participated in major and career exploration activities as part of their STEM based high school program, but ultimately came to the decision not to pursue STEM based degrees. Because these students and their families had to apply to the high school program in the 8th grade, be selected through a
lottery process, and ultimately decide to enroll in a STEM based program, a loosely structured interview process allowed the interviewer to focus on the students’ life history in primary and middle school, as they were making decisions to attend the STEM based school, and ultimately how they decided to move away from STEM based majors. These interviews are anticipated to last approximately 60 to 90 minutes and will be recorded and transcribed for data analysis purposes. Students who participated in these interviews were compensated for their time with a $25 Amazon.com gift card.

Data Analysis

In a narrative analytic approach, the interview is the tool from which rich textual data can be transcribed and analyzed to provide a deeper understanding of the phenomenon of interest (Vanderstoep & Johnston, 2009). That is to say that while the interviews are the venue in which the stories are told, the narrative analysis of the transcripts is where the researcher is pushed to bring the data to life, discovering patterns across narratives, finding meaning in the stories and the purposes they serve, and investigating the historical and cultural significance for those telling the stories.

Among the various methods of narrative analysis (see Bernard & Ryan, 2009, Chapter 11), a phenomenological approach to data collection and analysis was used to best to help the reader understand “a convincing description of what other people have experienced” (p. 262). This approach consisted of six steps, including identifying the phenomenon of interest, taking steps to minimize researcher bias, collecting deep, open-ended narratives from those who have lived the experience in question, identifying the central elements of the phenomenon in question with an intentionality towards keeping biases at bay, and developing the central elements into a written narrative that is strengthened by exemplary quotes of the participants. The sixth step
included the iterative process of rechecking biases and returning to the data to dig deeper until the lived experiences of the participants seems comprehensively exhausted (Bernard & Ryan, 2009, p. 259).

During the process of interviewing students and the school’s Career Development Coordinator, initial themes and sub-themes were recorded via researcher memos taken after each interview. These initial themes and memos formed the basis of a codebook where further theme discovery took place and the essential elements of the themes were developed alongside transcriptions from the interviews into identifiable codes. Thematic codes were then reapplied to exemplary portions of the text to highlight the essence of the discovered themes as experienced by the students (Bernard & Ryan, 2009). A final framework that establishes common patterns in the unique stories and themes of students’ major and career decision-making experiences was developed through the process of restorying (Creswell, 2013).

**Trustworthiness**

Lincoln and Guba (1985, 1986) have used the term trustworthiness in naturalistic research to challenge the traditional notions of rigor, validity, and reliability represented in positivist research. They recognized that traditional questions of truth, reality, and knowledge are impacted by the humanistic qualities of those involved in asking and answering the questions, and proposed alternative techniques that enhance the accuracy and credibility of qualitative research (Creswell, 2014). For this study, the following methods were used to enhance credibility, transferability, dependability, and confirmability.

Lincoln and Guba (1985) argue that demonstrating credibility is among the most important factors in establishing trustworthiness. Credibility seeks to provide confidence in the findings and answers the question of “how congruent…the findings [are] with reality” (Sharan B
Merriam, 1998). In this instance, the researcher has been a member of this community and participated in prolonged engagement, which helped to establish rapport with the participants and better understand the uniqueness of their high school experience. Because this type of prolonged engagement also presents opportunities for potential bias, this research also relied on the triangulation of data sources to substantiate findings and the performing of member checks to ensure that transcriptions captured the essence of what the participants were communicating and that the findings “ring true” (Sharan B Merriam, 1995). To address transferability, or the applicability of the findings in this study to other contexts, this study relied on thick rich descriptions that allow for readers to understand the depth and intricacies of the stories being shared in order to make a decision about if the findings can be transferred to other contexts (Creswell, 2013; Lincoln & Guba, 1985, 1986). Finally, to establish dependability, that any resulting discoveries from the research are consistent, and confirmability, that the findings are objectively shaped by the participants’ experiences as opposed to researcher bias, the researcher has developed an audit trail of the study (Lincoln & Guba, 1985). The researcher has also attempted to bracket out any personal experiences or attitudes that might have created bias or shaped any interpretations of the findings through the reflexive statement below (Creswell, 2013).

**Reflexive Statement**

Researchers come to the table with their own lived experiences and biases, including work and cultural experiences, emotions, values, likes, and dislikes, and have an ethical responsibility to the participants and readers of their research to make those stances known (Creswell, 2013; Hesse-Biber & Leavy, 2011). My interest in the ECHS population grows out of my professional work as an Early College High School Liaison, a professional role that I had served in for more than four years. I worked with a STEM based ECHS program with a student
population of about 250, situated on a four-year public university campus, and during that time, I served as the students’ academic advisor and instructor of an orientation course that focused on, among other things, major and career decision-making. Through this experience, I became embedded in the culture of this program and developed a meaningful rapport with these students not only as their advisor and instructor, but as someone who attended their community events and developed friendships with their teachers and principals. I care about their successes and challenges, and continue to root for them as they transition into adulthood. I witnessed first-hand as students went through processes of self-exploration related to areas of academic interest and believe that students are capable of making major and career decisions during their upper-class years of high school. From observation, I also saw that decisions about majors and careers could be cyclical, and that not all students were clear on their major or career trajectory even as they graduated high school. In reflecting on my own experiences as a high school student, I was also college bound, had an interest in pursuing an engineering degree, took courses STEM based courses, and had an internship at an engineering firm, and yet, I moved away from an engineering focus by my senior year of high school. In reflecting back on my own experiences, the combination of feeling like I was strong enough in calculus-based math courses and not enjoying the practical experiences of the internship as much as I had hoped were major factors in moving away from an engineering pathway.

Limitations of the Study

There are many limitations to this study. The sample population for which this study drew from is limited in part by the small nature of ECHS enrollments. Specifically, the ECHS site chosen for this study has only had a few graduating classes with approximately 50 students per class, making the number of potential interviewees that participated in the STEM based
program but chose not to pursue STEM relatively limited. Another challenge in sample selection included that participants were only selected from one STEM based ECHS program when other programs that could have offered different student perspectives exist. While this presented a challenge to the dependability of this research to be applicable in other ECHS student contexts, the decision not to use more than one site was balanced with the accessibility that the researcher had to the sample site as a trusted member of that community (Creswell, 2014; Lincoln & Guba, 1985). In choosing to interview former ECHS students who were now enrolled full-time at four-year institutions away from the site location, the interviews had to be performed on a schedule conducive to the participants, which limited the number of interviews with each student to one. Having the opportunity for additional interviews would have given participants another opportunity to expand on their personal histories, add additional context, and correct the record if the researcher misrepresented anything, all of which would have strengthened trustworthiness in the study by enhancing confirmability (Lincoln & Guba, 1985).

**Participant Profiles**

Each participant in this study provided a narrative of their career interests and exploration that included earliest memories of family work history, youth activities, events, and school subjects, rationales about deciding to attend a STEM based ECHS program, major and career exploration throughout high school, and the decision-making processes that led them to their college major and current career of interest. All ten participants in this study, outlined in Table 2.1, are briefly introduced in the following section based on their individual narrative.
Table 2.1

Demographics of STEM ECHS Participants in non-STEM Programs of Study

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Institution Type</th>
<th>Current Programs of Study</th>
<th>Race/Ethnicity</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beth</td>
<td>Public, Masters Colleges &amp; U.: Larger Programs; More Selective</td>
<td>Psychology</td>
<td>White</td>
<td>Female</td>
</tr>
<tr>
<td>Elizabeth</td>
<td>Public, Doctoral: Very High Research Activity; More Selective</td>
<td>International Studies; Religious Studies</td>
<td>White</td>
<td>Female</td>
</tr>
<tr>
<td>Lily</td>
<td>Public, Doctoral: Very High Research Activity; More Selective</td>
<td>Accounting; Minor: Criminology</td>
<td>White</td>
<td>Female</td>
</tr>
<tr>
<td>Lisa</td>
<td>Public, Doctoral: Very High Research Activity; More Selective</td>
<td>Psychology</td>
<td>White/Asian American</td>
<td>Female</td>
</tr>
<tr>
<td>Michael</td>
<td>Private, Doctoral/Professional; Selective</td>
<td>Political Science; History</td>
<td>White</td>
<td>Male</td>
</tr>
<tr>
<td>Nina</td>
<td>Public, Doctoral: High Research Activity; More Selective</td>
<td>Business Information Systems</td>
<td>African American</td>
<td>Female</td>
</tr>
<tr>
<td>Quintin</td>
<td>Public, Doctoral: Very High Research Activity; More Selective</td>
<td>Business Administration; Minors: Spanish &amp; International Studies</td>
<td>White/Hispanic</td>
<td>Male</td>
</tr>
<tr>
<td>Ruth</td>
<td>Public, Doctoral: Very High Research Activity; More Selective</td>
<td>Business Administration</td>
<td>Hispanic</td>
<td>Female</td>
</tr>
<tr>
<td>Sarah</td>
<td>Public, Masters Colleges &amp; U.: Larger Programs; More Selective</td>
<td>Psychology; Minor: Criminal Justice</td>
<td>White</td>
<td>Female</td>
</tr>
<tr>
<td>Seth</td>
<td>Public, Baccalaureate: Arts and Sciences; More Selective</td>
<td>History; Minor: German</td>
<td>White</td>
<td>Male</td>
</tr>
</tbody>
</table>
Beth grew up with a large family – both of her parents had divorced and remarried, so she had two sets of parents and six siblings. Both sets of her parents worked a lot when she was younger and so she was raised by a combination of parents, grandmother, and neighbors. From a young age, she observed that working required putting in a lot of hours and that’s what she expected work would look like for herself. She was an active child that liked to play outside, and some of her most memorable family vacations involved trips to the mountains:

Yeah. I don't know. It feels like an adventure is always outdoors when I'm in the mountains. Then here in Raleigh it's just about the hustle. I feel like that's how life always feels, but in the mountains it was always like, "Let's go for a hike," when I was a kid or stuff like that. That's how I feel now. I'm like, "Let's go and do stuff. Let's find a new creek or a waterfall."

She also dreamed of becoming a rock star and played guitar for many years when she was younger. Her family recognized that she was a smart child and encouraged her to pursue professions like engineering, medicine, and law, but Beth had, as she described it, a “let’s figure it out along the way” mentality about future career aspirations, even as she was well through the STEM based ECHS program:

I always felt like I had to go and do something big. I always felt like I needed to go and be that scientists. Someone recommended being an actuary, because I was really good at math. A mathematician was on my list too, when I was younger, and all of that stuff. It was a disappointment to my parents when I first decided I wanted to be a communications major, and then now psychology. It's definitely the popular majors that people do when they don't know what they want to do with their life. It's different than
going to law school or something like that, which all of those are interesting to me, but I
just don't think long-term, I would want to stick with it.

Beth applied to the ECHS on the recommendation of a middle school teacher and her
parents also supported her ambitions to go to the ECHS program over her base high school. She
had excelled in math courses growing up (though she did not care for sciences) and thought it
would be good to have the opportunity to explore STEM majors in more depth. Beth’s departure
from STEM based majors came as the result of a series of events that included her negative
experiences in her high school math courses and college chemistry and biology courses, her
elimination of a criminology major through a professional interview with an FBI agent, and her
senior internship at an artist management and event production company that exposed her to
communications and social media management.

Elizabeth

Elizabeth was exposed to STEM based careers at a young age, from her father’s civil
engineer career to her one grandmother’s major in mathematics and her other grandmother’s
career in the Centers for Disease Control and Prevention. For Elizabeth, it was more than just
exposure, however; she connected her family’s pursuits of STEM based careers to her own
young identity, stating “so I got the sort of high level of science from [her grandmother in the
CDC] and from that side of the family.” She also understood that she was destined for college at
a young age with both of her parents and many of her extended family having earned at least a
bachelor’s degree. Most of her exploration as a child came in the form of family travel and
summer camps. Elizabeth was naturally gifted in math and sciences, but while she “did not have
a dream career” at a young age, she knew that she did not want a career in STEM disciplines.
This created conflict for her:
I didn't really have a dream career. I didn't really know what that entailed. I think part of that is because I was really good in math and science, but didn't want to do it career wise. I was very confused about what do I do when I'm good at something but I don't want to do it for the rest of my life, so I think that played a role in me not really having a clear picture of what my future would entail, but I would say math and science are my two favorite subjects throughout elementary and middle school. Getting to high school it sort of shifted, and I started to like the humanities a lot more.

Elizabeth had two major turning points that stood out to her as being influential in her pivot away from STEM. The first were a series of interdisciplinary projects at the ECHS that she felt exposed her to how important humanities and social sciences are in the world, including a project on nuclear non-proliferation and converting a large research paper on carbon scrubbing into a children’s book and then sharing that book with a local elementary school. The second major turning point for her was a large ongoing service project at her church that brought her faith into perspective as building a lifestyle of serving others. These experiences were vivid for her and gave her the confidence to overcome the pressures that she felt to remain in a STEM major:

Yeah, and I was always like the smart kid that was going to be a doctor or whatever, and for the longest time I felt all these outside pressures, like you have to do this, you have to do that because you're the smart one who's going to make it big, and it took me really until late high school to realize you can be smart in a field that you love. What I consider success may not be what everyone else's dream, and that's okay, and I can create my path and be successful in that path, and still feel fulfilled and like I've done something that I really care about and is making a difference.
Lily

Lily’s decision-making process about subjects of interest, majors, and careers throughout her life has been heavily influenced by her parents, especially her father. Both of her parents are scientists – her mother a biologist and her father a chemist – and from a young age, she had a high level of pressure placed on her to select subjects and careers of interest that would bring her financial success in STEM based fields. As a child, Lily had little interest in the sciences, but when she expressed interests in visual and performing arts during her childhood, those interests were highlighted as hobbies to supplement professional work in a more STEM related field. Because she was successful in math as a younger child, her parents focused on that as a main driving point to pursue math related fields of interest.

Logistics played a major role in Lily’s choice to attend the STEM based ECHS, and while her interest in general engineering at that time was a component of those considerations, it was secondary to other reasons she indicated, including proximity to her house and her parents’ work, the ability to earn college credits generally, and that it was a better academic option for her than her base traditional high school. Her path towards a degree in accounting was not an overnight decision, but rather a series of events, activities, and courses that nudged her away from other STEM majors. She indicated that her process of exploration revolved around eliminating subjects and majors of interest as she was exposed to them rather than a hunt for the perfect major. For example, her participation in a job shadowing sponsored by the ECHS exposed her to structural engineering, and while she found that the people at that company were passionate about their jobs, it indicated to her that she didn’t have the same level of excitement for this field (or related engineering fields like civil engineering) that would motivate her to push through coursework she wasn’t interested in. Her experiences with her high school and college
level STEM courses, especially her negative experiences in a chemistry lab setting in high school, and her calculus II experience in college, further reinforced that she was not interested in applied STEM type majors, both from a hard science or engineering perspective.

Lily’s shift towards accounting started with her attendance at an event that hosted a panel of professionals in various careers within the field of business. Her exposure to those experts, especially the person on the panel who had started his career in engineering but moved to business, helped her start to see business as a potential option. From there, she did more exploring in areas of business, found accounting as an opportunity to still practice the type of math she felt naturally successful at, while finding a career path that still met the types of criteria her parents wanted her to consider (i.e. widely available and financially successful). Her discovery of criminology/sociology as a secondary field of interest came from exploring elective college courses while still in the ECHS program. Her intro to sociology course was a prerequisite for a social deviance course that she was interested in, and this has led to her continued interest in this field. For Lily, she recognized that she can bring accounting skills and criminology together professionally by pursuing careers in forensic accounting. In this way, she’s valuing the accounting/math that she enjoys and gets to apply the critical thinking that is involved in trying to understand why people make socially deviant decisions.

Lisa

Lisa’s parents each completed their associate’s degree and worked in an engineering field as blue collar technicians. Both parents are still working to complete their bachelor’s degrees, though Lisa has many extended family members on her mom’s side that have bachelor’s degrees in engineering fields from the same host institution as the ECHS program. Her parents’ field of work and desire to see Lisa complete her bachelor’s degree had an early influence on
conversations about engineering and other STEM based career options. At the same time, Lisa was a pretty easy-going child and never felt that she was drawn to any particular career when she was younger, so the push to attend the STEM based ECHS program was primarily from her parents, though she was laissez-faire about the decision and thought it might be an opportunity to explore STEM in more depth:

I didn't mind that it was a STEM school. I thought it was actually really cool because it's like here are these subjects that I'm not necessarily the most gifted at, or the most talented, or drawn to, but I definitely want to learn more about them, and that was awesome to me, even if it was classes like computer programming, that I didn't necessarily care for or like. It was just still just more of an exploring process like maybe I would like one, maybe I would like a specific type of engineering versus another.

Lisa did not have one or two single events that nudged her away from STEM based fields. She found that over her first couple of years at the ECHS program, her interests naturally aligned more with her non-STEM high school courses, and this was amplified once she was able to enroll in college courses at the host institution. It was at this time that she began to find a true interest in psychology and has been drawn to it ever since. Her high school experience continued a life-long trend of exposing her to STEM fields, and she knew that she’d always have an appreciation for them but came to realize that the world also needs people in non-STEM careers as well. When she announced her plan to pursue psychology to friends, family, and teachers, she found the ECHS faculty and friends to be supportive, and that her dad wanted her to do what she felt was right, but it took a little longer for her mom to come around on the idea, though once Lisa demonstrated that she performed well in those courses, her mom became more supportive as well.
Michael’s father is a pastor in their local community and his mother stayed at home, though he noted that that nature of his dad’s work in the community meant that his dad did not work traditional nine-to-five hours. He also pointed out that for his mom, being married to the priest often meant that she was also active in the church in support of his dad’s work. This type of lifestyle did not escape Michael either:

I mean, I guess it's something I realize now with other people like I went to work with my parents twice a week, once on Sundays and during the week. I guess you get a community element to it that's different. I know everyone at my dad's work because it's the people at the church I go to. It's not like a customer sort of thing, but you're involved in it in a different way. Yeah, it changes everybody’s lifestyle.

The types of field trips and other school experiences he remembered from elementary and middle school were focused on history and government subjects.

Similar to many of his peers, Michael was motivated to attend the ECHS program primarily for the ability to earn college credits and gain the college readiness skills that could help him get ahead. He did have a brief interest in pharmacy around the time he was applying to the ECHS program, but otherwise he never felt a strong pull towards STEM based majors or careers. Once he had eliminated pharmacy as a career choice in ninth grade, he knew he was heading away from STEM, but he still went through an exploration process that focused on law before moving to public administration. His interest in public administration was peaked when he had an internship in a city government office that he was connected with through the ECHS program. His also felt that his horticulture internship exposed him to the policy side of agriculture – another opportunity that came as a result of attending STEM.
Michael ultimately connected his early family experiences growing up as the son of a pastor to his strong commitment to community that he valued, and it has had a clear impact on his desire to continue working in a community setting in service of others. He had graduated with his bachelor’s degree in political science and history and was about to start a master’s degree in public administration, with an intention of working for a local or city government. Even though he has not pursued a STEM based career, he connected many of his past experiences in the program to his future in public administration, knowing that he will need to work with policy experts in fields such as agriculture, engineering, and environmental science.

**Nina**

Nina’s parents both work in blue collar fields and from an early age, they had spoken with her about excelling in school and getting opportunities that her parents did not experience. Nina also observed that her older cousins and other extended members of her family attend college and enter fields such as banking and pharmacy, and so she knew from a young age that she would be pushed to go to college. Nina experienced these types of pressures in a positive way, seeing the message from her parents as, “Hey, this is what we got far enough doing, so you go forth and you push the boundaries and you go farther.” As a young girl, Nina took dance classes from first through eighth grade, and aspired to have careers in fields such as dance choreography, singing and acting, or other performance-based careers. She also thought about owning her own dance studio. She did enjoy sciences for the hands-on component of learning in elementary and middle school, but when she applied to the STEM based ECHS program, Nina decided that she wanted to attend because she recognized that it was a good opportunity for her future, though she was also nudged by her mom to consider the program for the opportunity to
explore additional careers outside of performance arts. She also did not want to disappoint her parents.

For Nina, she started high school thinking about civil engineering, but realized through her math and science courses that this was not the path for her. As she started taking college classes and thinking about the value of those courses, she realized she needed to get serious about picking a career path so that she did not waste time taking credits she did not need. She thought back to her earlier interests in owning her own business and started to consider a degree in business administration. At the same time, she also had an opportunity to intern at a private health care company as a business analyst, which further cemented her interest in working with people. She found that she worked well in a position where she would work adjacent to information technology teams without having to do the computer programming:

So it's good, because my job is literally bridging the gap between people. I have a whole team to help me figure it out and help me do it, but ultimately I'm the person that knows what one side may need that the other side may not need or that the other side has to understand.

In Nina’s case, her parents – especially her mom – were influential in having her think about applying to STEM and considering careers she perceived to be more realistic than dancing, though that didn’t mean they weren’t supportive of her childhood aspirations. Now that Nina has graduated from the ECHS program and gained the college ready skills that she has, her mom is more supportive of Nina pursuing a business degree, even if it means owning her own dance studio:

My mom was fine with it. My mom never had an affinity for what I did, as long as it was more than what I had dreamed of when I was younger. So she didn't care if I was a
business major. She didn't care if I was a biology major. She didn't care if I was a computer engineer, as long as it was something that I enjoy doing and it was further than me wanting to be a dancer… she even says now, she's like, "If you still want to do dance and dance choreography, now you have a business degree to open up a studio."

Quintin

Quintin was a first-generation college student, and while his parents have had successful business careers, they were also honest with him about the challenges that came from not having college degrees and wanted him to graduate from college. He also observed that many of his other family members who did not attend college were in fields of work with little to no advancement opportunities and he did not want that for himself. While he did have an affinity for math and sciences subjects in middle school and interests in computer operating systems and hardware, attending the STEM based ECHS program was motivated in large part by the opportunity to start earning college credits early and prepare academically for the rigors of a bachelor’s degree. At the time that he applied to the ECHS program, his career ambitions involving STEM were unclear to him:

I don't think I even really understood the concept of STEM coming into STEM, or how that is what stood out about the school. I was just like, well we'll use computers while we're there and stuff like that. I didn't really think about my career that much at that point, or the distinction between a business career or a STEM career, the different fields.

Quintin found that the STEM program gave him clarity about what it meant to study and work in a STEM based field, and the more exposed he was, the more he realized that while he appreciated the people that did that work, it was not what interested him. Quintin had two major events that served as turning points away from STEM based careers: taking college level
calculus for engineering and identifying business-based internships. As he took engineering based calculus, he realized that he did not want to be an engineer, which led him to start asking his high school faculty about potential internships to explore new areas of interest. One of his instructors helped him secure a business analyst internship that exposed him to the operational side of organizations:

I knew a lot about STEM, but I didn't know what business consisted of. So going into a nonprofit organization where they did business processes, and learning how they made money and how they managed it. Using business to control STEM for profit was interesting to me. I did understand the concepts of STEM, but I just didn't want to do it. Having that internship was huge in helping me understand that I wanted to do business.

This experience led him to many additional business-based internships, including another nonprofit and a large healthcare-based organization that has invited him back each summer while he completes his bachelor’s degree in business administration. His experience in the STEM based ECHS program has given him the background to work alongside people who do the engineering and computer programming work while allowing him to focus on the business need.

Ruth

Ruth lived with her parents and brother, while most of her extended family was in Columbia. Her father owned his own auto repair shop and both of her parents also administered a Hispanic theological program at a local college. She looked up to her parents for their strong work ethic, and spent time at her father’s auto shop as a child helping clean up when she was younger and manage inventory as a teenager. She was involved in her church as a musician and also described herself as a non-traditional type of girl who liked cars, puzzles, and reading. She has a strong bond with her family, noting multiple times during the interview that she wanted to
make them proud with her actions, that they were very supportive of her and that they wanted her to be successful.

Ruth was originally drawn to the STEM ECHS at a time when her decision-making was in line with the types of choices that middle school students might make – she somewhat remembered the ECHS guidance counselor presentation at her middle school, but felt more influenced by the fact that her friend was also applying to the ECHS program. When she got in, her decision-making was around the potential quality of education she’d receive at the ECHS, which at the time was starting its initial cohort of students, versus at her assigned larger school. She was also intrigued by the opportunity to earn free college credits. But her interest in STEM at that time was by no means solidified, she was still exploring many options and had an interest in a variety of things, and was not in a place where she felt confident in “what she wanted to be when she grew up.”

Ruth’s practical approach to her decision-making that led her to a degree in business with a concentration in supply chain management can be seen throughout her high school experience: her decisions to move away from engineering based on the observation of the challenges her peers faced in harder STEM courses, her knowledge of her own level of effort required to succeeding in similar courses, her consideration of subjects she was passionate about but that she knew were more challenging to pursue professionally (music, history, etc.), and her deliberate approach when shifting towards business and the efforts she took to learn about each concentration in the business school before landing on a specific major. In hindsight, she also threaded together smaller nudges that were not as apparent when she was making her decisions about majors, but that are now clearer. Experiences such as observing her dad manage his own business, her working in his business when she was younger (especially doing inventory,
ordering parts, etc.), her participation in a job shadowing experience at GE where she heard from a supply chain manager, and her experiences playing music in church and helping manage some of those operations (both in further learning that she enjoys that type of logistics management and that she can have a passion for music but not want to pursue it professionally) all point to a defined interest in logistics, efficient operations, planning, and other core business functions that exist in supply chain management.

Sarah

Sarah watched both of her parents work in professions that they weren’t passionate about or in settings that were frustrating, and she observed that they were not excited about work for most of her upbringing. Her dad did not finish college, but her mom had a bachelor’s degree and was the parent that applied the most pressure for Sarah to attend college in a STEM based field of study. In fact, Sarah’s mother had an outsized role in her STEM tracking. While Sarah wanted to attend her traditional high school with her friends, her mother pushed her to attend the STEM ECHS program. Her mother also maintained pressure on Sarah to remain in a pre-veterinarian course of study long after Sarah was no longer interested in that field.

Growing up, Sarah did have a strong interest in areas of STEM and felt especially moved by a trip to a tiger preserve, which gave birth to her interest in becoming a veterinarian. Her exposure to medical based dramas on television also gave rise to an interest in medical anthropology. In her early years of high school, she was still interested in sciences, but found that when she took college level calculus I and II, it was challenging in a way that she had not experienced before and was no longer interested in pursuing careers based in math. Sarah also had a couple of major experiences that pushed her away from her interests in veterinary school. In her sophomore year of high school, her family had to have their cat euthanized and it made
her realize that she would not be able to handle that side of the work. Additionally, she attended a summer veterinary camp before her junior year in which she learned she was too squeamish for that field of work. However, Sarah felt challenged by questions related to what she wanted to be when she grew up and felt pressured to always have an answer. In her case, because she no longer had a clear answer, she defaulted to what she liked when she was very young and had a crafted narrative around becoming a vet. The challenge was that as she got older, this narrative caused greater dissonance for her; she was so invested in the story that it forced her to stay in a path she was no longer interested in longer than she should have. It also became an obstacle to exploring other majors/careers, even when resources for doing so were made readily available to her. This heavy investment in the narrative could have also been what kept her family pressuring her to stay the course, because the narrative was not just hers, but also became her mom’s story when she bragged about her daughter. Even in college, Sarah still feels that pressure from her mother, but she has more confidence in her major now that she has taken multiple courses, and she has now been able to have meaningful conversations with her mother about pursuing psychology.

Seth

Seth grew up in a household with two schoolteachers, one that taught humanities and another that taught STEM courses, and he feels that as a result he grew up having “the best of both worlds.” Consequently, he also grew up observing the financial challenges that they faced as public educators, which has impacted his decision not to go into public education:

I observed the struggles and pains of being a teacher, I guess. They focus on work a lot. Obviously because they're teachers in a public school, they don't get paid that much. So they have like three other jobs. It's been a factor in the things that I want to do because it's
like now I know I definitely don't want to be a teacher. Because I see the way they work and they work really hard, but they also have like three other jobs that are considered full-time as well. So it's like I don't want to do that.

In childhood, Seth found that he had curiosity around STEM based careers such as zoology, meteorology, and microbiology, and much of these interests he attributed to his love of reading and being outdoors, though as is typical for a young person, he often changed his mind about what he thought he wanted to do professionally. As he went through middle school, he had found that the way he was learning math via Common Core was not working for him and this started to nudge him away from STEM. By the time he applied to the ECHS program, his decision was driven less by his interest in STEM and more by his desire not to attend his traditional high school, the appeal of the small ECHS environment, and the opportunity to get a fresh start. Seth was driving the decision and his parents were supportive.

Once he was at the STEM school, Seth felt challenged by the increased pace of learning, especially in math where he felt behind because of his experience with Common Core. This was exacerbated by the teaching style of his tenth-grade math teacher. By the time he had completed his high school portion of the curriculum, he had a disdain for math and learned that while he appreciated sciences, he wasn’t a science person. Additionally, he was exposed to AP US History and fell in love with that course, which easily became the major turning point in his shift away from STEM:

That was the class I enjoyed the most out of all of the high school, which is really funny because it was really hard. But I loved it. It was so much fun for me and that's honestly what got me to be like, "That's it. I want to do history for the rest of my life." But it was really that class and the engagement that I had to have in order to do well in that class. It
drove me to succeed, basically. I would say I don't work well under pressure, but there was still so much pressure and I think that drove me to do pretty well. Moderate amount of pressure. But that really, that was the class that changed everything for me really.

### Overview of Thematic Findings

The narratives of these students, while each unique, exposed some common elements of the STEM based ECHS experience, especially regarding the decision-making processes that these students went through as they considered and ultimately rejected pursuing a STEM based major or career. The four themes derived from these students’ experiences include:

a) Parents play an active role in early college and career decision-making;

b) In a STEM environment, exposure to non-stem disciplines is critical for exploration;

c) STEM departure was driven by a few seismic experiences or many smaller factors;

and,

d) Uncoupling the STEM program from STEM curricula and careers can be challenging.


###Parents Play an Active Role in Early College and Career Decision-Making

While these students participated in a variety of activities, had different types of family vacations or other opportunities to travel, and were drawn to different academic topics in elementary and middle school, there were some common experiences involving parental influence in pursuing STEM based majors and careers, especially around the time that these students started applying to the STEM based ECHS program. One finding was that for students who came from families where at least one parent worked in a STEM field, this increased
exposure to STEM at an early age led to a feeling of pressure for the student to also consider pursuing a STEM related field. The amount of pressure that each student felt varied, but the common experience shared by Elizabeth, Lily, and Lisa was well represented by this statement made by Elizabeth:

I think for me college was never really a question because the vast majority of the people including all but one of my grandparents went to college, and a lot of them worked in STEM based fields, and so math and science were always very prevalent in my life.

The pressure Lily faced to pursue STEM from her parents, a biologist and a chemist, started at a young age and persisted long after Lily had decided to move away from the sciences.

Elizabeth’s statement above also captures the expectation of attending college from her family, and this was another common theme across all of the students interviewed, though parents’ rationale for why their student should attend college differed. For the students of parents that earned a bachelor’s degree, college was treated as a natural occurrence that would happen for the student and felt like an extension of the social strata that the parent had achieved, but for the parents of first-generation college students like Quintin and Nina, college was espoused as a way to gain opportunities the parents either never had or had to fight hard to earn.

Quintin expressed that his parents talked about college as a means to achieve a higher quality living:

Growing up, my parents, especially my mom always was like, "You're going to go to college. You need to go to college to get the step up in your career. Neither your dad or I did, and it made it more difficult." For the rest of my family, nobody has gone to college either. I guess you could say my parents are outliers in that they achieved higher paying jobs. A lot of the rest of my family, they work as grocery store clerks and stuff like that.
They'll be 50, and not working in a field where they have room to advance. I think that motivated me a lot to want to go to college as well so I could achieve a better life. For these parents, the ECHS does not just represent an opportunity to explore STEM based majors, but serves as an early insurance policy of sorts that their student will be exposed to college, have the opportunity to earn free college credits, and will gain the college skills necessary to acquire the bachelor’s degree that they never earned.

As all of the students in this study learned about the ECHS program, applied, and were accepted, the overwhelming feelings from their parents were a combination of pride, excitement, and relief that their student made it into the highly competitive program. The students understood the tangible benefits of attending the ECHS – the free credits, the enhanced academic opportunities compared to their base school, and better college preparation – but their focus was less concerned with STEM and career exploration and focused more on the types of things that mattered to them in the moment. Sarah was concerned about leaving her middle school friends behind, Beth and Lisa had a laissez-faire approach to their new environment, and students like Quintin and Seth saw the school as an opportunity to start anew after a less than ideal middle school experience, with Seth pointing out:

I think that was really appealing to me because I was very introverted. I didn't really have that many friends in middle school. Just about maybe every kid, I maybe had problems with. Like bullies and whatnot. So going to a small school that was completely separated from [my hometown] was really appealing to me because it kind of felt like, "Cool, a brand new start. I get to start fresh and I get to change myself," that I didn't get to in [my hometown].
The parents took the long view and understood how the program would continue to propel their students towards a STEM based major in college, but the students were more focused on the shorter-term personal impact that attending the school would have on their lives.

Parental and family support also played a major role in the how comfortable the student was in moving away from a STEM program of study once they were in the ECHS program. Students that were well supported by their parents and families to move away from the STEM field seemed to have more certainty in the non-STEM direction they were headed and felt more confidence in talking to others about their pivot to a new major. Elizabeth found that the support of her family, especially her mother who helped her to find many ways to explore interests and cultures growing up, made a big difference in how comfortable she could be in moving away from STEM:

My mom, I told her over the phone that I was adding religious studies 'cause I was too scared to do it in person, which it would've been fine, but I told her on the phone when she was driving. We were driving different places, we're both in the car, and so I knew that we'd have some time before we were back together so I was like, there will be time to navigate all of it. It went fine, she said that she pretty much knew, and she's really happy that I'm happy.

Conversely, the perceived lack of parental support or pressure to stay within a STEM based major causes additional stress for students and prolongs the amount of time they wait before they disclose to others that they actually want to move away from the STEM field. This is regardless of the variety of reasons that a parent might want the student to maintain a STEM based major – their student is good in STEM based courses, the parent perceives the career opportunities to be
better, or they want to make sure the student has a backup plan in case their interest in social sciences or humanities does not work out, among others. This was the case with Sarah:

Yeah, it was, like, my mom, my whole family bragging on people. I would talk to people in my family and they'd be like, "Oh my gosh, I was bragging about you the other day to someone." Like, "Stop. Like, just ... " I felt like I always had to do super well in my classes and be this amazing student and go on and do something amazing with my life.

Then I was like, "No, I just kind of want to get a psych degree and do something I'm actually interested in." You know?

Sometimes a similar pressure came from the ECHS program too; even after deciding to move away from STEM, some students felt a pressure to continue pursuing, learning, and appreciating STEM due to the STEM based curriculum, a lack of non-STEM electives, the requirement to continue taking college level math beyond what was needed for non-STEM degrees, and more.

**In a STEM Environment, Exposure to non-STEM Disciplines is Critical for Exploration**

A variety of things cause students to apply for and attend the STEM based ECHS, some of which align with the program’s mission of preparing underrepresented students in STEM based majors, but other reasons are related more to logistical reasons like school proximity to home or not finding the base high school an attractive option, or the general appeal of college preparation, regardless of the STEM focus. The reality is that most of these students came to the STEM based ECHS program not knowing what they wanted to major in or pursue professionally, and when they had some idea, they had not taken the opportunity to truly explore their interests fully. Even in situations where they felt confident coming into the ECHS program knowing what they wanted to do, they had typically only been exposed anecdotally to potential areas of interest and had limited knowledge about future major and career options. For Michael, he came into the
ECHS with thoughts of studying pharmacy, but it was not until he had a class assignment that caused him to learn more about the field that he realized that it was not for him:

I think at one point in middle school I was thinking about being a pharmacist and I was still thinking that until relatively early in 9th grade. And then we did some project in our science class or I think it was the engineering class we took where we had to pick a field. So I picked pharmacy and everybody's was like, "That sounds awful", so I was like never mind, which was a good thing you know. Better to figure it out then than much, much later.

Exposure to non-STEM components of their curricula at the high school level came mostly through mandated humanities and social science courses, and when this happened, it strengthened not only the exposure to non-STEM topics, but it enhanced how these students thought about STEM based careers, how they might still engage with STEM even if they do not pursue it professionally, and they gained an appreciation for how STEM and non-STEM exist together in the world. While the ECHS program did not have the additional elective courses that traditional high schools use to expose students to topics outside of core courses, the program used an interdisciplinary approach to STEM through project-based learning which helped connect the humanities and social sciences to STEM for these students. This approach helped students who came into the program more focused on STEM to find meaning, appreciation, and validation for the humanities and social sciences. It showed that there is value in bringing facts, reasoning, and logic to those subjects, and that it is okay to approach liberal arts through a STEM lens, but it is also important to consider how STEM is influenced by art, culture, literature, and design. This method also helped students validate their decisions to approach non-STEM majors,
recognizing that there are contributions to be made in non-STEM fields. Elizabeth captured that phenomenon this way:

I knew that these skills would set me apart from other people and so I feel like the fact that I have this background and I had four years of thinking like an engineer, so to speak, I come into my humanities classes with a different outlook and perspective than a lot of my peers, and I think it’s made me more successful in those classes because I have a different way of thinking, and the way that I write my papers, I love to bring linguistics into my religious studies papers, and so looking at the original diction of these texts, and that's like a very fact based approach, but that's something that often my professors are like this is so cool. No one's ever done this before, no one's ever pulled out these translations and looked at all of this, and that's like my thing that I want to do. I think that's a result of the STEM background

Some of these students felt that they would have benefitted more if some of the additional extracurricular bandwidth was given to non-STEM based options. They reported that once they began to move away from STEM based majors or careers, they were provided with less opportunities from the high school to pursue non-STEM options. They had to use their college courses to get explore other options, but at the cost of potentially taking courses that would not count towards a future major. They also felt that they had to advocate harder for themselves to get similar opportunities for which other STEM students were provided, as captured here by Elizabeth:

I had the opportunity to meet with folks in these fields, however, I had to pursue that on my own. I didn't feel like it was fed to me like it was for a lot of my peers in STEM fields. We had all these speakers that would come and people that would come, like audience
members for project presentations that were all from STEM fields, and so it was given to them. They could walk up and ask for someone's email address. It was so easy to get in touch. I had to seek that out. I had to go out of my way to do this once I knew international studies might be for me.

More generally, there was a feeling that while exposure to STEM is important, maybe the pendulum has swung too far in that direction at the expense of other subjects that are also important in society. Seth captured the essence of what some students felt was an overemphasis on STEM education that exists throughout public systems:

But in the end, it was like I came here for science, I stayed for history. Socially, it didn't really change anything, but it did kind of change my perspective on school. Because STEM majors are being so focused on everywhere really and it's now kind of like humanities are the underdog it seems like now anyway. You kind of feel like an underdog in that sense where it's like you don't really see a lot of history majors out there unless you go to a liberal arts school… But yeah, it's kind of like, "Yeah, I'm a history major. I can throw out history fun facts. Just like you want a fact? Boom, got you. Here's a crazy fact. You're welcome."

**STEM Departure was Driven by A Few Seismic Experiences or Many Smaller Factors**

These students’ departure from STEM generally followed two trends. Some of the students experienced two or three major life events during high school that served as major turning points (Denzin, 1989) in their departure from STEM. These turning points included things such as impactful internship opportunities, feelings of dissonance toward STEM after failing college level STEM based courses (e.g. calculus, chemistry, biology), or some type of
extracurricular involvement that provided new perspective. For Nina, the job shadowing experience she had in tenth grade was an “aha” moment for her that helped her pivot:

That was actually incredibly helpful, even in the sense of me knowing what I didn't want to do. So the job shadow of it was how I realized I didn't want to do civil engineering. It was the emphasis on the math and the architecture and the big building stuff. I was just like, "I don't really know what you're talking about anymore." So it was kind of an emphasis on what I didn't want to do.

Her second turning point came when she started an internship that exposed her to the business side of information technology, and this led her to the pursuit of a career as a business analyst:

Then it kind of got into IT and the software development side of it, because I was offered an internship with Optum they were talking to me and they're like, "We do software development." I don't like coding and I don't like computer coding. So I was like, "Not for me." Then the teachers and faculty members at STEM had helped me realize that it's not just software engineering. There's also the business stuff. There's stuff for you to do, even if you don't want to code. It was a good way to get kind of the best of both worlds. I have so many friends who are in software engineering and computer science. So talking to everyone just kind of helped me navigate through what I didn't want to more of what I did want and to me succeeding later.

For other students, their departure from STEM happened over a series of minor events that acted as small nudges that moved the student away from STEM over time. To these students, it didn’t feel like a shift away from STEM as it was happening to them, though in hindsight, they reflected that this was their experience. These smaller nudges were things such as performing mediocremly in a number of STEM courses, getting opportunities to explore other non-STEM
options in their college elective courses, and feeling low levels of dissonance that they might be moving away from STEM but not sharing it with anyone until those feelings reached a place where they could no longer live in a way that was not authentic to them. For example, many students in this category felt a certain way about the common core math they took in high school, how it diverged from the traditional algebra-precalculus track they had in middle school, and the challenging teaching style of their instructor. This was not the last math class that these students were required to take, but it left a bad taste for math that stayed with them even as they had better experiences in college level math courses. Sarah’s roller coaster experience with math exemplifies this series of nudges:

Yeah, 10th grade math, I don't know if I ... I'm not going to call out her name, but the teacher we had didn't help the experience, and that was definitely ... I was just like, "Oh." I just stopped liking math after that. I was like, "Yeah, I'm done. It's not for me." It was definitely in the back of my mind, but I was also doing high school calculus. Like, she had us teaching ourselves, and then we would come into class and do practice problems. But you can't teach calculus to yourself. It was just a bad system, I think. It wasn't really the math, it was just the experience with it. So I was just kind of nervous going into college math classes, because I was like, "Oh my gosh, what if this is how math is going from here on out? Like, what if this is what it is now?" And I remember sitting in my math lectures for, like, 107, 108, and I already knew all of it because it was going back to, like, ninth grade math, because it was, like, precalc. And I was like, "Oh, this isn't that bad." Then, I took calc I and II, and those were, like, the first classes that I actually didn't do well in, and tried hard.
Uncoupling the STEM Program from STEM Curricula and Careers can be Challenging

For these students STEM was both a physical location and a place of belonging, a curriculum and a culture, a purpose for learning and exploration and an identity. As such, they had a hard time separating STEM the program and school from STEM the culture and identity. One prominent example of this was in how they talked about STEM. For these students, the term “STEM” was used interchangeably to refer not only to the ECHS program itself (i.e. “we attend STEM”) and the curriculum (i.e. “we are a STEM school”), but the students also coopted the term to refer to themselves as members of the community, calling themselves “Stemmies.” In reviewing the website and other high school literature distributed to the public, the high school does have an official team name and mascot, but it was clear when interviewing these students that they do not refer to themselves by their official team name, opting for “Stemmie” instead.

This posed unique challenges for students who had begun to move away from STEM interests but did not want to move away from the community or environment. There was cognitive congruence for these students when they were interested in at least some component of STEM and were in the STEM based ECHS environment, just as there was congruence once they were in their major of choice at their new four-year institution. But for most of these students, there was a period during their time in the ECHS program where felt cognitive dissonance, because they had lost interest in STEM based majors or careers but had grown to embrace the STEM community for which they were members. As Elizabeth pointed out, “The only thing I wish I had was that relationship with peers in high school. It was hard being in school surrounded by people that didn't get the things that really interest me.”

Even though it was a STEM based curriculum and the students had worked themselves away from STEM based majors, they still had a larger appreciation for the college readiness, and
other college knowledge skills that they got from the program. The students explored, wrestled with, and ultimately concluded they could abandon the STEM portion of the curriculum, but they never abandoned the foundational ECHS core principles – of college readiness, opportunities to earn free college credit, learning in a small school environment, and more. Subsequently, even though these students had pivoted away from STEM, their entire high school curriculum (including humanities and social science courses) was built around The Grand Challenges of Engineering for the 21st Century and the engineering design process, and as a result, they gained an appreciation for how humanities and social sciences could benefit from having a STEM lens (as well as how STEM could benefit from having creatives, strong writers, and others who are influenced by humanities and social sciences). These students brought some of their STEM curriculum to bare in their non-STEM studies and as Seth pointed out, they found themselves still thinking like an engineer:

Whenever we get a project, like I'm going to say, "All right, here's a project and hear what's it about." Like I'm automatically planning. I'm starting to think about, "Okay, how do I start this? What could be a possible end goal?" And I just find myself constantly... I feel like I still use the engineering design process because it's been burned into my brain, I feel like… This is what's in my head. But yeah, it's like whenever we get introduced projects, I'm always like, "All right, we have to start with ideas first and then we can build upon those." So it's like those things, they're stuck with me now, which cool. It's effective, so whatever.

**Discussion and Implications**

The findings from this study demonstrate the challenges that exist for students who opt into a specific type of curriculum related to future college majors and careers, but who are also
developmentally in a place where they are still unsure of their future ambitions. The findings demonstrated that the learning environment and experiential factors highlighted in Lent, Brown, and Hackett’s (1994, 2002) Social Cognitive Career Theory played a large role in shaping student’s successive outcome expectations and reshaping of future goals. The ECHS environment, which provides career programming, opportunities for involvement in job shadowing and internships, coursework designed to help students discover major and career decisions, shaped students’ changing perceptions of majors and careers and recalibrated earlier familial inputs that informed initial career aspirations. These findings also suggest that the ECHS has helped students acquire some components of college readiness, college knowledge, college credit acquisition, and preparation that ends in a student successfully matriculating to a four-year institution to finish their bachelor’s degree studies. However, students could benefit from additional supports and resources around major and career exploration, especially as they pivot away from STEM but remain in a STEM driven environment. This research can help bridge some of those challenges by alerting policymakers and administrators of similar types of ECHS programming to the transitional and decision-making processes that students potentially face while enrolled in a STEM tracked ECHS program.

Policy

One area of development for policymakers to consider is to increase the development of Science, Technology, Engineering, Art, and Math (STEAM) based ECHS programs as opposed to STEM only programs (Yakman, 2010). STEAM would enhance what the STEM based ECHS built by providing exposure in the arts, humanities and social sciences while allowing students the flexibility to study both STEM and non-STEM disciplines together and make better career decisions that are based in a wider breadth of exposure to academic content. Policymakers
should also work to derive what is scalable about exploring STEM and non-STEM careers from STEM based ECHS program and bring that programming to traditional high schools in a way that balances focus on STEM in secondary education with other STEM-adjacent or non-STEM based skills. While research from employers show that STEM qualifications are valuable in the workplace, they also want to employ college graduates that have soft skills – non-technical competencies such as critical thinking, complex problem solving, and interpersonal skills – especially at a time when research indicates that the gap between employer expectations of college graduates and their abilities continues to widen (Prinsley & Baranyai, 2015; Stewart, Wall, & Marciniec, 2016).

**Practice**

This study provides insights about the resources available to students for major and career exploration. One easy change that ECHS administrators could make is to increase information available to parents and students earlier in the process regarding non-STEM based opportunities for exploring majors and careers. For example, while the STEM ECHS program website shows the courses required for high school graduation per grade year, there is no information offered about what types of college courses are available for the students to take at the host institution or how those courses might supplement the STEM high school curriculum.

By design the STEM based ECHS brings in STEM based public speakers, invites guests from engineering and science disciplines to serve as judges for academic competitions, and connects students with job shadowing and internship type opportunities that are primarily based in STEM related industries. This is a great service to students that are either interested in or exploring STEM based majors and careers, but the reality is that for most high schoolers, decisions about future programs of study and employment are fluid and evolving. This research
found that students who were either beginning to explore other majors and careers or who already made a pivot away from STEM were more limited in the networking and employment opportunities that were made available to STEM-interested students. While the high school curriculum focuses on STEM, administrators for the school should recognize that these students are still in their formative years of major and career exploration and as such, they would benefit from being exposed to similar non-STEM guest speakers and networking opportunities. Because of the STEM nature of the program and the desire to fully expose students to STEM related disciplines, one recommendation could be that administrators seek the feedback of their students about majors and careers on a regular basis and make adjustments as appropriate based on the needs of the individual student.

Similarly, administrators might benefit from building programming or otherwise engaging parents more intentionally about major and career decision-making for their students. As was evident from this study, parents play an oversized role in how students think about pursuing STEM and the rationale for doing so. While there is nothing wrong with students who are uncertain of future major and career prospects exploring STEM when prompted by their parents, those who have a parent or family member apply pressure to remain in STEM for perceived tangible benefits (i.e. better pay and career prospects, the student doing better professionally than the parent, etc.) long after the student has lost interest in STEM subjects may be applying additional pressure because they are unaware of alternative majors and careers in non-STEM areas also provide those tangible benefits.

**Future Research**

In order to understand the continued consequences of attending a STEM based ECHS program but not pursuing a STEM based major or career, a longitudinal study that continues to
follow these students and their STEM pursuing peers could be beneficial. The interviews conducted for this study were with students who were either still in college or had just completed their bachelor’s degree; therefore this research could not speak to the tangible benefits that the program might have had on the student’s experiences seeking employment in non-STEM fields or once the students worked in their first professional setting as a college graduate. For those students that ultimately pursue advanced education, it could also be helpful to know how the decisions they made in high school informed their ongoing pursuit of education – will they pursue advanced degrees to course-correct for a bachelor’s program that they decided on too early or will their ongoing education build off of the decisions they made as high schoolers?

In could also be important to understand how ECHS administrators such as the principal, counselors, and career development professionals structure career readiness programming; interviewing those involved in the educational decision-making process could bring that knowledge to light. As mentioned previously, long-term application of STEAM as a curricular focus for an ECHS program that includes the liberal arts is also something to be explored and studied in depth, whether that is by introducing arts to an already existing STEM program or by developing a new ECHS program. Development of such a program could lead to comparison studies of ECHS programs by type to better understand the educational benefits of STEM versus STEAM in an ECHS setting, measuring factors ranging from student performance across disciplines to the experiences that students from differing programs have as they transition to four-year institutions.
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CHAPTER THREE: EARLY COLLEGE HIGH SCHOOL GRADUATES’ TRANSITIONS AS DEGREE SEEKING STUDENTS UNDERREPRESENTED IN STEM MAJORS: A CASE STUDY

In a little more than a fifteen years, the Early College High School (ECHS) movement has produced over 280 high schools across 31 states and the District of Columbia, serving more than 80,000 students across the country (Jobs for the Future, 2017b). To put that in perspective, according to the National Center for Educational Statistics (2015), there were less than 280 public high schools in 15 states (Alaska, Delaware, Hawaii, Idaho, Maine, Maryland, Nevada, New Hampshire, New Mexico, North Dakota, Oregon, Rhode Island, Vermont, West Virginia, Wyoming) and the District of Columbia. Started in 2002 by thirteen educational partner organizations and funding spearheaded from the Bill and Melinda Gates Foundation among others, the ECHS Initiative was the driving force behind the rapid growth of the Early College High School movement in America (Jobs for the Future, 2017a).

The movement prioritized two key areas: ensuring that students are graduating from high school with the skills necessary for college success, and focusing on the success of traditionally underrepresented populations in post-secondary education, including those from low socioeconomic backgrounds, minority students, English language learners, and first generation (those who are first to attend college in their family) college students (Berger, Adelman, & Cole, 2010; Bill and Melinda Gates Foundation [Gates Foundation], 2009; Edmunds, 2012; Kaniuka & Vickers, 2010). The motivation for this movement was also economic; the Bill and Melinda Gates Foundation, one of the primary financial supporters of the ECHS Initiative, looked to educational reform as a crucial way to reduce inequality and increase access for these populations (Gates Foundation, 2009). In 2009, only 71 percent of American students earned a
high school diploma, with fewer Hispanic (58 percent) and African American (55 percent) students persisting to high school graduation, and even smaller numbers completing high school ready for college (Gates Foundation, 2009). This was incongruent with a market where all future growth in the workforce was projected to come from minority populations (Gates Foundation, 2009). The ECHS Initiative was established in part to disrupt this trend of continuous low performance and create a strong commitment to the success of students underrepresented in higher education. Although the operation of the ECHS Initiative has officially ended, Jobs for the Future moved in to provide an organizational home for the ECHS movement at the national level, and support for ECHS programs has remained strong as they experienced continued growth and drew interest from state and federal policymakers (Julie A Edmunds et al., 2015; Jobs for the Future, 2017a).

**Statement of the Problem**

The operation of ECHS programs has been resource intensive, requiring commitments from public school districts, local higher education institutions, and other local and state entities operating in congruence while costing more per pupil (Howley et al., 2013; Webb, 2004). Across the board, ECHS programs have been developed primarily as a function of secondary education, even though they incorporate aspects of postsecondary education. That is to say that while ECHS students have typically had an opportunity to earn college credits, attend classes on a college campus, and participate in collegiate events, they have been a high school student foremost and have had a primary responsibility to their secondary institution. This included not only completing high school graduation requirements, but also attending to their high school community, and thriving in a setting which promoted the development of strong academic and non-academic behaviors with increased postsecondary access at an earlier age in order to
adequately prepare them to earn a bachelor’s degree (Berger et al., 2013; Edmunds, 2012; Jobs for the Future, 2009; Kaniuka & Vickers, 2010). The model has placed a large focus on high school students and their ability to earn college credit while still in high school. Likewise, most research related to ECHS programs has thus far focused on the high school portion of the operation. While it is important to understand how ECHS programs have impacted the students that participate, literature has been sparse regarding ECHS students that have completed high school moved on to pursue a four-year degree full time. This is especially true for those who have come from underrepresented backgrounds and had an interest in pursuing science, technology, engineering, or math (STEM) based majors.

**Purpose of the Study**

The depth of literature surrounding the operation of ECHS programs and their significance for high school students enrolled in the programs has continued to grow (see Chapter 1), but little research exists that addresses how the graduates of these programs have been impacted as they continue in their pursuit of a bachelor’s degree at four-year institution. Of the existing research, quantitative reports of large programmatic outcomes have been most prominent. For example, reports by The American Institutes for Research and SRI International provided a comprehensive quantitative analysis of the state of ECHS programs in 2013 and 2014 (Berger, Turk-Bicakci, Garet, Kundson, & Hoshen, 2014; Berger et al., 2013), and an 11-year longitudinal experimental study has highlighted how ECHS participants enrolled in college at higher rates, entered college with more college credits from high school, and completed associate degree programs at higher rates (Julie A Edmunds et al., 2015).

There has been limited qualitative research to address how the experiences of graduates’ participation in an ECHS program has impacted their transitional experiences as they seek to
complete their baccalaureate studies (see: Mccorry-Andalis, 2015; Outlaw, 2017; Singleton, 2011). Overall, ECHS programs have appeared to meet their goal of targeting traditionally underrepresented students for preparation in post-secondary education, but has not been clear from the perspective of ECHS graduates if these programs have been successful in preparing students adequately to transition to a four-year institution and persist through degree attainment.

At the same time, existing literature has established an ongoing need for developing a pipeline of students traditionally underrepresented in STEM majors and has indicated additional challenges and cultural barriers that underrepresented populations must frequently overcome to persist in STEM based majors (Allen-Ramdial & Campbell, 2014; Anderson & Kim, 2006; Chang et al., 2014; Hurtado et al., 2010; Malcom, 2010; Perna, Gasman, Gary, Lundy-Wagner, & Drezner, 2010). However, virtually no research has been produced that examines the impacts of STEM based ECHS programs on the transitional experiences of students who have been underrepresented in STEM fields, but who have an interest in pursuing such majors.

This study sought to address the lack of research surrounding underrepresented STEM ECHS graduates and their experiences transitioning to a four-year institution, exploring how one program’s student population prepared for their transition to college and experienced ongoing transition during their first and second academic years as a result of their participation in a STEM based ECHS program. This research also contributed to the ongoing policy and administrative dialog regarding the effectiveness of alternative high school programs operated by public school districts and how public money has been spent on education.

The purpose of this case study was to explore how the experiences gained as a result of participating in a STEM based ECHS program contributed to the transitional experiences of
underrepresented ECHS graduates as they began their pursuit of a STEM based bachelor’s degree at a four-year institution. The following research questions were proposed:

1. What were the transitional experiences of ECHS graduates underrepresented in STEM majors, from their pre-enrollment as degree-seeking students through their first and second academic years as they pursue a bachelor degree in a STEM major?

2. How has participation in a STEM based ECHS program facilitated the transitional experiences of ECHS graduates underrepresented in STEM majors during their first and second academic years at a four-year residential college?

3. How has participation in a STEM based ECHS program hindered the transitional experiences of ECHS graduates underrepresented in STEM majors during their first and second academic years at a four-year residential college?

**Review of the Literature**

ECHS programs have been underpinned by a philosophy of providing a comprehensive high school experience built around high academic expectations and extensive supports, with the goal of preparing students, especially those from underrepresented populations, to be ready for college in a way that allows them to transition to a university setting, persist and graduate with a bachelor’s degree (Berger et al., 2010; Julie A Edmunds, 2012). Chapter One of this dissertation provided foundational information about college readiness and underrepresented populations, as well as a comprehensive review of ECHS programs, their perceived benefits and limitations. The literature below expands on the literature covered in Chapter One around underrepresented students, further examining their experiences in college, especially those seeking to pursue STEM based majors.
Underrepresented Students Transitioning to and Through College

Although many students have faced challenges when transitioning to college and completing their first year on campus, there have also been unique hurdles impacting underrepresented student groups. Since the 1980s, students’ aspirations for attending college has grown across racial and socioeconomic groups, and yet gaps in enrollment rates (and ultimately degree attainment) have still remained high between African-American, Latino, and low-socioeconomic student populations and their White and Asian peers, highlighting the ongoing need for reform at the secondary level to better prepare these students (Roderick et al., 2009). At the same time, underrepresented students that have successfully made it through the college application process, graduated high school, and began their collegiate journey on campus have faced additional obstacles that have impacted their retention and graduation rates.

Since 1976, the number of Black and Hispanic students enrolled in degree granting colleges has grown, with most of these students having attended college at predominately White institutions (PWIs) (Fischer, 2007). Recent enrollment trends have indicated that from 2000 to 2013, the share of Hispanic and Black students enrolled in full-time bachelor degree programs has grown from 11% to 16% and 11% to 13% respectively, while the share of Asian and Pacific Islanders (6%) and American Indians and Alaskan Natives (1%) have remained steady (National Science Board, 2016). Future projections of college admissions through 2060 have also indicated that the majority of increased enrollment growth will come from minority student groups, especially those of Hispanic descent, and that this trend is likely to increase the number of institutions in the United States that become designated as Hispanic servicing institutions (National Science Board, 2016).
Minority college enrollment growth has also taken place at minority based institutions such as historically Black colleges and universities (HBCUs), Hispanic serving institutions (HSIs), and tribal colleges and universities (TCUs), but the rate of growth at these institutions has trailed that of PWIs (National Center for Education Statistics [NCES], 2017; Núñez, Johnelle Sparks, & Hernández, 2011; US Department of Education, 2017b). The total number of students enrolled in HBCUs has increased from 223,000 in 1976 to 293,000 in 2015, though these numbers are lower than PWI growth during this same time frame (32 percent vs 81 percent respectively). Overall, there was a decrease in the total percentage of Black students enrolled during this time, from 18 percent in 1976 to 9 percent in 2015 (NCES, 2017). HSIs, defined as community colleges or four-year institutions that have enrolled Latino students as at least 25% of their population and receive additional federal funding to help serve this population, have accounted for nearly half of all Hispanic college enrollment across the country in the 21st century (Núñez et al., 2011). One of the main differences between HBCUs and HSIs is that HBCUs were historically developed during legal segregation to primarily serve Black students, whereas HSIs are established based on enrollment, and have historically grown in number as the Latino population in the United States has grown, from 189 HSIs in 1994, to 472 in 2015 (Hispanic Association of Colleges and Universities, 2017). Meanwhile, TCUs are controlled by American Indian and Alaskan Native tribes directly, and the number of Native First students enrolled in TCUs has increased by 9 percent between the 2002-2003 and 2012-2013 academic years (US Department of Education, 2017b). Despite the growth in enrollment at minority focused institutions, they have been perpetually underfunded at the federal level, and that has limited their ability to provide the additional resources most needed to serve their respective populations (Crawford II, 2017; Hispanic Association of Colleges and Universities, 2017; Nelson & Frye,
Still, most minority student enrollment has been at PWIs, where they have found financial, sociocultural, and academic hurdles that have exacerbated the gap in graduation rates between minority, low income, and first-generation students and their peers.

Knowledge of curricular progress, awareness of institutional policies and procedures, and similar logistical hurdles have contributed to situations in which minority students do not persist towards graduation in a timely manner when compared to their peers. One study found that minority students earned five fewer credits during their first-year than their White counterparts, indicating that minority students were either enrolling in or passing fewer credits than their peers (Zajacova, Lynch, & Espenshade, 2005). One challenge for Latino students in learning how to navigate institutional policies and procedures is that almost half of the Latino population begins their collegiate experience directly out of high school at a community college, which requires that they learn more than one institutional system if and when they transfer to a four-year university (Núñez et al., 2011). Sixty-eight percent of Latino students have been first-generation college students, a much higher rate than their peers, limiting the familial knowledge that has been available to help them navigate these systems (Núñez et al., 2011). Black and Latino students that have completed their degrees have taken longer on average than White or Asian students; a similar pattern has existed for student from lower socioeconomic backgrounds versus their more well-off peers (Trusty, 2004). This has had the potential to exacerbate financial challenges, as more years of college enrollment increases total costs of attendance and prolongs the beginning of full-time employment, resulting in lost opportunity costs from earning full-time wages sooner. Finding support on campus can also be harder for URMs. African American students at PWIs have reported that it is important to see institutional investment in minority students, and that they look for factors such as increased numbers of Black faculty and staff,
increased faculty staff interactions, and support systems developed for Black students as signs of such investment (Gardner, Keller, & Piotrowski, 1996). African American students have also reported that institutional factors such as discrimination, isolation, and a lack of adequate resources have been distractions that have served as impediments to learning (Person & Christensen, 1996). These experiences of alienation, cultural differences from their home environment, and discrimination have created situations where minority students have not felt a sense of belonging, something integral to efforts of persistence (Hurd, 2000; Thayer, 2000).

Underrepresented students with access to resources and academically rigorous coursework have a better chance of overcoming barriers to adequate collegiate preparation and ongoing college success. For example, African American and Hispanic students who were enrolled in AP courses during high school have outperformed their non-AP peers in college level courses, even after controlling for SAT scores and socioeconomic status (Hargrove, Godin, & Dodd, 2008). High impact practices (HIPs) that engage students in active learning and integrated interactions with the institution, such as summer bridge programs, first year seminars (FYS), and learning communities (LCs), have been shown to benefit students who come to campus starting behind their peers, but that those who are most behind participate the least in these programs (American Association for Colleges and Universities, 2007). One study of more than 2,000 first-year students at a large urban commuter school determined that students who participate in a combination of HIPs find the most success, even after controlling for demographic factors such as race and socioeconomic status (Hansen & Schmidt, 2017).

Academic self-efficacy, or a student’s ability to establish successful academic behaviors such as developing effective study habits and exam preparation, and writing term papers, has also been determined to correlate with success for minority students (Zajacova et al., 2005).
Students who have been able to develop high levels of academic self-efficacy and develop coping mechanisms for college stress have demonstrated an increased confidence to carry out difficult tasks and have established specific skills to work through new academic challenges (Bandura, 1993; Zajacova et al., 2005). Self-efficacy has also been linked with purpose in life for students (DeWitz, Woolsey, & Walsh, 2009). One study of primarily non-traditional immigrant and minority first year students found that students’ self-efficacy was the strongest predictor of the students’ first-year cumulative GPA, and a strong predictor of total accumulation of credits, even when controlling for conventional variables such as high school performance and demographic background characteristics (Zajacova et al., 2005). Strong parental encouragement and support could be one way to help students develop academic self-efficacy, as it has been shown to positively impact the academic experiences of minority students and led to more positive interactions with college faculty and staff (Nora & Cabrera, 1996).

**Underrepresented Students in STEM Programs of Study**

In addition to the collegiate trials that have challenged underrepresented Black, Latino, and American Indian students, those who have had an interest in STEM based majors and careers have found that additional challenges remain when compared to their White and Asian counterparts. First-year students’ intentions to major in science and engineering based programs of study have been on the rise since the late 1990s across all ethnic groups except for American Indians and Alaskan Natives, and total proportions of freshmen interested in these majors has accelerated in more recent years, from about 33% of students in 2007 to about 45% of students as of 2014 (National Science Board, 2016, p. 2-41). Yet, despite rates of overall growth, a review of the types of science and engineering programs indicated that Asian students study natural sciences and engineering at higher rates, while Black and Latino students are...
underrepresented in those fields and overrepresented in social and behavioral science majors (National Science Board, 2016). Even though Black and Latino students have expressed similar interest in STEM fields to their White counterparts when entering college, they were 24% less likely to obtain a bachelor’s degree in those fields after six years (Anderson & Kim, 2006). In the field of engineering, Black, Latino, and Native American students have only made up 12% of degree earners, even though they represent approximately 30% of the population (Frehill, Di Fabio, & Hill, 2008). Across all ethnic groups and both sexes, fewer students have graduated with degrees in engineering than originally intended, while social and behavioral science graduates have been overrepresented relative to first-year intentions. Black, Hispanic, and Asian students are also underrepresented as graduates in natural science degrees compared to their first-year intentions (National Science Board, 2016).

Additionally, women have been historically underrepresented in areas of STEM education as well when compared to male students, despite women having come to outpace men in overall college enrollment (National Science Board, 2016). Since the late 1990s, women have earned approximately 57% of all four-year degrees and about half of all STEM degrees, but women are still vastly underrepresented in areas considered “hard sciences” such as engineering, computer sciences, mathematics, statistics, and physics. Where women have caught up to men in STEM areas have been in the fields of biological and agricultural sciences, social sciences, and psychology (National Science Board, 2016). An indication of how challenging it has been to increase female representation in STEM fields is that the number of science and engineering degrees relative to all other degrees awarded to women has remained unchanged from 2000 to 2013 (National Science Board, 2016).
Identifying the additional challenges that underrepresented students face in STEM based programs has been important for educators seeking to improve the standing of URMs in these fields. Nevertheless, attempts to understand the challenges of URMs in STEM have often been framed from what Shaun Harper refers to as “deficit-oriented research questions” (2010, p. 63), which has placed the burden for failure or shortcomings back on the student and their minority identity. Harper (2010, 2012) has proposed an alternative, an anti-deficit achievement framework that encourages researchers to explore how, despite obstacles, Black males have overcome challenges to find success in higher education and beyond. Although Harper’s model has focused on Black males, the reframing of questions from a deficit model to an achievement model is one that could be used to study other URMs as well.

The reframing of questions surrounding URM student success in STEM programs have led to findings of positive practices that can support the increase of minority representation in these fields. One such finding was that faculty can play a key role in serving as a role model or mentor in the development of minority scientists, regardless of the race of the faculty member (Griffin et al., 2010; Hubbard & Stage, 2010; Museus & Liverman, 2010). Another finding showed that the presence of minority STEM faculty members can serve as proof of success and can connect with minority students in meaningful ways through shared experiences of higher education culture while opening conversations about the challenges of race and racism on campus, providing an “ethic of care” (Griffin et al., 2010; Hubbard & Stage, 2010; Hurtado et al., 2011; Perna et al., 2010). Increasing STEM support, better defining pathways to a completed bachelor’s degree, and providing increased transfer support were also identified as ways to support the many Latino students that begin STEM programs at a community college (Malcom, 2010). Institutional culture has also been determined to greatly impact URM persistence in
STEM majors. For example, Black students that study STEM based programs at HBCUs earn degrees and go on to post-graduate studies in STEM fields at higher rates than their peers at PWIs (Hubbard & Stage, 2010; Museus & Liverman, 2010; Nixon et al., 2007; Perna et al., 2010). Developing a supportive academic culture can offset academic, financial, and psychological barriers, using practices such as smaller class sizes, developing a cooperative culture amongst peers, providing increased access to faculty, increasing the opportunities for undergraduate research and internships, providing increased opportunities for getting involved in academic clubs and organizations, and providing increased academic supports in order to retain and support URM students (Chang et al., 2014; Griffin et al., 2010; Hurtado et al., 2010; Museus & Liverman, 2010; Perna et al., 2010). For women pursuing STEM degrees, participating in extracurricular opportunities through research programs and connecting with other students who share academic interests through academic clubs related to STEM (Carlone & Johnson, 2007; Espinosa, 2011) and connecting with faculty that continue to nurture and develop their STEM identity (Carlone & Johnson, 2007) were important to their persistence. Again, the environment in which women study also mattered; while highly selective institutions diminished STEM degrees for all women, especially for women of color, institutions that were mission driven to educate women and minorities, such as Black women’s colleges, coeducational HBCUs, PWI women’s colleges, and HSIs had all increased production of STEM degrees in women of color (Chang et al., 2014; Espinosa, 2011; Wolf-Wendel, 1998).

**Conceptual Framework**

This study sought to understand the comprehensive transitional experiences of ECHS graduates that have been underrepresented in STEM based majors from their own perspective. Merriam and Simpson (2000) have advocated for the use of the literature review to guide the
conceptual framework when venturing into previously unexplored territory for which a model does not clearly exist, but where further research could offer up “hypotheses that encompass and explain the phenomenon” (p. 27). Because ECHS programs are unique in their approach of blending the lines between secondary and postsecondary environments, it was important to consider that the transitional experiences for these students started when they were still in high school but participating in a culture of college readiness, extended through their transition from high school to their enrollment at a four-year institution, and lasted through their first and second years as they acclimated to their new college as full-time degree seeking students. Often, ECHS students have had a blended experience of learning college readiness skills while actively participating in college processes, which has led to facing some issues of transition sooner, even before they have begun a transition in the traditional sense. For example, they may have experienced different policies about grading and attendance through enrollment in college courses, which has reinforced their college knowledge, but could have also brought a new challenge in how they approach studying for college level courses. On the other hand, ECHS students may have had experiences that informed their transition to a four-year institution, but there were other areas for which they were still moving through transition, even while they began the process of integration. Figure 3.1 demonstrates how these components of transition are interconnected for this population. The previously reviewed literature in Chapter One surrounding college readiness, student transition, and integration to college have formed a basis for which the conceptual framework for this research has been built. In keeping with Merriam’s (1998) guidelines that literature can be used to frame research in order “to make the case that the present study is necessary, urgent, and important to undertake” (p. 51), this research has contributed to the understanding of ECHS graduate transitions to college for underrepresented
students, a population for which little is known, and for whom a new, unique, and more comprehensive transitional experience exists.

Figure 3.1: The relationship of college transitional experience types for early college high school students moving through the process from enrolled high school student through their first and/or send year of enrollment at a four-year institution (Adapted from the works of Braxton, et al, 2013; Chickering & Schlossberg, 2002; Conley, 2010; Schlossberg, 1989; Schlossberg, et al., 1995; Tinto, 1993, 2006)

Limitations and Delimitations of the Study

This study sought to understand the significance that one STEM based ECHS program has had on underrepresented students in the STEM pipeline, but only represents the experiences of students in one ECHS program, as opposed to considering a cross case analysis of multiple types of STEM based ECHS programs. As is the case with most collective case studies, this study was limited by the time and resources available to the researcher to carry out individual interviews of participants that attend various four-year institutions, and as such, this study only had 10 participants. This limited the potential saturation of data from the various types of sub-cases in this study, trading the potential for more participants with allowing for time to complete follow up interviews as necessary with the participants in this study. Additionally, while American Indian and Alaskan Natives have been a population of underrepresented people in
STEM based occupations, there was no representation of this population at the ECHS program being studied, and therefore the voice of these people was not represented in this study. This research also relied on the self-reporting of participants, and while this approach has been considered an asset of qualitative research by gaining an understanding of a phenomenon directly through the voice of the experienced, it also necessitated acquiring data from imperfect participants.

For the purposes of this research, 10 individual interviews with ECHS graduates were conducted to develop cases in examining their transitional experience. Due to limitations of population access and financial constraints associated with transcription, I chose to interview students who have graduated from one STEM ECHS program, eliminating the potential for a cross-case analysis of transitional experiences from differing STEM based ECHS programs or other STEM schools of choice. Additionally, this study limited the extent to which it considered the significance of transitional experiences to the first and second years for this student population, even though underrepresented and transfer-like student populations have a history of ongoing transitional experiences beyond these years of enrollment. A study of only students in their first year of transition might help to better understand the more immediate issues these students have faced upon moving to their four-year institution, but due to the small class sizes of the ECHS program, interviewing students in their first and second years ensured an appropriate number of participants were included.

Methodology

This case study provided a qualitative perspective in which to better understand the impact that ECHS programs have on graduates underrepresented in STEM based programs of study and their experiences in transitioning to a four-year institution. It addressed the lack of
research surrounding the post-graduation experiences of this population, exploring concepts of college readiness, the transition to a four-year institution as a full-time, degree seeking student, and the institutional integration these students faced in their own voices as they pursued their continued education in a bachelor’s degree program.

Yin (2015) has noted that there are five major elements that distinguish qualitative research from other types of social science investigation; chief among them is “studying the meaning of people’s lives, as experienced under real world conditions” (p. 9). Qualitative researchers are most often concerned with questions of “how,” “why,” or “what” in pursuit of finding meaning in their data (Hesse-Biber & Leavy, 2011). Qualitative research is appropriate for the pursuit of knowledge that seeks to represent the views of participants, embracing the real-world context in which they are experienced. It provides “insights from existing or new concepts that may help to explain social behavior and thinking,” and recognizes that multiple sources of evidence is the key to interpreting participants’ words “more richly, if not more appropriately” (Yin, 2015, p. 9-11).

An exploratory qualitative approach provided a methodological way forward, seeking to learn more about the under-researched area of ECHS graduates underrepresented in STEM based programs of study for the sake of expanding knowledge and providing context for future research for this population by using an interpretive lens (Hesse-Biber & Leavy, 2011). Little has been known about the experiences of ECHS graduates that continued their studies at a four-year institution, and even less has been studied about STEM based ECHS graduates from underrepresented populations. The students who have participated in these programs were in a unique position to provide key insights and knowledge as the experts regarding their own ongoing transitional experiences.
Case Study Methods

Yin (2014) defines case study research as existing of two main components, the scope, and the features. The scope of a case study “is an empirical inquiry that investigates a contemporary phenomenon (the ‘case’) in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident” (Yin, 2014, p. 16). The features of a case study inquiry are that it relies on multiple sources of triangulated evidence in order to sift through the noise of varied and complex points of interest in order to better understand the data associated with the phenomenon and setting of interest, and it requires a clear theoretical underpinning based in previous research that serves to guide data collection and analytical strategies (Yin, 2014, p. 17). An individual case then, is “a contemporary phenomenon within its real-life context, especially when the boundaries between a phenomenon and context are not clear and the researcher has no control over the phenomenon and context” (Yin, 2002, p. 13)

The phenomenon of interest for this study was the preparation of STEM based ECHS graduates from a STEM ECHS program. The context in which to understand an in-depth analysis of this case was the transitional collegiate experiences ECHS graduates underrepresented in STEM based majors faced during the first and second years of enrollment in a four-year degree program. That is to say this research sought to understand how transitional experiences were shaped as a result of participating in a STEM based ECHS program for underrepresented students. The strategy most appropriate for this research was a single embedded case study design. Yin (2012) notes that a case study is of a single embedded design when the overarching unit of analysis (i.e. the bounded entity) being studied contains subcases that can be further analyzed. The aim of an embedded case study is to provide additional context,
so long as the study remains about the single case and doesn’t shift to become primarily about the subunits. This research study wanted to understand the transitional experiences of ECHS graduates from one STEM based ECHS program, bounding all participants to a single case. However, because the students selected to participate in this study identified with populations traditionally underrepresented in STEM based programs of study, their experiences and relationship to STEM based programs of study were valued as a construction of knowledge that gave voice to traditionally marginalized populations. These sub-case populations include Black and Hispanic men, and all women (National Science Board, 2016).

Sample Selection

Purposeful sampling is ideal for examining “information-rich cases strategically and purposefully” (Patton, 2002, p. 243). In this research, the intention of the case study was to learn about the transitional experiences of students traditionally underrepresented in STEM that graduated from one STEM based ECHS program and therefore the research required a criterion sampling strategy to select only participants that graduated from that program. In order to further capture the “unique or diverse variations” (p. 243) related to the transitional experiences of underrepresented students in STEM based programs, maximum variation sampling was the primary sampling strategy. This strategy allowed for the discovery of difference, but also provided an opportunity to “identify important common patterns that cut across variations” (p. 243). It also increased the utility of this research for college administrators or others involved in the operation of ECHS programs, and for all who seek to address the perpetual challenges surrounding underrepresentation of specific populations in STEM majors. To aid in achieving maximum variation and to better reach a saturation of data, I included 10 participants in the
study, representing the voice of Black and Hispanic male students as well as females from various racial and ethnic backgrounds.

The research site was a STEM based ECHS program in North Carolina. The ECHS program represents the criteria for intensity sampling, as there are many ECHS programs nationally, but very few STEM based programs that exist across the country, and therefore this case represented an opportunity “to illuminate the nature of success or failure, but not at the extreme” (Patton, 1990, p. 172). Paradoxically, this ECHS program served as a critical case (M. Q. Patton, 2002); what is learned from the students that participate in this program may be representative of similar experiences that underrepresented students have at other ECHS programs generally, and in the few STEM based ECHS programs that exist nationally. There was a logical generalization to think that the experiences of students that participate in programs designed around the same core principles and intentionally target underrepresented populations in higher education as part of their mission may face similar experiences.

Data Collection

The primary form of data collection for this research was semi-structured in-person interviews with ECHS graduates that self-identified as being from an underrepresented population, and that indicated an interest in pursuing a STEM based major upon graduation from high school. Semi-structured interviews ensured that the questions in the interview protocol were tied to the research questions, but allowed the flexibility to follow hunches or discover previously unknown aspects about the ECHS transitional experience (Hesse-Biber & Leavy, 2011). A copy of the interview protocol can be seen in Appendix B. All students that chose to participate in the interview process were presented with a consent form (Appendix C) informing them of the process and any potential risks to participation. Interviews lasted approximately one
hour and were digitally recorded and transcribed. Final transcription texts were securely stored via an online cloud service and uploaded to MAXQDA for analysis.

Another form of data collection, the analysis of archival documents, complemented the participant interviews and allowed for a more robust triangulation of data. As Merriam and Tisdell (2015) point out, documents are a strong source of data, and can be used to “furnish descriptive information, verify emerging hypotheses, advance new categories and hypotheses, offer historical understanding, track change and development, and so on” (p. 182). In order to gain a more comprehensive insight into the types of resources available to the students on their respective campuses, and to understand if the institutions in which they attended implement intentional programming around URM students in STEM and/or supports for ECHS graduates, college archival information of students’ respective campuses was also reviewed. Reviewed data included academic college websites in STEM programs of study, a search for online materials related to student clubs and organizations that support URM students (STEM and at-large), information regarding any faculty-student mentor programs, and other potentially relevant sources as they arise through the interview process.

Data Analysis

Hesse-Biber and Leavy (2011) regard the process of data analysis and data interpretation as going hand in hand, participating in an iterative process that involves moving back and forth between individual interviews, stopping to memo and process each interview for emerging themes before returning back to another interview. Merriam (1998) supports this process of meaning making, “consolidating, reducing, and interpreting what people have said and what the researcher has seen and read” in order to develop patterns among the data (p. 178). This research relied on the convergent and divergent thematic analysis of interviews to search for common
experiences (convergence) among all of the ECHS graduates, as well as potential differences (divergence) that highlighted unique challenges or brought a deeper understanding to the experiences of specific groups of underrepresented students (M. Q. Patton, 2002).

The embedded design of this case study allowed for a thematic analysis to take place within each underrepresented student sub-group, and across all underrepresented students with the STEM ECHS experience in order to determine if sub-themes emerge by race or gender while examining transitional themes from this group as a whole. The use of software in qualitative research is encouraged, and can enhance a researcher’s consistency, speed, and ability to consolidate multiple points of data, but the ultimate responsibility for the data analysis still falls to the researcher (Denzin & Lincoln, 2000). MAXQDA software was used to track and organize interviews, establish an ongoing audit trail, identify codes and themes from participants, store an ongoing collection of archival documents, and assist in the analysis of collected data. After all individual coding takes place, MAXQDA was used to further consolidate and reduce codes through an iterative coding process across sub-cases, noting any major themes as they arose. Member checks were used throughout the coding process to ensure that any interpretations that made meaning of the student voices and experiences were authentic and that any thematic development aligned with their experiences. Self-reported demographic information was used to help build participant profiles in the early stages of interviewing, and member checks were used to confirm or alter those profiles based on participant feedback. Archival data collected throughout this process was added to the coding database, helping to triangulate thematic findings and validate students’ constructed meaning of their interactions with campus resources.
Validity and Reliability

Yin (2002) proposes that case study researchers should seek to “maximize four conditions related to design quality: construct validity, internal validity, external validity, and reliability” (p. 19). These conditions of validation, while most often aligned with quantitative or positivist perspectives, “are common to all social science methods” (Yin, 2002, p. 34), and hold critical value in ensuring that case study research is performed with high levels of rigor. Similarly, Merriam (1998) suggests that in order to establish credibility for the researcher’s interpretation of their data, they must specify to the reader “a depiction in enough detail to show that the author’s conclusion ‘makes sense’” (p. 199).

In order to combat issues of internal validity, member checks were performed for all interviews with ECHS graduates, and triangulated data sources – including interviews, collegiate archival data, and supplemental descriptive data – was used to verify emerging findings. Additionally, a statement of the researcher’s bias and assumptions was presented below (Merriam, 2002). This triangulated data produced a convergence of evidence to support findings that enhance construct validity (Yin, 2014).

External validity from a qualitative perspective is concerned with generalizing results, but not from a sample towards a population, as is the case in quantitative research. Instead, generalization in the qualitative sense examines working hypotheses, concrete universals, and user generalizations (Merriam, 1995). Addressing issues of external validity, this study produced a collection of thick, rich data through interviews with ECHS graduates from underrepresented populations in STEM fields (Merriam, 2002). This study contributed to what is known about the challenges specific to this population, but approached the understanding of these students from a new perspective, that of ECHS graduate. The use of an audit trail with
interview guides, process notes, and data analysis sheets provides future researchers with the data needed to differentiate between this study and their own (Lincoln and Guba, 1985).

Reliability, from a qualitative perspective, is concerned not with the replication of findings in the way that it is from a quantitative approach, but instead addresses the issue of whether the results of a study are consistent with the data collected (Merriam, 2002). Establishing reliability for this research includes developing a case study protocol and maintaining a chain of evidence through the use of an audit trail throughout the research process (Merriam, 2002; Yin, 2014). The iterative process of member checking with students throughout the coding process will also helped to ensure that study results and data collected were congruent.

**Researcher Bias and Assumptions**

In qualitative studies, the researcher is intrinsically intertwined with the research and is often a primary instrument for data collection, determining what to ask, what to observe and what to write down (Creswell, 2013; Merriam, 2002; Mertens, 2015). As Wolcott (2010) points out, “our readers have a right to know about us” (p.36), and this is especially true in this instance where as the researcher, I was fundamentally connected to the participants in this study via my previous professional experiences as an Early College High School Liaison. In that role, I served as the academic advisor for this population, taught a two-course sequence of one-credit orientation courses to all ECHS juniors, and generally helped these students navigate the campus culture during their time in the program. I also had an administrative role in which I worked with colleagues across the university to help establish policies and procedures for this population and advocated for resources when they were needed. Through this experience, I developed a belief that ECHS programs do have a purpose in serving students who may have been marginalized in traditional high school programs.
In a more recent role as an advising administrator, I have continued to see that ECHS graduates that transfer to a four-year institution face unique challenges specific to their situation. At the same time, I recognize that ECHS students have not received the same level of attention in their transition as traditional first-year or transfer students, even though in many ways the profile of an ECHS student has similarities to these other student populations. Lastly, as a first-generation college student, I felt challenged by the shift in expectations when moving from high school to college level academic work, and in hindsight realized that I didn’t always have adequate supports in place at the postsecondary level. While I believe these programs have strong practices that help students to build college going skills, I worried that the high level of support students receive in high school could make their transition to college that much harder, especially for students from non-traditional backgrounds where both on campus and external support may not be enough to help students transition successfully.

**Individual Cases**

This research sought to understand how transitional experiences in the first two years of college attendance are shaped as a result of participating in a STEM based ECHS program for underrepresented students. The ten individual cases that make up the bounded case – the STEM based ECHS program – were all former high school graduates of that program who were actively pursuing a STEM based degree and came from populations traditionally underrepresented in STEM based majors. Using a maximum variation sampling strategy, the individual cases included represented Black and Hispanic males as well as Black, Hispanic, and White females.
Table 3.1

*Individual Case Details for the STEM Based ECHS Bounded Case*

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Institution Type</th>
<th>Current Programs of Study</th>
<th>Race/Ethnicity</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inez</td>
<td>Public, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Biology - Integrative &amp; Physiological Neurobiology; Asian Studies - Japanese</td>
<td>Black</td>
<td>Female</td>
</tr>
<tr>
<td>Ogechi</td>
<td>Private, More Selective, Baccalaureate; HBCU all female</td>
<td>Chemistry</td>
<td>Black</td>
<td>Female</td>
</tr>
<tr>
<td>Jordan</td>
<td>Private, More Selective, Baccalaureate; HBCU all female</td>
<td>Health Sciences</td>
<td>Black</td>
<td>Female</td>
</tr>
<tr>
<td>Jacob</td>
<td>Public, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Computer Science; Minor: Business Administration</td>
<td>Black</td>
<td>Male</td>
</tr>
<tr>
<td>Ken</td>
<td>Public, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Neuroscience</td>
<td>Black/African</td>
<td>Male</td>
</tr>
<tr>
<td>Natalia</td>
<td>Public, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Biochemistry</td>
<td>Latina</td>
<td>Female</td>
</tr>
<tr>
<td>Gabriella</td>
<td>Private, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Biology; Public Health</td>
<td>Peruvian/Hispanic</td>
<td>Female</td>
</tr>
<tr>
<td>Steve</td>
<td>Public, Very High Research Activity, More Selective, Doctoral U.</td>
<td>Aerospace Engineering</td>
<td>Puerto Rican/Hispanic</td>
<td>Male</td>
</tr>
<tr>
<td>Stephanie</td>
<td>Public, High Research Activity, More Selective, Doctoral U.</td>
<td>Mechanical Engineering Technology; Sociology; Minor: Mathematics</td>
<td>White</td>
<td>Female</td>
</tr>
<tr>
<td>Jenna</td>
<td>Private, Selective, Baccalaureate; all female</td>
<td>Computer Science</td>
<td>White</td>
<td>Female</td>
</tr>
</tbody>
</table>
Inez

Inez was in her third year of college and anticipated graduating in another year-and-a-half with a bachelor’s degree in biology and another bachelor’s degree in Asian studies (total 4.5 years in college full-time). She intended to pursue a PhD in neuropsychology or something related and has an interest in research (“not treating people”) while keeping ties with her passion for Japanese culture and language. Inez attended the college affiliated with her ECHS program and decided to live on campus to get the full college experience. Her initial social life, connections to working on campus, and club involvement were all positively impacted by this decision. According to Inez, “when I started living at a dorm on campus, or residence hall, it was just another door opened. Obviously, I had a roommate who wasn't my mom for the first time. I participated in hall counsel, [and I found] my first job on campus that I still kind of work for.” She also felt that the ECHS program facilitated her ability to cut down on the number of courses needed to complete her four-year degree which alleviated some financial concerns. She also felt like the program really made it easy for her to apply to college because of all the additional guidance built into the last year, including identifying additional scholarship opportunities, being made aware of deadlines for Federal Financial Aid (FAFSA), and more. According to Inez, “if you play your cards right and set it up right, a lot of the hassle work is done by the high school so you can focus directly on your studies.” Academically, she was challenged by the transition to harder upper level science courses and asking for assistance from professors or tutoring services. Even though she learned about academic behaviors and how to advocate for resources in the ECHS program, she sometimes had a hard time propelling herself to connect with appropriate resources. She was also sometimes challenged by her status as a full-time student; because of the credits earned in the ECHS program, it was not always clear
what classification (i.e. first-year, sophomore, etc.) she was, and it often involved explaining the
ECHS program to others. In one exchange, she provided the following:

Any time I'm in a class where it's like I did the pre-req's like when I was in high school
and I'm just now getting to take upper level class, some people are like, "Oh what year
are you? When did you take the pre-req for this class?" It's like, "Oh I took it three years
ago." And they're like, "Why are you still here?" It's like, "Well, that's a funny story."

Ogechi

Ogechi had completed her first year of college, majoring in chemistry with plans to
pursue a medical career, and reported plans to graduate in three years. Ogechi’s transitional
experiences, from her orientation through the completion of her first year, were shaped by both
her attendance at an HBCU and her moving out of state for college. She found that the academic
expectations set by her college were harder than her ECHS college courses and she had to adjust
accordingly, stating that “classes are a little bit harder than at most PWIs, [as] they hold you to a
level that's higher and they want you to excel in each and every one of the areas, whether it's in
the science or humanities.” Her social transition was influenced by her attendance at an all-
female college; her institution created sponsored social networks with two other HBCUs in the
area, and those connections informed the social connections that she made. She was also
connected to others through participation in a community service scholarship program and
student government. She felt that her ECHS experiences that most facilitated her successful
transition included taking challenging college level courses that prepared her for her rigorous
courses at her four-year institution. She also credited the ECHS program with building
foundational social skills that she utilized to quickly build a new social network at her new
college, and she indicated that the practical explorative experiences in high school helped her to
find what she wanted to major in earlier than most of her other college peers. Conversely, the credits that she earned at her ECHS caused challenges at her new institution because they were not automatically accepted, and it forced her to alter what she could enroll in for her initial fall semester.

**Jordan**

Jordan, a health sciences major who plans to pursue graduate studies in the field of public health, had completed her first year of college and planned on three more years to reach graduation. Similarly to Ogechi, her attendance at an HBCU informed many of the transitional experiences she had as she enrolled in college and completed her first year. She felt nervous but excited to start college, and found that the actual transition to a large city was blunted by her participation in a scholars program that had her move to campus early and begin engaging with her peers. She also found a social network in the clubs that she joined and through her interactions with the partner HBCUs in the area. Academically, her first semester was challenging, heightened by her enrollment in 18 credits and the distractions of living in a new environment. She also felt that her testing out of certain math courses at her new institution created issues because she moved into upper-level courses but might have benefited from revisiting her earlier math course topics. In linking her transition back to her ECHS program, she felt that the self-advocacy that she learned empowered her to reach out to her faculty and tutoring opportunities earlier. Her advocacy skills also helped her pursue other opportunities:

So with my summer internship I did this summer… I was like, you know what, I'm going to look it up, I'm applying for it. I didn't think I was really going to get because I applied for a lot of stuff and I got it. And so it's really....I knew it was there, I just had to go and apply for it and just take initiative and everything.
She felt that her biggest challenge resulting from attendance at the ECHS was that she was not as strong in humanities related coursework and didn’t get an opportunity to explore humanities or other non-STEM electives in high school. The preparation of what it would be like to identify as a minority in STEM was also limited.

**Jacob**

Jacob had just completed his second year of college as a full time student, and has two more years until he reaches graduation, majoring in computer science with a minor in business administration. He was also considering adding a second minor in non-profit studies and felt that he could fit it in because of all the additional credits he earned while in high school. He felt that his transitional experiences were primarily positive, stating “It felt like I was just continuing my fifth year of high school. Pretty much all I did was take college classes anyway [in my last year], so it's like I just added more classes to it. So academically, it was pretty easy.” From a college credit perspective, he also benefited from attending the same four-year institution where the ECHS program is located, so all of his credits earned in the ECHS program have counted towards his bachelor’s degree. He found that once he started at his institution full time and went into upper level courses, he leaned heavily on the academic skills that he learned from his time at the ECHS program, including the ability to manage his time and expectations of college level courses, and advocating for resources early when he needed them. He also felt that his social transition wasn’t difficult, though it was clear that it was a different experience from high school because he wasn’t used to the on-campus life that required more effort to be social, build new relationships, and join clubs. In fact, while he did not see this experience as being a hinderance of attending the ECHS program, he did think that the small high school can create a false sense of security related to building community because it happens early on in high school and is then
relatively set throughout the program, whereas college community and relationships can fluctuate and are driven much more by individual choices.

Ken

Ken pursued a degree in neuroscience with a minor in digital media and had been at his four-year institution for two years. He predicted being there for another two years to complete his bachelors and was planning to add a third year to complete a bachelor’s to master’s degree program in epidemiology. His identity as an African Black male was inseparable from his professional aspirations as he sought to work for the World Health Organization in their African offices in areas of virology, epidemiology, and microbiology. Generally, Ken had a positive transition to his new institution, felt very academically prepared, and was able to navigate the new large institution he attended to find his community. He credits the ECHS program’s ability to teach and reinforce the soft skills required for college and views them as importantly as the content knowledge he had. This student felt that he came to the table with skills in communication, public speaking, presenting, self-advocacy, being in a classroom setting, and more that were head and shoulders above his classmates, to the point where he was considered the “expert” in these areas by peers. In contrast, Ken felt most hindered by attending the ECHS program when it came to navigating the bureaucracy of the transfer credit evaluation process at his out-of-state institution. Because his institution initially only accepted a few of his transfer courses, he was initially enrolled in courses for which he should have already received credit, including challenging STEM based courses. When he contested this and asked to have his institution re-evaluate his credits, it required traversing a convoluted process:

So I went to the departments. They sent me to the transfer credits department and then they sent me back to the [academic] departments, or I had to go to the heads and get them
to evaluate the course that basically consisted of bringing them the syllabus and example course material and the course websites, and I had to wait on them to do that. Then take it back to the transfer department and rather than putting [the courses] in as course equivalencies, they just wrote them as overrides, so I didn't actually get credit for taking the class. I was just allowed to take the next class, which meant that every time I wanted to take the next class above that, I had to go back and get an override. Because even though I took Chemistry II, Chemistry I is still a prereq for the other class.

The silver lining of this experience is that he credits the ECHS program with teaching him the advocacy skills required to push through this process.

**Natalia**

Natalia pursued a degree in biochemistry and had professional aspirations to pursue medical school and become a surgeon. She had just completed her first year of full-time studies and predicted finishing in another two years, though that was dependent on the pace of her studies as she ramped up the amount of STEM coursework she was taking. Her transition was more jolting than she had anticipated:

I came in with the mindset thinking that it wasn't going to be anything new considering that in early college, I was taking college classes on campus…So I went in with that mindset and honestly that was the wrong mindset to have. Because the transition was actually a little bit rough, it was different. And one thing that early college doesn't really tell you is that every college is different. Every environment is different, obviously, but it's more than just the environment. It's just like an altogether transition academically, environmentally everything. And so, on the academic front, you get exposed to it by early
college, like you get exposed to how to study in college coursework, but it's not necessarily the same.

These challenges were most obvious to her when she considered the different rigor of STEM based courses and that she had to take multiple challenging STEM courses in the same semester to stay on track for graduation at her new institution. She felt that this impacted the amount of free time she had to participate on campus in other ways, and when combined with living at home and commuting to classes, she stated that she “had to put in a lot of efforts” to make social connections and get involved on campus compared to traditional first-year students. She also felt that some of her challenges in making social connections was the result of being in a small ECHS program where “everybody knows everybody.” She has found that the ECHS program most prepared her for her transition by allowing her to truly explore a variety of majors before getting to college. Compared to her peers, she felt confident in the direction of her major and did not feel like she was wasting time taking courses that she did not need. She also expressed that the ECHS helped her understand college processes and resources and she has not felt intimidated to communicate with faculty as needed.

**Gabriella**

Gabriella completed her first year of college pursing degrees in biology and public health, and she expected to take three more years to graduate. She was confident that she wanted to pursue medicine and was using the college opportunities that she was engaged in to further explore the type of medicine she wanted and eliminate options that she felt were not for her. She attended college out-of-state and her initial transition was defined by her feelings of social isolation and an adjustment to a new academic rigor, though she ultimately acclimated as she went into her spring semester. Her first semester challenges are not unlike other traditional first-
year students that attend college far away from home. She felt homesick and socially isolated, did not know what to do with new-found freedom, became overinvolved in extracurricular clubs as she explored her interests, and found that her overinvolvement created time management issues that impacted her academic life. Her social isolation phased out as she began to identify more closely with her Hispanic culture and its connection to her family. Her cultural identity grew in college as she built connections with other Hispanic students and became involved in organizations that promoted Hispanic culture. She began to own her Hispanic identity in a way that she had not done in high school, though she still felt like her Hispanic identity played a less important role in her academic life or her pursuit of a STEM based major. Gabriella felt like the ECHS program prepared her to have the college knowledge to be successful, knowing when and how to ask for help from faculty, identifying key mentors who could provide advice and additional opportunities, and not being intimidated by large class sizes or speaking in public. She especially felt that the ECHS program taught her to work with other people who are different from her:

Not everyone anywhere is going to be of the same culture as you, so just what they really prepared me for is that you're going to have to work with people that are completely different than you. Not only in race or ethnicity or in gender but everything. Like the way people work. The introverted, extroverted I felt is a huge determinant in how you can work with someone else… They really helped me understand that you're going to find different people, which I think a lot of my friends don't get. They still get frustrated with people who are different than them, not because they're different, because they don't understand it… They helped me see that people are different and how to work with them because you have to deal with different people differently. People work differently.
Steve

Steve had been a full-time college student for one year, majoring in aerospace engineering, and anticipated graduating in two or three years depending on his coursework or if he decides to add a second major. He was also considering pursuing a doctorate in computational fluid dynamics but was not committed to this post-graduation pathway at that time. He attributed his faster acceleration to graduation in part on the fact that he attended the same college that hosts the ECHS program and had a fluid credit transfer experience. Overall, he was not anxious about attending college and felt that the ECHS program made his initial academic transition feel seamless, noting that it did not feel that different from his later years of high school. He also observed that moving on campus from his parent’s house also removed some of the high stress that they placed on him to do well academically when he was in high school. Steve found that participation in the ECHS program made his social transitions more challenging because he missed out on the opportunity to build comradery with other first-years in the same way that engineering students typically do as they take first level engineering courses together and join engineering clubs. As he has moved into upper level engineering courses, he did find that the combination of a more advanced rigor and the pressure to succeed began to impact his mental health, but he was able to recognize that success is more than a measurement of grades:

I had to take a step back during finals week and be like, you know what, I'm going to study a little less, get a lower grade, but I'm not going to go insane. This semester, man, I got Bs. It was the first semester where I didn't get an A. It was just because I couldn't do it anymore. I was just so stressed out…It’s because people idolize staying up, [pulling] all-nighters; they idolize people taking drugs to do better and stuff like that. It's kind of
the culture of engineering school. I just don't think it's worth it, personally. If I get B’s, I get a B. I'm not going to kill myself over it.

**Stephanie**

Stephanie had been at her institution for one year, studying mechanical engineering technology and sociology, with an additional minor in mathematics. She anticipated having three more years of study to reach graduation. She has long had a passion for robotics and “space stuff” (i.e. NASA, cyber security, etc.) and while she’s still working out what that might look like professionally once she graduates, she hoped to combine these interests with her passion for understanding how people make social decisions. She also has a pay-it-forward mentality that is rooted in her passion for equality and fairness:

But, with the change I want to spark people's interest in it…I remember in third grade I went and saw a rocket launch in Florida. And that's what really made me like ... this is really cool...So there's always a chance to do that and with big engineering happenings there's always gonna be that little kid that's like oh my god, this is so cool. Which is really important to me because I want to get more people involved in it and I want to make ... I want to help people have their "Oh my gosh, this is what I want to do with my life" moments.

Stephanie was ready to leave the ECHS program after four years, choosing not to stay a fifth year for additional college credits. She did not experience the same sense of community that other students had in the ECHS, and while she developed a close circle of friends, for the most part she saw the small environment as having too much drama that facilitated judgment from others. She summarized her social progression at the high school, saying “I don't think it really hindered me because I kind of went through the like, ‘Oh my gosh I care about this!’” And
suddenly, ‘Oh my gosh I hate these people.’ To like, ‘I really don't care about anyone here.’

Academically, she wished that she would have been able to take more specific engineering
courses, but was restricted while at the ECHS as to what she could enroll in. She had also
experienced challenges around her transfer course equivalencies once she got to her new
institution and has had to retake a few courses for which she felt confident she knew the material
already. All in all, she came to the realization that while the ECHS did not hinder her transition,
she could have had a similar experience earning credits at a traditional high school through a
combination of dual-enrollment and AP/IB coursework without the restrictive social
environment.

**Jenna**

Jenna was completing her first year of study in computer science at an all-female college
and expected to have about three semesters of college remaining. Her transition to her new
institution was difficult in her first year, especially from the social aspect. She built strong bonds
with the small cohort of her ECHS peers and found that attending a new institution without her
close friends to be extremely isolating. She also had to adjust to the all-female environment,
which she found simultaneously empowering and challenging given her closest friends in high
school were males, stating “I love it but it's like a sorority.” For Jenna, it was hindering to have
spent five years in a community that provided so many resources and had such a strong support
system, and to feel that she lost it all within the summer between high school graduation and her
first semester. She felt that she ultimately recovered, but it took most of her first year of college
to adjust. Academically, she was strongly prepared by the college level computer science
courses that she took while still in the ECHS program, to the point where she was asked to serve
as a student tutor in her second semester at her new college. The computer science department at
her new institution was a very different experience with much smaller class sizes, and of course, all female students. She was able to discover that while she had to work hard to be successful in her major courses, what kept her passionate about staying the course were extracurricular experiences that led her to want to teach school-aged girls to code.

**Findings**

The cross-case analysis yielded four major themes in the data that represent the major findings of this research:

a) Despite tradeoffs, students attribute transitional success to ECHS program;

b) Attending college at the ECHS host institution provided additional benefits;

c) URM experiences varied, but ECHS could benefit from enhanced diversity focus; and,

d) Small social environment may hinder transitional timeframe and social integration.

Additionally, these findings support the general timeline that students experience in their transition, as represented in the conceptual framework: college readiness, transition, and integration. However, as is highlighted in the following section, these students’ academic integration was generally expedited as a function of attending the ECHS program, while their social integration was generally delayed as a function of attending the ECHS program.

Furthermore, the transition for those that stayed at the home institution carried over from their high school experience, resulting in transitions that were smoother, with students that became acclimated faster and had a feeling of mostly having one transitional experience. Students that attended institutions elsewhere seemed to have experienced the same initial transition that took place in high school that their host-institution peers experienced, but then faced a second transition that was much more varied when they arrived at their new institution. For a couple of
these students, the second transition was emotionally taxing and the entire transition to college more drawn out.

**Despite Tradeoffs, Students Attribute Transitional Success to ECHS Program**

Attending the ECHS program meant accepting certain tradeoffs in the experiences these students would have compared to their traditional high school peers. For example, there was no social culture built around attending high school sporting events (including no homecoming), and high school clubs were more limited (and the clubs that did exist required a higher level of student involvement to keep them running). One of the biggest qualms voiced by the students was that they were limited in both the extracurricular activities they could participate in and the additional course options (both in elective and advanced science course options) they could choose from. They felt that while their host institution had many clubs and organizations that could have filled this gap, they were generally not able to participate in college level clubs without clearing additional administrative hurdles. These students understood that they were in a unique high school and made certain concessions when attending the ECHS program, but they did not realize the tangible tradeoffs until they were in college with their peers who attended traditional high school programs. In hindsight, there was an overwhelming feeling that the tradeoffs were worth it.

Overall, students reported that they felt prepared for college in a variety of ways that they attributed directly to the ECHS program, ranging from college knowledge experiences such as where to go for resources and understanding the role of their faculty and other instructors, to college success skills such as understanding expectations for public speaking and presentations, working in groups with other people and managing group expectations, and identifying extracurricular involvement opportunities that enhanced their programs of study. These students
recognized that a big part of the success in transitioning from high school to college was because of the systematic way that their transition is scaffolded for them. As Inez pointed out, “It's very not handheld in a pejorative way, but it's very step by step, like here's how we're going to guide you into it.” It is not the case that these students faced no academic difficulty at their new institutions, but they were more inclined to recognize what difficulty looked like in their own mind and identify appropriate resources to help mitigate their challenges. Not unlike traditional college students of all backgrounds, this process sometimes took a semester or longer for the students to move from identifying their academic challenge to taking appropriate action. In alignment with the theoretical framework proposed above, the students’ college readiness skills gained through the ECHS program seemed to advance their transitional experience and provide for a smoother flow into a four-year program.

The students also observed that compared to their peers, they had done much more career and major exploration and felt confident in the academic direction they were headed by the time they reached their new institution. They observed that this was in part due to the ECHS’s focus on career development where each student was required to participate in job shadowing, take a sequence of major and career exploration courses, and participate in an internship during their last year of high school. Many of these students continued to practice these actions at their new institutions and found ways to enhance their extracurricular experiences that supplemented their majors. In one example, Steve applied to 15 different internships in order to make sure he had a summer experience that he knew would help him in his pursuit of aerospace engineering. When asked how he identified which internships to apply for, he said he did his research on his own to find the right opportunities. It turned out that applying for that many internships was a good decision on his part:
I applied for like 15 internships this summer, and got denied from all of them except for the one from NASA. Even then, it was because I was the second in line for this, and actually met the girl that had the position before me but she declined it. Just a funny thing, but I applied through NASA, and I just got it, I guess.

This hidden curriculum of negotiation and processing skills that ECHS students developed was started early in their program experience, reinforced throughout their time in high school, but was not fully evident to the students until they had transitioned to their new institution and interacted with peers from traditional high schools. Once they had entered college full time, it became readily apparent to them that they had a wealth of secondary knowledge that their traditional high school peers lacked. These students became the “experts” among their peers, sharing what they knew about navigating campus, finding resources, presenting and speaking effectively, and otherwise being successful in college. One key finding of this research was that the legacy of this ECHS program extended beyond the walls of the school and continues to live through the ongoing success, not only of the students that participated, but of other non-ECHS students that benefit from this shared knowledge. This type of hidden curriculum, along with major and career exploration, were not explicitly covered in the theoretical framework, but should be considered as components to add in future research.

ECHS programs across the nation, including this one, tout that students can earn upwards of 60 college credits that can help them to graduate from their four-year degree in as little as two years, the experiences of these students were much more varied. Some students did emphasize that the credits helped them to graduate early (though none of these students did so in two years), but more often, students saw the earned credits as opportunities to expand the types of academic experiences they could pursue in college, including adding second majors and/or minors to their
primary program of study, or taking time to pursue additional internship opportunities. In Inez’s case for example, she was only graduating one semester early, but recognized that the free credits on the front end allowed her to double major in two unrelated fields and still finish in the equivalent of 3.5 years of college. She suspected that she would have needed to stay the equivalent of five years if not for the many college courses from high school. The notion that as long as they were graduating in four years, students had more flexibility to enhance their academic options was not uncommon.

**Attending College at the ECHS Host Institution Provided Additional Benefits**

The students that remained at the host institution in which the ECHS program is located benefited in ways that were inherently different than those who pursued degrees at other institutions, regardless of if those other colleges were in-state or out-of-state, public or private. The most obvious way in which these students benefited was the direct acceptance of all college credits taken while still in the ECHS program without the need for negotiating with an admissions department or registrar’s office. This was not always the case for students that attended other institutions; these students found that their new institution dealt with college credit in different ways, whether it was accepting fewer total credits, or accepting the credits but not applying them towards their program of study. In a few of the students’ cases, they were only able to transfer approximately one semester’s worth of credit to their new institution, even though they had earned many more credits during their time at the ECHS. Gabriella pointed out that compared to her peers that brought in AP test credits, she lost out on bringing in as many hours as they did:

> My credits didn’t help me. All my friends who came in with AP credits they’re the ones that benefited…Oh my goodness, because one of my good friends transferred in like 25.
He doesn't have to take physics, biology, math. Like he doesn't take anything. He's already in the ... like he took [organic chemistry] this semester. He's thriving because he has to take nothing. He can graduate a year early because he transferred in so many, but with the early college, it didn't work out.

For those that attend other institutions, they also found that what they took while they were in the ECHS program was not guaranteed to align with their curriculum at their new institution. Natalia pointed out once she was at college, that she found herself “taking some really weird courses or courses that you wouldn't think that you would take normally, [having] to fill out your Gen Eds because, like previously in early college, like you weren't really focused on filling out your Gen Eds.” She also indicated that while she was able to transfer her credits from the ECHS program to her new institution, they came in primarily as elective credit stating, “so honestly, I have credits, like I came in with credits because of the early college, but those don't count for much other than just credits…towards graduation”

Students that stayed at the host institution also tended to report that their academic transition was smoother than those that left, likely because they had already adjusted to the specific rigor of the home institution (i.e. a second academic adjustment wasn’t necessary). Conversely, some of the students that attended other institutions reported a second academic transition (the first taking place in the college courses taken at the ECHS) wherein they had to recalibrate academic expectations or behaviors based on the initial experiences that took place in their first semester at their new institution. This aligned with the theoretical framework in that students who attend a second institution sometimes circled back through another cycle of transition and integration as they reacclimated, but for students who remained at the host institution, their timeline of transition and integration was more linear.
URM Experiences Varied, but ECHS Could Benefit from Enhanced Diversity Focus

Students generally had a variety of experiences as underrepresented minorities in their fields of study, some of which were clustered more around identity, while others felt that their identity either did not or should not impact their pursuit of STEM. For example, when asked how Steve thinks about both his cultural identity as a Puerto Rican student and a student underrepresented in STEM, he waived off the question:

I don't really think about it. I'm just a guy in college. The only time I think about it is when people ask me about it. I got signed up for a minority engineering program against my will, I just never answered the emails or anything….I just feel like it's weird because they treat it like we need special help, but we're just as smart. It's not like we're special. Alternatively, Gabriella came to more fully embrace her Peruvian heritage, joining the Latin dance team and finding a shared cultural identity with other Hispanic students from Central and South America:

When I went to college I found I got a lot closer to my culture than I am [at home]. Over there I'm like 100% Hispanic. Everything I do is Hispanic. I'm always talking in Spanish. I just feel more Hispanic if that makes sense. And my whole friend group I think most of us are Hispanic.

She thinks of these friends as more like family and they even remind her of her family back home. She has brought some of this identity back home with her on breaks, and can share that experience with her parents, but she still did some code switching when she was home around her old friends.

One of the more common observations of the female students was that it seemed more women in their STEM courses had trajectories towards the health sciences such as biology and
chemistry, as opposed to engineering, computer science, or physical sciences. Stephanie noted that she was one of only two females in her upper level computer science courses, stating

Pretty much all of my mechanical engineering and technology classes I know I'm gonna be the only girl in because there's only one section. There's only one section in the classes I took last year unless there was magically in comes another sophomore junior, there's not gonna be another girl.

Although Jenna attended an all-female college, she noted that her computer science courses were her smallest courses. The dominant narrative that computer science was a male field and the isolation that causes was also a hurdle she faced outside of the classroom, noting:

When I go to hackathons or when I talk to my guy friends who are all engineers, I think, yeah they actually are all engineers, it's normally when we talk about school they always belittle me. I'm like, I'm taking the same classes as you are. They're still hard and they think that because it's an all-girls school, they're easier on us. It's not. I keep telling them that it's the same course load as [their college] and they don't believe it.

Inez felt like she had imposter syndrome at times and drew parallels between that feeling and being in certain STEM courses where she was a minority as both a female and an African American student:

I remember specifically in my physics two class, it must be a classroom of 150 people, I swear I only saw two other African American students, and I think both of them were male. It was just kind of like moments like that where it's like I don't think I realized it until a couple of weeks into the semester, I just looked around and I'm like oh okay that's how it is. Sometimes, just simple things like the ratio of what kind of people are in each of the lecture classes, which undoubtedly it's usually always definitely majority
Caucasian and then you have other racial ethnicities being represented. Sometimes that makes it feel more like I don't have people to relate to. That's not saying I can't relate to someone of a different ethnicity from me, but it's just like, I don't know how to describe it. I guess it's like imposter syndrome like I shouldn't be here type of thing.

She also drew the conclusion that there were more females in her anatomy course than in her physics courses, which aligned with larger trends of gender enrollment by STEM concentration.

These students recognized that a part of their identity was historically underrepresented in the STEM field, and they generally recognized their high school population as feeling more diverse than that of the general population of the host-institution, but some of the students felt that in hindsight, the ECHS program could have been more overt in discussions of diversity generally and diversity in STEM more specifically. For example, Jenna noted:

I didn't know it was an actual problem until the first day, but I saw all the guys. But that in and of itself, that was never even referred to. In all my years, I never heard “there's a lot of guys in this classroom because of this. We want to get more girls.”…That's something they could have addressed, just telling us that we are underrepresented. I didn't even know Latinos and all of them were underrepresented too. They could have also mentioned that because there were quite a few in our class too… Freshman year nobody sat us down and said, we want you guys to be engineers, because you're underrepresented, we want you guys to go farther because of that. But there was never that connection and I don't think there is that now either.

While serving a diverse population, students felt that the ECHS program still operated like a meritocracy, and as such, they did not facilitate conversations around diversity and inclusion that would have been helpful for them to explore. This point was especially salient for the two black
women that transitioned from the PWI that hosted their ECHS program to the HBCU where they were completing their bachelor’s degree. These students felt that the culture of the HBCU was one in which they were being prepared not only academically, but also socially and practically for a world in which they would need to navigate as a black female. Ogechi speaks to this cultural difference, stating:

I think overall my experience at an HBCU versus a PWI has been ultimately like...not worrying about race or worrying about like male and female competition, and although there is that female competition, I think it is kind of like uplifting one another as well as competition within each other, and then not having to worry about race as often as I did at a PWI or making sure like, I wasn't discredited because of what I looked like or the opportunities that I was missing out of, because all the opportunities are offered to each and every student no matter where you're from, what you look like or what you're doing. So I think in that transition from a PWI to an HBCU has been like, it's been from nonsupport to kind of support.

Jordan seconded that sentiment, pointing out that even though she’s on an all-female campus, her HBCU is intentional about partnering with other nearby HBCUs to provide exposure to a wide variety of scholars from different backgrounds:

The second semester, we had a...I don't think it was biochemist, but she came and she talked to us about how she went to Antarctica and how like she wears [our college’s] gear and how being at [my HBCU] prepared for that, that she can do this because she was around male counterparts of all types and races, so going to all female school and then to go into environment with just men, it's like, you know what, when I was back at [my
HBCU], I knew I could do this, I could still do this now. And so we do talk about being an empowered woman, not just African American but an empowered female as well.

**Small Social Environment May Hinder Transitional Timeframe and Social Integration**

While students expressed many ways in which they felt more academically prepared than their non-ECHS peers, they experienced a wider range of social transitions that were not all positive, and that in some cases were unexpected. As Steve pointed out:

The friend group coming with [me] wasn't actually that big. I think only what, four, five people made it to [my college from STEM]. Something like that. Maybe more. I think it was four or five. But anyway, it wasn't that big, so I had to meet new people. I do ... I'd been with the same people for five years, so my social skills weren't super developed for meeting people and then sticking with ... I can talk to people fine, it's just I couldn't stick with them, like make solid friendships, which I did eventually. But at first I just talked to people but I never tried to follow up.

He also expressed challenges that came with being both a first-year, full-time student but having the credits of a college junior. For example, living in upper-class housing made socializing difficult:

Yeah, it's an upper-class dorm, which is also interesting, because there's no ... No one ...

There's no socializing in the halls because they know people, so if they want to hang out with people, they'll invite people they know to come over. But there's no ... I have no idea who lives near me in that place because no one talks to each other.

Natalia also found difficulty socially integrating at her new campus, and because she lived off campus, her experience felt more like that of a transfer student at a new college than a first-year:
Going to college. I honestly struggled a little bit socially, it's like you're being thrown into a whole entire new social environment with different social dynamics. And like of course you know that it's going to be different than high school, especially coming from early college where like everybody knows everybody, it's just really weird being thrown onto a huge campus and you know nobody.

More than half of the students interviewed expressed themes of social adjustment including homesickness, having to navigate new social structures, and feeling like they did not fit in with either first-year students or upper-class students. While most new college students experience the transitions that come with moving to a new location and having to build new relationships, some of these students were caught off guard with how unprepared they were for these experiences, especially given how much the ECHS program focused on preparing them for college in a holistic way. The social training that these students felt they needed was not captured in the definition of college readiness put forth by Conley (2008); this social component of readiness is something for future researchers to consider.

**Document Analysis**

In addition to these findings, a document analysis of college websites for STEM programs of study, online materials related to student clubs and organizations at students’ institution, and information regarding faculty-student or other mentor programs demonstrated that while minority serving programming existed, much of it required students to proactively seek it out. This was congruent with the experiences of the students interviewed; they were generally aware of such programming, but it did not serve as a defining part of their own college experiences.
In performing the document analysis, there were no programs developed specifically to support ECHS student populations, and programs for underrepresented students were broadly institutional wide programming or programming that took place via student sponsored and led groups. All of the colleges represented had minority serving student organizations at the institutional level, including historically black fraternities and sororities, Latino Greek letter organizations, and clubs such as Black Student Union and African Student Association. STEM focused student run organizations were also present and included Women in Science and Engineering, Minority Association of Pre-Medical Students, and the National Society of Black Engineers, among others. Departmental level minority serving programs were harder to find, as their resources appeared to be dedicated more toward the academic support of all students. A search of minority mentorship programs at these institutions most often highlighted student to student mentoring opportunities that emphasized academic skill development in STEM subjects. For example, one institution had a student chemistry mentor program, but emphasis was around chemistry support and not aspects of student identity. Intentional searches online for faculty led mentorship programs at these institutions netted results related to faculty and graduate student mentorships, or faculty guidelines for establishing student mentorships, but the search showed little in the way of faculty-undergraduate mentorship programs. One exception was a women and minority engineering program at one of the institutions that had a mission to “develop and maintain programs that assist in the recruitment, retention, mentoring, job placement and graduation of top quality, underrepresented (Women, African American, Native American and Hispanic) students” in that academic college.
Discussion and Implications

The findings within and across these cases could have practical implications for how many ECHS programs are administered, including those with a STEM based curriculum, and considerations for the way in which their resources are used. Additionally, this case study could provide insights for educational policymakers that consider issues such as creating and amending policies around the operation of small public schools of choice or statewide policies related to transfer course equivalencies between state institutions. Understanding the long-term value of ECHS operations over other types of early college credit earning programs such as AP or IB is also important.

Administration of ECHS Programming

The findings from this study inform future considerations for those who have administrative responsibilities over ECHS programs, and many of these suggestions are relevant regardless of whether the program is aligned with a STEM curriculum or not. One challenge that students identified was that the promotional information they receive in middle school did not necessarily align with their lived ECHS experience. An example of this experience was that students did not understand the implications and realities of the college credit transfer process beyond the host institution – especially when students ended up attending private or out-of-state colleges. Students and their families were also unaware that there were no guarantees of transferability or that some institutions limited the amount of transfer credits a student could transfer in from another institution. In Gabriella’s case for example, she could only transfer in 12 credit hours from her ECHS experience because her new institution limited credit intake, even while her peers brought in many more college equivalent courses through means such as Advanced Placement (AP) or International Baccalaureate (IB):
My credits didn't help me. All my friends who came in with AP credits they're the ones that benefited… One of my good friends transferred in like 25. He doesn't have to take physics, biology, math. Like he doesn't take anything. He's already in the ... Like he took orgo this semester. He's thriving because he has to take nothing. He can graduate a year early because he transferred in so many but with college it didn't work out.

In reviewing the STEM ECHS program’s website, credit transferability is only addressed very briefly, informing students that accepting credits is up to the student’s new institution, but it does not provide guidance on a process to talk in more detail with staff, outline how to get in touch with new institutions, or offer insights on examples of credit equivalencies. Enhancing the information that is publicly available to students and their families prior to enrollment could help here. Another step that could be taken is to enhance training for the ECHS Liaison and guidance counselor roles to increase awareness of credit transferability to external institutions of interest to their students. Being able to help the students understand if the classes they enroll in will transfer, how they will transfer (i.e. as equivalents or only general elective credit), limitations to the transfer process, and other expectations students should have about these processes can better align expectations to reality. It might be that a student still decides that these credit transfer limitations are worth attending an institution with strict policies, but they will be making that decision with appropriate information.

Another potential area of improved support from the high school administration centers around increasing financial literacy as a part of college readiness. Even when students take full advantage of the ECHS program and earn upwards of 60 college credits and attends an institution that accepts all of these credits, it is still incredibly rare that a student and their families do not incur additional financial expenses as they complete their bachelor’s degree.
These students need more than basic financial training to understand the complexities of college financing and the many auxiliary services (e.g. financial aid, registrar, bursar or cashier) that they might have to navigate as a full-time college student. During a time when inflation adjusted costs to attend college have increased 213% between 1987 and 2017, students need to understand personal financing, budgeting, effective strategies for saving and more (Ma, Baum, Pender, & Welch, 2017).

ECHS administration should also help students establish the skills needed to navigate the social and community building challenges that come with attending college full time. There is room to enhance how the students interact with the university setting while still in ECHS. These students felt like they are in an “ECHS bubble” when they are still in high school, and although they are on a college campus, they missed out on some of the social aspects that could have helped them better transition. Working with university administrators to find ways for the ECHS students to engage in meaningful social interactions could help students smooth this part of their transition. Examples could include identifying appropriate clubs and organizations in which ECHS students could actively participate, or finding other social experiences that help ECHS students reduce the stigma they associate with current college students. As Jacob put it, “I was taking the classes, but I missed the key component of being in a social environment with [college] students.”

Beyond helping these students better navigate their social transition to college, additional support and training regarding identity, diversity, and experiencing STEM as an underrepresented student could provide additional tools and resources to these students empower them to find success in STEM based majors and careers. This is especially important as the students leave what they have perceived to be a relatively safe community space and enter the
larger college population where they must be more reliant on their own coping skills to mitigate negative experiences they may encounter because of their identity.

Policy

From a policy perspective, this study gives insights into the challenges that some students faced when trying to transfer their college credits from the state institution associated with the ECHS program to other in-state institutions. Similar to existing articulation agreements in place for the state community college system that guarantees credit transferability to the state’s four-year institutions, policymakers might consider if there is value in creating a similar process for streamlining credit acceptance between the four-year university system institutions (even if only for common general education level courses). As ECHS programs continue to grow nationally, this type of policy consideration could also make college granting credit more equitable across different high school types, regardless of how that credit was earned (i.e. AP or IB test credits, dual enrollment type programs at traditional high schools, or ECHS and other types of innovative high school initiatives). While this does not address similar challenges with transferring credit to private or out-of-state institutions, it would provide relief to those students who choose to stay in state and attend public institutions. It could also have the benefit of incentivizing these students to remain in state at least through college graduation, increasing the recuperation of tax dollars at the state level for the initial higher cost of operating ECHS programs.

Future Research

Areas of future qualitative research include continuing to follow this cohort as they graduate from college with their bachelor’s degree and either pursue post-graduate education or entry level careers. Similar to understanding their experiences as underrepresented students in STEM majors, understanding how these young adults pursue professional education, search for
STEM employment and enter the STEM workforce may provide additional insights at the other end of the minority STEM pipeline. Additionally, learning what types of professional support underrepresented minorities find as they pursue work could help ECHS programming that targets similar populations build those supports in earlier when possible. It would also be good to understand how perceptions of their minority identity change as they advance in their careers.

Further consideration should also be given to the quantitative understanding the costs and financial trade-offs of operating ECHS programs that cost more per pupil to run. While an argument could certainly be made that these schools provide additional opportunities for underrepresented students, policymakers need to measure this public good longitudinally, looking at items such as bachelor’s degree attainment, time and money spent in college, and placement in STEM careers. Understanding how these students fare against other high performing students that participate in AP or IB programs is also worth analyzing.
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CONCLUSION

These three chapters, taken together, provide the historical context of early operational policies and practices that propelled the ECHS movement to its present form, and provides insights into students’ collegiate and career decision-making experiences that were shaped by their participation in one STEM based ECHS program. The study of career and major decision-making for non-STEM students in a STEM based ECHS program provides literature in an area where none currently exists. The study of STEM based ECHS students underrepresented in STEM and persisting in STEM based majors through their collegiate careers expands the conversation around underrepresented students in the STEM pipeline to include ECHS programs. While the past decade has produced some quantitative and longitudinal studies of ECHS programs and their impact on college enrollment and completion, there is no known literature that takes a qualitative approach to understanding students’ experiences from the perspective of high school graduates actively completing bachelor’s degrees. The findings of these studies showed that while students mostly felt that their ECHS experience was positive, important to their major and career deciding processes, and provided college ready skills they might not otherwise have, there are still policy and practical considerations that could continue to improve the impact that STEM based ECHS programs have in preparing students for life beyond high school.

Policy

Policy considerations based on the narrative and case study research include revamping common articulation agreements between four-year public institutions within states in which ECHS programs operate on four-year campuses. Strong policies that protect transfer credits for ECHS graduates who choose to attend another state institution besides the one associated with
their ECHS program protects these students in a couple of ways. For one, it would ensure that the credits students work hard to earn are given the same weight as other common high school methods for bringing in college level credit, such as AP or IB tests, especially as these students earn their college credits in actual college courses. Second, it would help protect the student financially, matching the spirit of ECHS program missions of giving students a head start on free college credit while reducing the remaining time required to obtain their bachelor’s degree. Financially, an articulation agreement with the state university system and ECHS programs at four-year institutions could incentivize students to remain at state institutions for the duration of their degree, which might retain these students in state as they enter the workforce and contribute to the state tax base.

Policymakers could also consider the development of STEAM based ECHS programs that incorporate the liberal arts into the curriculum and provide for a more well-rounded educational experience (Yakman, 2010). This also has the benefit of exposing students to both STEM and non-STEM components of education, which helps them to make more informed major and career decisions while better preparing them for the workforce (Prinsley & Baranyai, 2015; Stewart, Wall, & Marciniec, 2016). Lastly, while it was outside of the scope of these studies, it is clear that there are financial implications for policymakers to consider about running ECHS programs and if their increased cost per pupil nets long-term value. A longitudinal study that explores the long-term financial earnings of former ECHS students in the workforce compared to a matched cohort of peers could help policymakers learn if they recover the higher initial cost of education down the road via an increased tax base. The study of underrepresented students in STEM found that students shared the college knowledge they gained in the program with their non-ECHS peers at college, but a better, more direct way to impact non-ECHS
students would be to consider how to scale what works about the college readiness component of the program to the traditional high school curriculum. This should be explored at the state department of education level.

**Practice and Administration**

From an administrative perspective, these studies provide insight on how to better support students that participate in ECHS programs, especially those focused on STEM based education. Program administrators should seek to provide resources to students and their families early as it relates to enrolling in a STEM based ECHS and the impact it might have on limiting exposure to the arts, humanities, and social sciences. Regardless of a student’s career and academic interests as they apply for ECHS programs in eighth grade, the reality is that most students are still learning about who they are and the world around them. Because of this, those who operate STEM specific ECHS programs should consider the supplemental resources – networking, job shadowing and internships, extracurricular activities – that they have available to students whose aspirations have pivoted away from STEM toward other areas of interest.

Of particular concern is an increased partnership between the higher education institution and the ECHS program that increases the extracurricular activities available to these students. If the goal is to prepare ECHS students for college, providing earlier opportunities for them to engage with traditional college students and participate in the wide array of clubs and organizations could make up for the lack of traditional high school extracurricular activities. As the focus of ECHS programming tends to be around academic preparedness and skills, administrators at the high school and college level must work congruently and advocate harder for students to have these important social experiences. Additionally, if the college and university partners affiliated with ECHS programs are to be considered true partners in the
relationship, they have an obligation to best understand how to best serve these students when they are in the program and beyond. This includes considerations for the types of resources needed for this student population and creating mandates that these students are not served last among the undergraduate student body when it comes to course enrollment and resources. As the operation of ECHS programs continue to expand, higher education institutions that accept former ECHS graduates into degree seeking programs need to consider how they serve these students as a unique population not unlike transfer students, first-generation students, or other targeted student populations that receive additional supports.

For ECHS participants of any curriculum, enhancing resources around financial literacy and understanding the logistics of credit transferability to other institutions, especially those that are private or out-of-state, could help students to make more informed decisions as they apply to college and decide where to attend. This is especially important when ECHS programs are advertised as opportunities to save upwards of two years of college tuition, but the lived experience of these students demonstrated that they often planned to stay longer because of issues around credit transferability or curricular requirements that they were unaware of while still in high school.

**Future Research**

Limited longitudinal data is currently available that helps policymakers understand the long-term benefits of ECHS programming as it relates to the original outcomes. For example, it is still unknown if ECHS programs produce college graduates at higher rates than similar students in traditional high school programming, especially when considering populations like underrepresented students in STEM based majors. Similarly, over the past fifteen years, ECHS programs have been funded by a combination of public-school systems, post-secondary
institutional partners, non-profit organizations and education grants, but little is known about their long-term financial impact. As these programs age to a place where their graduates have entered the workforce and produce earnings, economists should measure the long-term financial impact that these programs have had to better understand if they build the tax base and cover the initial costs of operating more expensive high school programs with smaller student populations.
References


APPENDICES
Appendix A

Non-STEM Persisting Interview Guide

Opening:

Alex: Before we begin, I want to provide you with some background information about my study and why I’m interviewing graduates from the STEM ECHS program like you. [briefly explain research purpose, how I’ll use interview data collected].

Alex: My research also requires that I protect your confidentiality, including any information collected during this interview. I will be protecting your identity and maintaining confidentiality by storing all data collected on an encrypted drive online using two-factor authentication, and will only be accessing that data on a computer which is also encrypted and password protected.

Alex: Another part of my process in protecting your identity is to provide everyone with a pseudo-name, and I feel that it is important to honor your voice by allowing you to select your own pseudo-name if you’d like. If you have one you know you want to use now, that’s great, but if you want to think on it and get back to me, that’s okay too. If you aren’t interested in picking a name for yourself, I’m also happy to randomly assign one for you.

Alex: Lastly, before we begin, I would like your permission to record our conversation. Recording the conversation allows me to be present with you and hear your stories without having to worry about writing down everything you say. You may see me jot down a note or two, but those tend to be reminders to myself to follow up on something without interrupting you. I’ll be using an app on my phone, which is also password protected, to record the conversation, and will then transfer the audio file to my encrypted file online later today. The audio files will be transcribed to text by a professional third party, and that person will be the only other person besides me that would hear the audio files. Is it okay if I record this conversation? Great, let’s begin.

Warm-up Questions (answered prior to recording in participant demographic/crosswalk document):

1. We’ll start off easy. What is your email address and phone number?
2. Since graduating from the STEM ECHS, you started attending __________ College/University. How long have you been there now? How long do you have remaining?
3. I want to make sure that I have the name of your major listed correctly; can you tell me what the title of your degree is and explain a little bit about what it is that you study in that degree?
4. What thoughts do you have about what you want to do after college as it relates to your degree?
5. What race or ethnicity do you most identify with?
6. What gender do you most identify with, if at all?
RQ1: What are the personal and familial experiences that impact students’ decisions to attend a STEM based ECHS program?
   1. Let’s talk about your family history a little bit. Who is in your family? What type of work do your parents do? What did you observe about family members and work when you were growing up?
   2. What types of activities did you like doing as a kid? Were there any field trips, travel, or other major events that stick out to you as being especially memorable? What was family vacation like if your family went anywhere?
   3. What types of things did you want to be/professions did you want to have when you were growing up? Do you remember any instances from elementary or middle school where you were drawn towards something you learned about? What were your favorite subjects in elementary/middle school?
   4. What factors influenced your decision to attend the ECHS that you did? What were your interests in STEM at that time? What about the school was appealing to you? How much was the decision yours versus your parents, grandparents, other family members, etc.?

RQ2: What are the thoughts, processes, actions and other experiences that students go through as participants in a STEM based ECHS program as they make decisions about their majors and careers?
   1. Once you started attending the ECHS, especially in the 9th and/or 10th grade, what types of things did you like most about your experiences at school? What were your favorite subjects at that time? What activities were you involved in?
   2. At what moment in the program did you feel most engaged with your high school curriculum?
   3. What experiences in the ECHS program surprised you the most or were different from what you expected?
   4. What thoughts did you have in 9th/10th grade about what you wanted to major in at college? What types of professions did you see yourself moving towards? Outside of class, what types of activities did you do that either reinforced those thoughts or brought new perspectives?
   5. At this time, did you know you were starting to shift away from a STEM based major/career? If so, what factors were at play? Were you in a place where you felt that you could talk to others about it?

RQ3: What experiences ultimately lead students away from STEM based majors and careers as they actively participate in a STEM based ECHS program?
   1. At what period of time in the ECHS program did you feel most distanced from what you were learning as it relates to a STEM curriculum?
   2. Tell me about your shift away from STEM. When did it start to happen for you? What influences played a role/had an impact on your shift? Was it a clear call, or was it many smaller things that nudged you?
   3. At the point that you started shifting, how much did you know about other majors/career fields? Was this decision in part because of a lack of exposure to what STEM was prior to enrolling at STEM ECHS? Was it that you had more time/space to explore in high school? Was it related to taking college level STEM courses or being on a STEM campus? Was it a decision made due to academics, social factors, etc.?
4. What was the reaction to family, friends, teachers and other people close to you once you told them your plan?

5. Did anyone try to convince you to stay in a STEM major/career path, even after you decided it wasn’t for you? If so, how did that impact you?

RQ4: How do students’ scholastic experiences change after they have decided not to pursue STEM majors or careers in an environment and culture that actively promotes STEM education?

1. Once you decided you no longer wanted to pursue a STEM major/career, how did that change your high school experience for you? How did it change what activities you participated in? Did it change anything about your social life, friend groups, etc.?

2. How did it change the perceptions of your high school knowing that it was so STEM focused? Did it change how you engaged with high school faculty or staff? Did it change how you engaged with college faculty or staff? Did you feel isolated by your shift while still being in this environment? Do you feel like you were supported in your decision to move away from STEM? What obstacles popped up for you?

3. How did you define a new path for yourself that wasn’t based in STEM? What resources did you use, if any? What supports did you find for yourself, and were they different than previous experiences?

4. How did your shift away from STEM influence your college searching, application, selection process?
Appendix B:

Underrepresented STEM Persisting Interview Guide

Opening:

Alex: Before we begin, I want to provide you with some background information about my study and why I’m interviewing graduates from the STEM ECHS program like you. [briefly explain research purpose, how I’ll use interview data collected].

Alex: My research also requires that I protect your confidentiality, including any information collected during this interview. I will be protecting your identity and maintaining confidentiality by storing all data collected on an encrypted drive online using two-factor authentication, and will only be accessing that data on a computer which is also encrypted and password protected.

Alex: Another part of my process in protecting your identity is to provide everyone with a pseudo-name, and I feel that it is important to honor your voice by allowing you to select your own pseudo-name if you’d like. If you have one you know you want to use now, that’s great, but if you want to think on it and get back to me, that’s okay too. If you aren’t interested in picking a name for yourself, I’m also happy to randomly assign one for you.

Alex: Lastly, before we begin, I would like your permission to record our conversation. Recording the conversation allows me to be present with you and hear your stories without having to worry about writing down everything you say. You may see me jot down a note or two, but those tend to be reminders to myself to follow up on something without interrupting you. I’ll be using an app on my phone, which is also password protected, to record the conversation, and will then transfer the audio file to my encrypted file online later today. The audio files will be transcribed to text by a professional third party, and that person will be the only other person besides me that would hear the audio files. Is it okay if I record this conversation? Great, let’s begin.

Warm-up Questions:

7. We’ll start off easy. What is your email address and phone number?
8. Since graduating from the STEM ECHS, you started attending __________ College/University. How long have you been there now? How long do you have remaining?
9. I want to make sure that I have the name of your major listed correctly; can you tell me what the title of your degree is and explain a little bit about what it is that you study in that degree?
10. What thoughts do you have about what you want to do after college as it relates to your degree?
11. What race or ethnicity do you most identify with?
12. What gender do you most identify with, if at all?
RQ1: What are the transitional experiences of ECHS graduates underrepresented in STEM majors, from their pre-enrollment as degree-seeking students through their first and second academic years as they pursue a bachelor’s degree in a STEM major?

5. Tell me about your transition to college. What was the experience like once you graduated from STEM and knew you were coming to college, but hadn’t yet started your fall semester yet?

6. How did things change for you as you moved onto campus for the first time, went through the orientation experience, and started your fall semester?

7. Overall, how have you felt that your transition into your major has been for you - especially in thinking about as you have maybe moved into upper level courses, had to make decisions about what areas of interest within your major you might want to pursue, thought about research opportunities, etc.?

8. You’re pursuing a STEM degree and are also a student underrepresented in those majors (e.g. women, minorities, sometimes multiple identities). How do you see yourself as an underrepresented student in a STEM major? Tell me how you self-identify or refer to yourself in that regard?

9. When thinking about your transition to college, what obstacles or challenges have you came across? How were they different from the challenges that you might have expected based on your experiences as an ECHS student who already had some experiences being on a college campus?

   a. What connections might you have found between the obstacles or challenges that you’ve faced and your identity as an underrepresented student in a STEM based major?

10. You’re still here, despite any challenges you’ve found. What experiences or opportunities have you come across that have supported you, encouraged you, or pushed you to persevere since arriving?

   a. Of the supports or resources that you’ve found, how has your identity as an underrepresented student in a STEM based program played a role, in either obvious or not-so-obvious ways?

   b. I have found that sometimes students find or seek out resources, and sometimes the resources seem to find their way to the student. What has been your experience in encountering resources in this regard?

RQ2: How has participation in a STEM based ECHS program facilitated the transitional experiences of ECHS graduates underrepresented in STEM majors during their first and second academic years at a four-year residential college?

6. You participated in a pretty unique high school experience, and I’m sure that’s become even more obvious as you’ve arrived on campus and met other students. When I was the Liaison at STEM, I remember that the identity of the school could take on a big role for students. Thinking back on your experiences between when you graduated from high school until now, what role has your identity as a STEM based early college student played and how has it changed over time?

7. Thinking back on the experiences you had as a result of attending STEM, in what ways do you think participating in a STEM based early college program has helped or your transition to college?

8. In what ways do you feel that your ECHS program helped prepare you to go into a STEM field of study as an underrepresented student?
9. What experiences have you felt more prepared for because of your participation in the ECHS program?

10. Describe any examples you can think of where your experiences as an ECHS student made you feel like you were ahead of your peers in some way.

RQ3: How has participation in a STEM based ECHS program hindered the transitional experiences of ECHS graduates underrepresented in STEM majors during their first and second academic years at a four-year residential college?

6. The flip-side of attending such a unique high school is that there are probably also things that you feel like you missed out on, or things that are different compared to your peers. Thinking back again to the time from when you had graduated high school until now, what negative experiences have you have had because of your identity as a STEM early college graduate?

7. In what ways have you felt hindered in your transition to college, either before you arrived on campus or once you were in the swing of things, because you participated in a STEM based ECHS program?

8. In what ways do you feel that your ECHS program didn’t prepare you for the reality of being an underrepresented student in a STEM field of study?

9. Talk to me about any experiences have you felt less prepared for because of your participation in the ECHS program.

10. What specific instances have you faced where you’ve felt behind your peers, academically, socially, or in other ways, because of what you experienced as an ECHS student?

I know I’ve asked a lot about your experiences as a former ECHS student, your transition to college, the experiences you’ve had on campus, and your identity in STEM, but have I missed anything? This is a time for you to share anything else or anything that you feel is important for me to know about your experiences.
Appendix C

North Carolina State University
INFORMED CONSENT FORM for RESEARCH

Title of Study: EARLY COLLEGE HIGH SCHOOL GRADUATES’ TRANSITIONS AS DEGREE SEEKING STUDENTS UNDERREPRESENTED IN STEM MAJORS: A CASE STUDY
Principal Investigator: Alexander L. Walldie Faculty Sponsor (if applicable): Paul D. Umbach

What are some general things you should know about research studies?

You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time without penalty. The purpose of research studies is to gain a better understanding of a certain topic or issue.

You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. If you would like, a copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher(s) named above.

What is the purpose of this study?

The purpose of the study is to explore the experiences that graduates of a science, technology, engineering, and math (STEM) based Early College High School (ECHS) program have as they transitioned to their bachelor degree program at a four-year college or university. This study also seeks to understand how ECHS students make decisions about their college majors and careers, and to explore the role that a STEM based ECHS program and its curriculum had on the decision-making processes of students who decided not to continue pursuing a bachelor’s degree in a STEM related field.

What will happen if you take part in the study?

If you agree to participate in this study, you will be asked to participate in an individual interview that asks questions regarding your experiences as a former STEM based ECHS student and how those experiences have impacted your decision-making regarding majors and careers, and shaped your transition to your new college or university. This interview will last approximately 60-75 minutes and will take place at an agreed upon public location such as a college library, student union, or other public space. To ensure accuracy and to focus on the interview, an audio recorder will be used to record the interview. The researcher may follow up with you via email to provide samples of the interview for your review and may ask you for feedback about his analysis of your interview.

Risks and Benefits

There are minimal risks associated with participation in this research. There are no direct benefits to your participation in the research. The indirect benefits are that faculty, staff, and other members of your college learn more about the experience of ECHS students and work to provide additional resources. The STEM academic communities may also learn more about the ECHS population and how to better support underrepresented students in STEM based degree programs. K-12 school districts could learn about the impact that ECHS programs might have on students even after the students have graduated and left the school district.

Confidentiality

The information in the study records will be kept confidential to the full extent allowed by law. Data will be stored securely in a cloud storage drive that is password protected and requires two-factor authentication. The computer that accesses the cloud storage is encrypted and password protected for additional security. No reference will be made in oral or written reports which could link you to the study.

Compensation

For participating in this study you will receive a $25 Amazon gift card to compensate you for your time. The gift card will be given at the end of the individual interview, even if you choose to end the interview early. If you choose not to participate before the interview, no compensation will be provided.

What if you are a college student?

Participation in this study is not a course requirement at any university and your participation or lack thereof, will not affect your class standing or grades.
What if you have questions about this study?
If you have questions at any time about the study itself or the procedures implemented in this study, you may contact the researcher, Alexander Waldie, at alwaldie@ncsu.edu and/or (919) xxx-xxxx.

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact the NCSU IRB Office via email at irb-director@ncsu.edu or via phone at 1.919.515.4514.