ABSTRACT

Susan Hope Howard, THE EFFECTS OF SECONDARY MATHEMATICS COURSES ON RURAL STUDENT COLLEGE CHOICE (Under the direction of Dr. Crystal Chambers). Department of Educational Leadership, May 2023.

Participation in a rigorous high school mathematics curriculum plays a key role in both college choice and college completion. Rural students have lower access to advanced mathematics courses and enroll in college at lower rates despite having a higher rate of high school completion than their non-rural peers. This dissertation utilizes the Hossler and Gallagher (1987) model of college choice and the High School Longitudinal Study of 2009 (HSLS:09) to further examine the relationship between rural high school mathematics and college choice. It was found that high school mathematics course work increased the probability of overall enrollment in college and of enrollment at a four-year institution. These results are important to higher educational leadership studies as they indicate the necessity for continued partnerships across the pipeline such as Math Pathways, The Launch Years, GEAR UP, and Career and College Promise, which work to increase access to college for rural students.

THE EFFECTS OF SECONDARY MATHEMATICS COURSES ON RURAL STUDENT COLLEGE CHOICE

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DEDICATION

To everyone who stubbornly insisted upon believing in me, especially you.

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CHAPTER 1: INTRODUCTION

According to Adelman (2006), "the highest level of mathematics reached in high school continues to be a key marker in precollegiate momentum, with the tipping point of momentum toward a bachelor's degree now firmly above Algebra 2" (p. xix). When considering the lower rate of post-secondary enrollment for rural students (Brand & Xie, 2010; Showalter et al., 2019) despite a higher high school graduation rate than their urban and suburban peers, inquiring into the quality and quantity of mathematics provided in rural districts may be helpful in garnering stronger supports for rural college enrollment success. In this study, I explore the connection between secondary mathematics courses and college choice of rural secondary students. The aspect of college choice that I will examine refers to the decision to enroll in a 2-year or 4-year college immediately following the completion of high school.

Background of the Problem

I use data from the High School Longitudinal Study of 2009 (HSLS:09) in a secondary-data analysis for this dissertation. This data set was chosen because it is a large representative sample of secondary students in the United States. The HSLS:09 is the fifth longitudinal study in a series conducted by the National Center of Education Statistics (NCES) to examine the impact of the American secondary educational system on a student's post-secondary and career goals.

While there are numerous definitions used to classify rural populations, I adopt the urban-centric classifications utilized in the HSLS:09 and developed by the NCES in consultation with the U.S. Census Bureau (Ingles et al., 2013) for this dissertation. An urban-centric system classifies towns and rural areas based on their proximity to larger urban centers. This contrasts with previous metro-centric classifications which were based on the size of a town's population. A full discussion of rural definitions and the impact on the research is provided in Chapter 2.

Problem Statement

Rural students with a more robust course of studies in mathematics are more likely to enroll in four-year institutions after high school (Chambers, 2020a) with students who complete mathematics courses beyond Algebra 2 obtaining college degrees at a higher rate (Adelman, 2006; Kim et al., 2015). While rural students complete high school at a higher rate, they enroll in college at a lower rate (Brand & Xie, 2010; Showalter et al., 2019). Attendance and completion rates are even lower for rural males than rural females (Bray et al., 2019). My dissertation examines the impact of high school mathematics courses and college choice for rural students.

Purpose of Study

The purpose of the study is to fully examine the relationship between high school mathematics courses and college choice as it pertains to the rural student. Access to advanced mathematics courses in high school is lower for rural students, and these students enter high school at a lower level of mathematics than non-rural students. Limiting the scope of my dissertation to rural students will allow for intragroup comparison to determine if high school mathematics is associated with college choice for rural students or if there is a greater lurking variable impacting the situation such as socioeconomic status.

Research Questions

This dissertation uses publicly available data from the High School Longitudinal Study of 2009 (HSLS:09) to answer the following questions:

1. What is the relationship between secondary mathematics courses and enrollment in any postsecondary institution for rural students?
2. What is the relationship between secondary mathematics courses and enrollment in a four-year postsecondary institution for rural students?

3. What is the relationship between secondary mathematics courses and enrollment in a two-year postsecondary institution for rural students?

Significance of Study

This study is significant because "… more than 9.3 million--or nearly one in five students in the US--attend a rural school. This means that more students in the U.S. attend rural schools than in the nation's 85 largest school districts combined" (Showalter et al., 2019). Of these students nearly one in six live in poverty (McHenry-Sorber, 2019). College is an opportunity to raise that family out of poverty (Walpole, 2007).

In 1973, 28% of jobs required postsecondary education and training. This number jumped to 56% in the 1990s when the majority of today's college parents were attending college and entering the workforce. Pre-pandemic it was estimated that 65% of all jobs would require postsecondary education and training by 2020 (Carnevale et al., 2013). Examining the education of the current workforce offers an additional skewed view as many workers without postsecondary degrees are older and counter educational gaps with years of experience and industry training.

The increased need for postsecondary education means this study is important for educational leadership. What happens in high school impacts what happens in college as students flow through the pipeline. If taking higher level mathematics courses indicates a desire for college, then college recruiters should look at this area. Conversely, if low mathematical achievement is impacting college admissions, then this should be communicated and partnerships between K-12 and postsecondary institutions should be formed to address this issue. Those in leadership positions should be keenly aware when setting policies and curriculum.

Several programs and initiatives currently exist and highlight the national importance of my study. Programs and initiatives such as Early Mathematics Placement Testing, Achieving the Dream, and Math Pathways continually examine the important role mathematics plays in successfully obtaining a college degree and work with high schools and colleges alike. These initiatives and more seek to study the phenomenon while alleviating any barriers produced for students. This study seeks to extend this work by specifically focusing on the relationship between high school mathematics courses and rural student's college choice.

Overview of the Study

Using student data obtained from the HSLS:09, I will conduct a forced entry logistical regression on the publicly available rural student data. Due to the structure of the data set only the traditional student is being considered at this time. While non-traditional students should be considered in college-choice research, this subset has not had time to fully occur in the observed data. Participants in the HSLS:09 entered the ninth grade in the fall of 2009 which places high school graduation in 2013 and college graduation in 2017 for traditional students. Data including high school transcripts was gathered from participants in the 2013-2014 academic year and post-secondary transcripts were gathered in the 2017-2018 academic year.

Conceptual Framework

College choice refers to a student's decision process when making postsecondary plans. Those choices are direct entry into the workforce, military service, vocational training, or attending a 2-year or 4-year higher learning institution. There are many names and models for this phenomenon which are discussed in the literature review. This discussion also includes my rationale for my selection of college choice models.

For my dissertation, I will use Hossler and Gallagher's (1987) three-phase model of college choice as the framework. The three phases of this model are predisposition, search, and choice. During predisposition the student is deciding if they are interested in attending college. They then enter the search phase where they are exploring various colleges and colleges are attempting to reach prospective students. The final phase of choice is where students debate the pros and cons among schools in their final choice set. It is also where colleges court potential students and try to entice the student to their school via incentives like scholarships or financial aid packages. Examining high school mathematics falls in both the predisposition and search phases of college choice as the completion of higher-level high school mathematics courses may indicate a strong predisposition to college as students work to meet the admissions requirements for an institution. These courses can also impact the choice phase if a student did not enter the search phase early enough in their high school career to take the required course work for college admission. This framework and its phases as they relate to this dissertation are explored more in depth in the Chapter 2 section, Hossler and Gallagher.

Definitions of Key Terms

2-year institution - A higher education institution either public or private which awards certifications or degrees that typically require two years of coursework.

4-year institution - A higher education institution either public of private which awards certifications or degrees that typically require four years of coursework.

HSLS:09: High School Longitudinal Study of 2009.

NCES - National Center of Education Statistics.

Rural – students classified as rural-fringe, rural distant, or rural remote by NCES

Rural-Fringe - Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.

Rural Distant - Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster.

Rural Remote - Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Assumptions

One assumption of this dissertation is the difference in admissions requirements for 2-year institutions and 4-year institutions. Though many 2-year institutions are community colleges with open door admission policies not all such institutions are community colleges. Effort will be made to note if a 2-year institution is not a community college.

Bias

Even the use of the word "rural" brings imagery to mind based on the experiences of the individual. I have lived in rural parts of both western and eastern North Carolina but recognize there are many other types of rural than cotton or tobacco fields. In fact, rural does not imply an agricultural area or extreme poverty. This bias is avoided in data selection as the HSLS:09 is a nationally representative study with a rigorous quantitative definition of rurality. Additional effort is made to avoid this potential bias when reviewing the literature for this dissertation.

Scope and Delimitations

The scope of this study are rural students who participated in the High School Longitudinal Study of 2009. Since these students all entered ninth grade in the fall of 2009 the scope of this study involves traditional college students. That is those students graduating high school in the spring of 2013 and entering college that fall. Data are not currently available for students who may have entered college after 2013 or completed college after 2017.

Limitations

The limitations of this study are those concurrent with any secondary data analysis. Since I did not design nor collect the initial data, I have no control over the available data or access to the participants to ask any follow up questions. However, the data was collected by the National Center for Educational Statistics (NCES) as part of a large scale longitudinal study created in part to provide data for policy makers and researchers alike.

The quantitative design of the study limits the ability to ascertain the motivations and reasoning of individuals involved. While the original participants cannot be interviewed, the HSLS:09 did conduct interviews and do provide variables to this effect. Still further qualitative study of rural students is recommended for future studies.

An additional limitation to this study is the use of the public data set. Use of the restricted data set was not possible due to the length of the application process and the associated costs (roughly $5,000). However, the public data set is robust and well-utilized in current works. A preliminary review of the available variables indicates this study is possible without the restricted variables.

Advances in Practice

This dissertation seeks to advance practices in higher education through deeper understanding of the relationship between high school mathematics courses and college choice for rural students. Results may provide support and direction for existing programs such as

NCEMPT and national initiatives such as Math Pathways so that the rate of rural student college enrollment rates increase to match those of their non-rural peers.

Summary

The goal of this dissertation is to examine the link between rural high school mathematics courses and rural student college choice. Completion of Algebra II and more advanced high school mathematics course are strong indicators of college choice and success. I will use data from the HSLS:09 to conduct a forced entry logistic regression specifically on rural students. The Hossler and Gallagher (1987) three-phase model for college choice will be used as the theoretical framework of this study.

CHAPTER 2: REVIEW OF LITERATURE

The purpose of this study is to determine the impact of high school mathematics coursework on rural student college-choice. In this chapter I explore definitions of rurality, how the term rurality is used in federally sponsored longitudinal surveys, and how rural students as defined through this narrow lens fare in the college choice process, specifically focusing on their access to rigorous mathematics coursework and quality mathematics instruction.

Defining Rural

As verbally illustrated by Caitlin Howley (2021, p. 3):

> Rural places live in our imaginations, perhaps as bucolic villages nestled in the New England woods, or as farmsteads surrounded by the Great Plains wheat fields. Maybe we envision adobe homes spread out across wide desert spaces, a lone cottage on the bayou, a logging town in the Northwest, or a few cabins huddled in an Appalachian holler. Likewise do rural people sometimes inhabit our imaginations, in ways both flattering and unflattering. On the one hand, we may think of rural residents as easy-going, down-to-earth people of solid traditional values, or as rugged individualists with rough manners but hearts of gold. On the other hand, some people may stereotype rural folk as simple and unsophisticated, or as uneducated, angry rebels who maybe drink too much beer and threaten their neighbors. But to the extent that these visions hint at the complexity of rural places and people, they also fail to capture the reality of rural life, which is still more complicated.

This complexity notwithstanding, federal definitions of rurality, of which there are at least 70, tend to distill rurality into two components: population density and distance from metropolitan areas (Ratcliffe, 2015; Ratcliffe et al., 2016).

According to Ratcliffe (2015), “the Census Bureau defines urban and rural areas for statistical purposes only; nevertheless, various federal programs use these areas to determine eligibility for participation as well as funding levels.” Use of U.S. Census Bureau’s designation of urbanicity or rurality does not imply continuity among studies. These classifications have adapted with every census since 1910 which designated 54.4% of the population as rural to the 2010 census which classifies 19.3% of the population as rural (Ratcliffe et al., 2016).

The United States Census Bureau simply defines a rural area as an area that “is not urban—that is, after defining individual urban areas, rural is what is left” (Ratcliffe et al., 2016, p. 1). Based on this classification and the 2010 Census, 19.3% of the United States population is considered rural. However, the United States Department of Agriculture (USDA) states that anywhere from 17 to 49% of the United States population is considered part of the rural population. Using the lowest estimate of 17% equates to approximately 52.5 million people by the April 1, 2010, population census.

While the main federal basis of rural definition is simply “not urban,” the juxtaposition of terms requires a determination of boundaries. These “rural definitions can be based on administrative, land-use, or economic concepts, exhibiting considerable variation in socioeconomic characteristics and well-being of the measured population” (Cromartie & Bucholtz, 2008, p. 29). The concept and subsequent definition depend on finding the most accurate descriptor for the goals of the government program being administered or the aim of the research being conducted.

Administrative definitions utilize municipal or other jurisdictional boundaries for a concept of urbanicity as a starting point when determining program eligibility for programs aiding through local governments such as USDA rural development programs. For instance, the

USDA's Rural Business Development Grant Programs for Fiscal Year 2022 awards funds for rural public entities to deliver technical assistance and training for small rural businesses. Eligible entities are "rural areas or towns outside the urbanized periphery of any city with a population of 50,000 or more" (USDA Rural Development, 2021).

While the administrative concept looks at boundaries, the land-use concepts identify urban areas based on population density. The United States Census Bureau

> uses a definition based on population density and other measures of dense development when identifying urban territory. The definition seeks to draw the boundary around an urban area's "footprint" to include its developed territory. To accomplish this, the Census Bureau's definition of urban is largely based on residential population density and a few other land-use characteristics to identify densely developed territory (Ratcliffe et al., 2016, p. 2)

Basing classification on land-use criteria can be utilized in infrastructure programs meant to overcome disadvantages faced in a scarcely populated area. An example is wastewater management and the USDA's Grants for Rural and Native Alaskan Villages which assist remote villages with providing residences and business with safe, reliable drinking water and waste disposal. One eligibility requirement for the program is a population of 10,000 or less (United States Department of Agriculture, 2019). However, as most policies and many policy makers are urban centric in their orientation, rural education finance policies are urban retrofits giving rise to inequities (Shuls, 2018).

Instead of administrative boundaries or the specific usage of the land, an economic concept is "used in most rural research applications, recognizes the influences of cities on labor, trade, and media markets that extend well beyond densely settled cores…" (Cromartie &

Bucholtz, 2008, p. 30). This concept may be more appropriate if the program requires coordination of efforts within a broader area such as transportation of students to and from an after-school tutoring program.

Rurality and the National Center for Education Statistics (NCES)

NCES draws from Census Bureau definitions and considers the economic concept when partitioning their rural category into the subcategories of fringe, distant, and remote. With the foundation of rural definitions formally established the conversation turns to the five longitudinal studies conducted by the NCES. These studies encompass almost 50 years of educational research with each study building on its predecessor. Through examining and comparing these studies a baseline is established for selection of the High School Longitudinal Study of 2009 (HSLS:09) data set as it contributes to the national dialogue regarding the role of secondary mathematics on college choice and success for rural students.

NCES utilized information from Census 2000 while identifying schools for participation in HSLS:09. Census 2000 is significant because updates to the urban-rural classifications underwent the most extensive changes since the concept of an urbanized area was introduced in the 1950 Census. These changes resulted from the evolution of software developed for the 1990 Census, TIGER database, and the increased use of geographic information system (GIS) software which expanded the perceptions of land use and allowed for more localized blocking of urban areas. Under the new criteria, Census 2000 identified 79% of the U.S. population as living in an urbanized area (Ratcliffe, 2015).

HSLS:09 Rural Classification System

Utilizing a classification system that is revised with each decennial census presents a challenge to longitudinal studies. NCES was proactive in 2006 when they began selecting schools for the HSLS:09. Working with the U.S. Census Bureau the two organizations collaborated to create a new locale classification system which was applied to Census 2000. Previous NCES secondary longitudinal studies locale codes were metro-centric which means they were based on metropolitan statistical areas. The HSLS:09 used new urban-centric codes which

> follow the same logic as the older locale codes but incorporate an approach that prioritizes population size and proximity to an urbanized area in assigning locale. The highest level (four terms) of the new locale code system was used in HSLS:09 school sampling to create substrata (with geography as superstrata). The four major categories are city (large or mid-size city), suburban (urban fringe of large or mid-size city), town (large or small), and rural (outside or inside a Core-Based Statistical Area) (Ingles et al., 2013, p. C-11)

The four categories are further subdivided into the NCES geocode scheme for a total of twelve categories. Under this model there are three types of rural classification – fringe, distant, and remote— based on the proximity of a location to a large urban center as defined in Table 1. This system adopts the economic concept because it differentiates towns and rural areas based on their proximity to urbanized areas. The previous metro-centric classification systems made the distinction based on population size.

Using the schools' actual addresses and geographical coordinates NCES classified all schools into one of the twelve categories. Not only can an exact location for a school be identified, but town and rural subtypes can be identified using measures of distance from an urban center which "allows NCES to identify and differentiate rural schools and school district

Table 1

NCES Urban Centric Classifications of Rurality

Locale	Definition
Rural-Fringe	Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster
Rural-Distant	Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster
Rural-Remote	Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster

Note. (National Center for Education Statistics, 2022a).

in relatively remote areas from those that may be located just outside an urban center" (National Center for Education Statistics, 2022a).

While the new system allows for a more precise quantification of rural locations, it also highlights the importance for vigilance when comparing studies and drawing conclusions. When Manly et al. (2019) applied the new HSLS:09 rural definitions to the preceding NCES longitudinal study, ELS:2002, data the number of students considered rural increased from 20 to 23% which potentially changes the conclusions drawn by the ELS:2002. For example, using the ELS:2002 definition of rurality there is no difference between bachelor's degree attainment in rural and suburban students. However, using the same data set with the HSLS:09 definitions of rurality show suburban students "had a probability of bachelor's degree attainment that was four to five percentage points higher than rural students" (p. 769).

Comparison of NCES Studies

To fully understand the HSLS:09, I look back at its NCES predecessors. Each study builds upon the last as it gives rise to new questions. One study evolves from another to the point in which they are intricately linked and can be used for comparison and deeper understanding of the high school experience and college choice process.

NCES has conducted four previous longitudinal studies – 1972, 1980, 1988, 2002— before the HSLS: 09. The first in the series was the National Longitudinal Study of the High School Class of 1972 (NLS-72) which sampled over 21,000 high school seniors and provided longitudinal data to both educational researchers and policy makers. The NLS-72 followed participants until 1986 and provided a link between early work experience and participation in and completion of postsecondary programs. In an effort **"…** to conduct intensive studies of students from disadvantaged backgrounds, NLS-72 oversampled schools in low -income areas and schools with significant minority enrollments" (National Center for Education Statistics, 2017).

NLS-72 conducted the base year study in the spring of 1972. High school seniors completed a questionnaire, and the school completed the School Record Information Form Shortly thereafter the first follow-up was conducted from October 1973 until April 1974. Additional participants were added at this time. All participants provided information regarding work, education, and location in October 1973. There were three additional follow-ups—1974, 1976, 1979 – conducted with the participants. There was a 78% retention rate from the base year to the final follow-up (National Center for Education Statistics, 2017).

Before NLS-72 concluded, NCES began their second longitudinal study in 1980. High School and Beyond (HS&B) included two cohorts of high school students. One cohort of high school seniors comparable to those in NLS-72 and a second cohort of high school sophomores. The goal was to provide further data regarding the impact of early high school experiences on a student's subsequent high school and postsecondary educational experiences. The expanded age range also allowed researchers to examine the high school experience of students who ultimately dropped out.

Additional data was collected from both cohorts in 1982, 1984, and 1986. Postsecondary transcripts were collected for both cohorts with an additional sampling of the sophomore cohort in 1992 and an update of their postsecondary transcripts in 1993 (National Center for Educational Statistics, 2022b). The long-term data and postsecondary transcript collection allowed researchers to begin exploring questions of college choice, persistence, and short-term labor market outcomes. In fact, the four models of college choice discussed later in this literature review were all published while the HS&B was being conducted and are still utilized today.

Approximately midway through the HS&B, in 1988 the NCES launched their third study entitled the National Education Longitudinal Study of 1988 (NELS:88). This study further expanded the age range of participants by choosing an initial cohort of 8th graders, one of their parents, two of their teachers, and their school administrator. Student tests included reading, mathematics, science, and social studies.

NELS:88 followed participants throughout their secondary and post-secondary careers with follow up surveys and data collected in 1990, 1992, 1994, and 2000. The cohort was adjusted to represent United States tenth graders in 1990 when a subset of the base year participants and nonparticipants were tracked and resurveyed. At this time, most of the cohort were sophomores but some members were in other grades or had dropped out. A similar process was followed in 1992 to obtain a representative senior cohort and to repeat surveys issued to dropouts. The final follow-up and gathering of post-secondary transcripts occurred in 2000 (National Center for Educational Statistics, 2020b).

Residential data collected during NELS:88 was mapped to the 1990 United States Census. This mapping was similar to a mapping done of a subset of the HS&B sophomore cohort (National Center for Educational Statistics, 2020a). Linking the NELS:88 with census data allowed educational researchers and policy makers to begin considering factors such as a student or school's urbanicity and the implications on postsecondary and career experiences and provide a foundation for this dissertation.

Unlike previous NCES longitudinal studies the NELS:88 did not overlap with the next study. Two years after NELS:88 concluded the Educational Longitudinal Study of 2002 (ELS:2002) began. This study built upon its predecessors as the data gathered was compared to the previous NCES studies while updating survey content and connecting these studies to the new millennium. ELS:2002 initially surveyed a 10^{th} grade cohort in 2002 and followed up with a 12^{th} grade cohort in 2004. Students were tracked throughout their high school and postsecondary years. The base year study included surveys for the student's parents, math and English teachers, and school administrators (National Center for Education Statistics, 2020a).

The latest evolution of NCES longitudinal studies is the High School Longitudinal Study of 2009 (HSLS:09). Currently, this is the only ongoing longitudinal study being conducted by NCES. While the relationship between mathematics and student achievement is examined earlier in the NCES series, the HSLS:09 contains a specific focus on Science, Technology, Engineering, and Mathematics (STEM) education, mathematical self-efficacy, and a base year survey of the mathematics and science teachers. HSLS:09 created a cohort of over 23,000 ninth graders in 944 high schools, including public and private schools. The large survey size resulted in 10 state representative data sets.

The HSLS:09 cohort is of great interest. Being born around 1994 and entering the school system in the fall of 1999 this group was predominately educated in the current millennia. These are the last students who can answer they were in school when the planes hit the twin towers. This is the No Child Left Behind (NCLB) cohort whose educational experience is the product of the policies and theories that arose from all previous NCES studies. Their experiences reflect decades of educational interventions and are a roadmap of where educational reform should look next.

A comparison of the policy initiatives from each study is given in Table 2.

Table 2

Policy Initiatives of NCES Longitudinal Studies

Study	Transitions	Equity	Cognitive	Courses/School	Parents/Social Capital
NLS-72	Post-High School Transitions	Equity/Access/Choice	Cognitive Growth and its Correlates	Course-taking Patterns and Opportunities	Parental and Community Involvement/Social Capital
HS&B	Post-High School Transitions	Equity/Access/Choice	Cognitive Growth and its Correlates	Course-taking Patterns and Opportunities	Parental and Community Involvement/Social Capital
NELS:88	Post-High School Transitions Transition into high school			Secondary Experiences High School Dropouts	Accomplishments 12 years after 1988
ELS:2022	Post-High School Transitions	Equity/Access/Choice	Cognitive Growth and its Correlates	Course-taking Patterns and Opportunities School Effectiveness	
HSLS:09	Transition into math and science courses in high school			The changing environment of high school	How do parents and students make decisions about postsecondary education?

Note. Table adapted from NCES stated policies in respective studies document.

Rural Students

While there are many quantitative designations of a rural area discussed in this section, the qualitative should also be considered as it reveals potential bias in both the reader and the researcher. Merely invoking of the term “rural” brings imagery to anyone’s mind.

> Since the 2016 presidential campaign, for better or worse, the general public and media have placed rural America in the national spotlight. While the election placed an important spotlight on the lives, challenges, and strengths of people living in rural communities, the spotlight came with the perpetuation of myths of rural America (Means, 2018, p. 1)

These myths include stereotypical views of rural America as poor, white, and agrarian (Goetz et al., 2018) and may lead to people of color being overlooked by researchers and policymakers, further widening the gap among rural populations as “… educational attainment among rural Whites is higher than that of racial and ethnic minorities in rural areas” (Marré, 2017, p. 1). While reinforcing rural folklore, the attention also highlighted challenges rural students face when seeking higher education and how these challenges impact their entire lives (Agger et al., 2018; Friesen & Purc-Stephenson, 2016; McDonough et al., 2010).

Reviewing the literature requires the reader to be cognizant of both their potential bias and the potential bias of the researcher. Rural areas are as diverse as their quantitative classifications and the personal imagery the term invokes. There are rural areas rich in resources with high socioeconomic status (SES) just as the counter is also true. The racial and ethnic make-up of a rural community similarly does not constitute a specific group or culture. Classifying students as living in a rural area encompasses a wide subgroup as “a total of 9,318,822 students (19.3%) attended a rural school (i.e., a school designated as rural, whether in a rural or non-rural district)" during the 2016-2017 school year (Showalter et al., 2019, p. 10). This number was calculated using the same criteria for a rural school as the HSLS:09.

While rural students are more likely to complete high school than their urban contemporaries, they are less likely to attend college (Showalter et al., 2019). This places the student at a much lower earning potential for their lifetime and decreases the odds of bringing themselves and their family out of poverty (Bloome et al., 2018; Walpole, 2007). This section looks both at the specific challenges rural students face in college choice and degree completion and some distinct advantages experienced in a rural community that help rural students who attend college.

Challenges

These issues are best summarized by educational researcher Jerry Johnson in an interview given to The Rural Educator. Dr. Johnson is one of three authors who prepared the biennial report, "Why Rural Matters 2018-2019: The Time is Now." When asked a question regarding the challenges and opportunities facing rural education, Johnson responded,

> The biggest challenges would include large inequities in (a) instructional expenditures per student, (b) teacher salaries, (c) how much rural districts must rely on local tax bases, and (d) opportunities to prepare adequately for college (especially access to AP coursework). Poverty is widespread, with nearly one in six rural students living in poverty. In every state, academic performance gaps exist between rural students living in poverty and their rural peers who are not living in poverty. Some districts, especially in places where consolidation has occurred, must spend large amounts of their budget on transportation costs. Rural districts in some areas of the country have sizable portions of students changing residences each year. (McHenry-Sorber, 2019, p. 63)

The opportunity to prepare for college through advanced course work is especially critical in mathematics (Chambers et al., 2016; Kim et al., 2015). While Algebra 2 may meet the requirements for a high school diploma, more advanced mathematics is required for college success, Adelman (2006) found the highest degree of mathematics completed in high school is a key indicator of precollegiate momentum “with the tipping point of momentum toward a bachelor’s degree now firmly above Algebra 2” (p. xix). Similar research found completing Algebra II only has a positive significant effect on two-year college attendance and had no effect on degree attainment (Kim et al., 2015). Further discussion of the importance of high school mathematics and college success continues in the section Secondary Mathematics and Rural Students.

Earning a bachelor’s degree would greatly assist the large number of rural students that Johnson mentions living in poverty as obtaining a bachelor’s degree is the single best way to raise oneself out of poverty (Walpole, 2007). However, rural students face a dilemma that is compounded by mixed messages from community leaders. Pursuing a bachelor’s degree and a higher paying job often means leaving their rural community behind which further hurts that rural economy. Rural students feel the pressure to remain in their community and pursue work in a traditional trade or industry that does not require a college degree (Tieken, 2016).

This compounds the issues as blue-collar jobs are growing the slowest with only an 8% increase predicted by the end of 2020. In contrast, projections for jobs in healthcare and STEM fields show 31% and 26% increase in employment respectively with 95% of healthcare professions and 93% of STEM occupations requiring postsecondary and training credentials (Carnevale et al., 2013).

There are some efforts to overcome these educational inequities. For example, the North Carolina Department of Information Technology's Broadband Infrastructure Office (BIO) administers the Growing Rural Economies with Access to Technology (GREAT) Program which funds deployment of broadband within the unserved areas of economically distressed counties where "at least 1.1 million North Carolina households lack access to high-speed internet, cannot afford it or do not have the skills needed to take advantage of the digital economy" (N.C. Department of Information Technology Division of Broadband and Digital Equity, 2022). As

> If we are not able to bridge this Homework Gap, our state's children, our future workforce, will not be adequately prepared for the jobs of the 21st century. In addition, expanding broadband access, especially in our rural communities, will help to expand economic opportunities for families across North Carolina (Huffman, 2018, p. 18)

North Carolina is not unique in the challenge. According to Anderson and Perrin (2018), approximately 15% of U.S. households with school-age children do not have access to high-speed internet. The percentage more than doubles when considering household income. Around 33% of households with school-age children and annual incomes below $30,000 lack access to high-speed internet which amplifies the disadvantages for these students.

Of all the challenges faced by rural students, socioeconomic status rather than family income level appears as a strong lurking variable. Byun et al. (2012) noted that "the significant rural-urban difference in college enrollment was no longer evident" once they added socioeconomic status to their model. Li (2019) found that while "rural students were less likely to report the highest (>$175,000) and the lowest (below poverty line) levels of family income," they were also "more likely to report a median level of family income" and "significantly less likely to have college-educated parents than were suburban students" (p. 7). These results challenge the poverty narrative of rural populations and creates more of a middle-class portrait for rural students and are significant to this dissertation as the HSLS:09 was utilized in the study. The contrasting nature of these findings to the numerous studies who reference overwhelming poverty in rural areas could relate back to the lack of a clear definition of rurality as Sowl and Crain (2021) found

> the emphasis on Appalachia has been used to characterize all rural communities as poor, uneducated, disinclined to pursue college, and exhibiting strong community attachment, which may not reflect the realities of all rural youth (and overemphasizes deficit narratives within Appalachia itself) (p. 26)

in their systematic literature review of 134 research publications dealing with college access and college choice for rural youth between 2000 and 2020.

Two aspects of socioeconomic standing impacting college choice that are consistent throughout the research on rural students is lower parental education levels (Byun et al., 2012; King, 2018; Li, 2019; Sowl & Crain, 2021; Tieken, 2020) and lower parental expectations for a 4-year college degree (Byun et al., 2012; King, 2018; Li, 2019; Sowl & Crain, 2021; Tieken, 2020) than non-rural students. The significant impact of parental education level and parental expectations on college choice are discussed at length in the College Choice section below.

Advantages

The advantage provided by a rural community is seen throughout the literature. Byun et al. (2012) "results showed that rural students were more advantaged in community social resources compared to nonrural students, and these resources were associated with a significant increase in the likelihood of bachelor's degree attainment" (p. 412). These resources included knowing and communicating with the parents of their child's peers and more frequent participation in religious services and organizations which may provide additional resources. Additionally, Li (2019) found that rural students relied on the social relationships between families and communities more when pursuing higher education than did non-rural students" (p. 7). This reliance on relationships assists the rural student once they enroll in college as they are more apt to seek out campus communities and supportive resources such as tutoring (Nelson, 2018)

There is some argument that community ties negatively impact college choice as students are encouraged to remain in or eventually return to their community to prevent rural "brain drain" from the best and the brightest leaving for college never to return (Roscigno & Crowle, 2001; Tieken, 2016). However, other research contradicts these findings as the local community is seen to encourage the student to pursue better opportunities outside of their community through earning a postsecondary degree (Nelson, 2016; Petrin et al., 2014). Rural student college choice was based more on the individual's perceptions of their local economy than any input from teachers or counselors with students in "communities not experiencing pronounced economic distress… frequently found [to have] both expectations—and precedents—of rural return" (Petrin et al., 2014, p. 317). There is additional evidence that many rural students seek out a college degree so they may return and improve their local community (Farmer et al., 2006; Petrin et al., 2014; Wright, 2012).

Benefit of Obtaining a College Degree

According to the United States Bureau of Labor and Statistics, higher educational levels correspond with lower rates of unemployment and higher wages. See Table 3 for a summary. Obtaining an associate's or a bachelor's degree yields a percent increase in median weekly earnings of 19 and 67% respectively when compared to earning a high school diploma alone.

Table 3

Unemployment Rates and Earnings by Educational Attainment, 2019

Educational Attainment	Unemployment Rate	Median Usual Weekly Earnings
Doctoral degree	1.1%	$1,882
Professional degree	1.6%	$1,861
Master's degree	2.0%	$1,497
Bachelor's degree	2.2%	$1,248
Associate's degree	2.7%	$ 887
Some college, no degree	3.3%	$ 833
High school diploma	3.7%	$ 746
Less than a high school diploma	5.4%	$ 592
Total	3.0%	$ 969

Note. Data are for persons age 25 and over. Earnings are for full-time wage and salary workers. Source: Current Population Survey, U.S. Department of Labor, U.S. Bureau of Labor Statistics.

Even merely completing some college courses without obtaining a degree increases median weekly earning by almost a hundred dollars while decreasing the unemployment rate over earning a high school diploma. This held true during the Financial Cliff of 2008 and the ensuing Great Recession as other researchers found

> Through booms and slumps, rising and falling unemployment, job creation and job loss, workers with postsecondary education earn 74% more than workers with a high school diploma or less. Among those with full-time, full-year jobs, the wage premium rises to 82%. (Carnevale et al., 2013, p. 7)

If students made the college choice strictly under a rational-behavior model, then the choice would be clear. Under this model "… individuals make decisions about whether to pursue higher education on the basis of cost-benefit analyses. People choose higher education only if it increases their lifetime earnings expectations" (Brand & Xie, 2010, p. 2). However, not everyone chooses college, which is why it is important to consider additional models of college choice.

College Choice

The framework of college choice is referred to by a myriad of names and is of interest to both higher education institutions and policy makers. Whether it is called college choice, student choice, student enrollment management, or any other name, the basic concept remains the same. All stakeholders are focusing on the individual student's decisions regarding postsecondary plans. The student must choose between direct entry into the workforce, military service, vocational training, or attending a 2-year or 4-year higher learning institution. Just as there are many names for this phenomenon, there are numerous models for each descriptor all trying to define and predict how the decision to attend college is made.

Park and Hossler (2014) state “academic research on student college choice and student retention, perhaps more than any other domain of research in the field of higher education, has expanded dramatically in the last five decades” (p. 49) . They identified three types of approach—economic, sociological, information processing—in college choice models. The economic approach is a rational-behavior choice model where students weigh the benefits of college versus the associated cost of attending college and compare this against other options to make their choice. Research utilizing economic frameworks focus on the financial aspects as the basis of college choice that occur in the later stages of college choice.

Sociological models focus on earlier stages of college choice while still considering economic factors. They include

> influences of social and cultural capital such as parental education, family income, the extent to which students are taken to museums or read to by parents, and the impact these social interactions have upon students’ educational aspirations… Focusing on the earlier stage of college choice, the sociological approach explains how an individual’s social status shapes his or her educational aspirations and college choice. (Hossler & Bontrager, 2014, p. 51)

When Byun et al. (2017) utilized a sociological framework to examine variables to predict college attendance among rural youth they found the parent’s level of education had a significant association in enrollment patterns. Parents who attended college were able to help prepare their children even if the school did not have the resources.

Use of parents as an information source overlaps with models utilizing an information processing framework which focus on how students collect and utilize information. “According to this approach, primary college information channels are parents and siblings, high school teachers and counselors, college admissions personnel, recruitment materials, college guidebooks, and college fairs" (Hossler & Bontrager, 2014, p. 51). This information would include financial factors meaning information processing frameworks intersect with economic frameworks as well as sociological frameworks.

Instead of overlapping multiple frameworks, combined models approach college choice as a multistage developmental process (Hossler & Gallagher, 1987; Hossler & Bontrager, 2014). For example, Chapman (1981) purposed a longitudinal model where "student college choice is influenced by a set of student characteristics in combination with a series of external influence" (p. 492). While Litten (1982) found Chapman's work to be beneficial in examining "structural and attribute variables and their relationships to the outcomes of the college-selection process," he also found it to be too generalized and lacking "an understanding of the college-selection process itself" (p. 384). Therefore, Litten divided college choice into a five-step process with the outside influences flowing into the model at various points in the process. An examination of the five-steps reveals a three-phase process— (1) desire to attend, (2) investigation of institutions (3) application and enrollment (Hossler & Gallagher, 1987).

A similar three-phase model was proposed by Jackson (1982), who identified the phases of college choice as preference, exclusion, and evaluation. During the first phase "students' aspirations develop as sociologists suggest they do; these and an assessment of resources combine to yield criteria for evaluating alternatives" (p. 238). This leads to the second phase of exclusion where students decided which institutions meet their needs and which should be excluded for consideration. The exclusions could contain entire categories such as 2-year or 4-year college or any college at all. Students who choose college enter the third phase where they evaluate their remaining options and decide where to apply.

Hossler and Gallagher

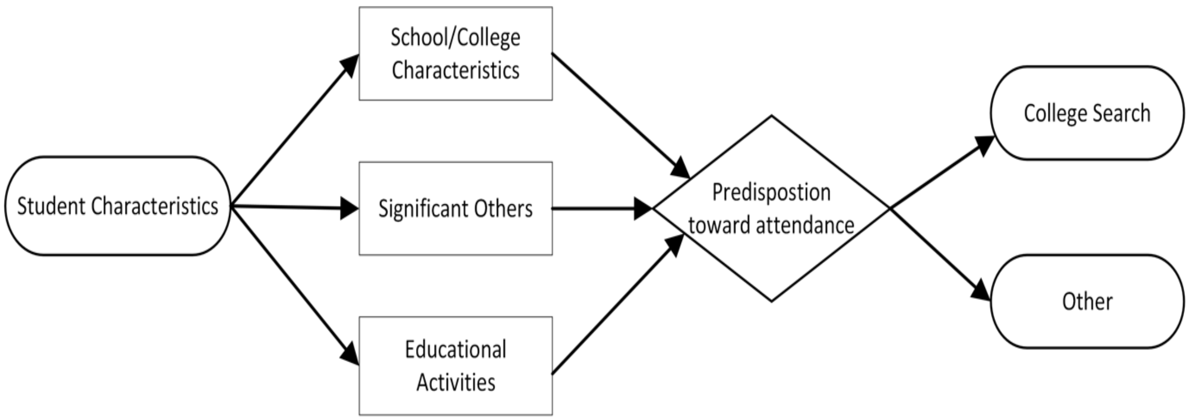
Hossler and Gallagher (1987) utilized the work of Chapman (1981), Litten (1982), and Jackson (1982) when developing their three-phase college choice model, which is a synthesis and simplification of previous models and is a student-centered model (Hossler et al., 1999). I selected this model as the framework for this dissertation because it is a well-established framework that "is the simplest model and has been widely accepted as a foundation in later studies on college choice" (Hossler & Bontrager, 2014, p. 52). I confirmed this by searching for scholarly articles applying Hossler and Gallagher (1987) that were published since 2018. There were almost 500 articles meeting the search criteria. The three phases of the model and related literature regarding rural students are detailed below.

Predisposition

The first phase is a "developmental phase in which students determine whether or not they would like to continue their education beyond high school" (Hossler & Gallagher, 1987, p. 209). During this phase students will decide to either attend college, enlist in the military, or enter the job market upon leaving high school with a decision generally being made between the eighth and tenth grade (Hossler et al., 1999). It is recommended that any intervention be taken before this point as "once students begin to articulate formal plans, it becomes more difficult to alter them" (p. 22). This does not mean the student's decision is irrevocable or resistant to life changes. An and Sorensen (2017) found changes in family structure occurring late in high school to be negatively correlated with college enrollment. Chambers (2020) found an increase in degree aspirations between ninth and 12th grades among rural black students with 10.1% having no degree aspirations in ninth grade decreasing to 4.2% by the time those students reached the 12th grade.

In addition to knowing when the decision to attend college is made it would be beneficial to identify when students enter the predisposition phase. However, most studies on college predisposition do not identify when the stage begins (Freeman & Brown, 2012). Figure 1 outlines the predisposition phase with an entry point of student characteristics. These characteristics are factors such as family income and socioeconomic status (SES), social and cultural capital, race and ethnicity, academic ability, and the attitudes of parents and peers (Hossler & Gallagher, 1987; Hossler & Bontrager, 2014). None of these characteristics indicate a specific age and all are beyond the individual's control.

Hossler et al. (1999) found that "parents' expectations and encouragements have the greatest effect on the predisposition phase of the college decision-making process. This is followed by student achievement, parents' education level, the influence of peers, and involvement of students in high school organizations and activities" (p. 28). While Byun et al. (2012) found "perceiving high expectations of going to college from parents, talking with parents about how to pay for college, and discussing careers and work with parents were all positively related to educational aspirations for rural youth" (p. 368), they also noted the parents in their study had lower educational goals for their children and that the education level of the parents was slightly less than a two-year college education. The notion of a lowered expectation conflicts with other studies that found rural parental expectations to mirror those of parents in a town or a city locale (Griffin et al., 2011; Provasnik et al., 2007) when the highest level of degree attainment was a four-year degree. However, rural parents did have higher rates for expecting the highest level of degree completion to be a high school diploma, vocational or technical school or a two-year degree than parents in other locales (Provasnik et al., 2007).



Note. Adapted from Hossler and Gallagher (1987).

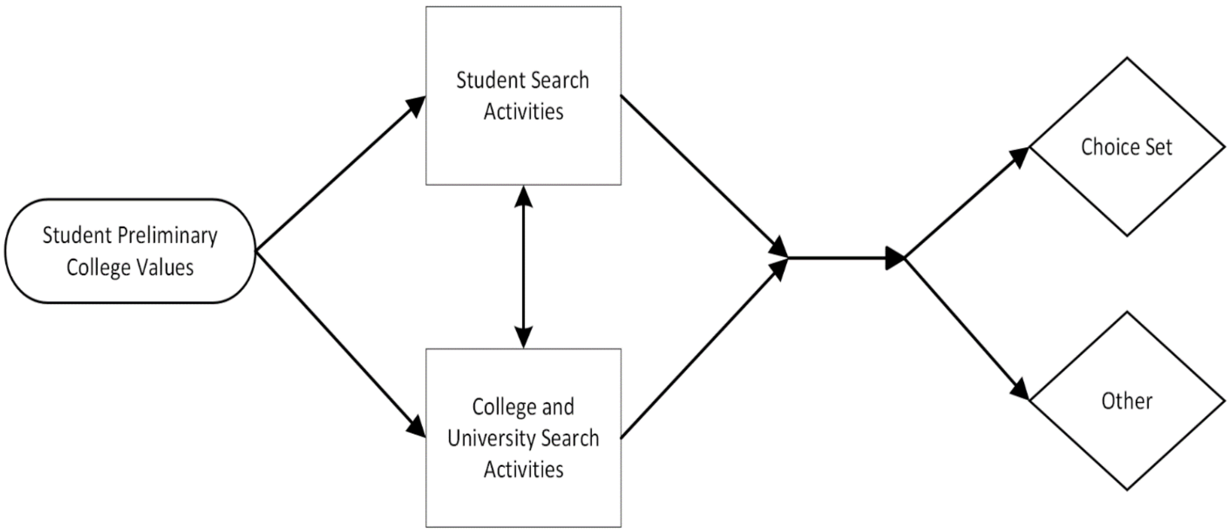
Figure 1. Phase One: Predisposition.

After parental expectations, student achievement has the greatest effect on the predisposition phase (Hossler et al., 1999). Adelman (2006) found “the highest level of mathematics reached in high school continues to be a key marker in precollegiate momentum, with the tipping point of momentum toward a bachelor’s degree now firmly above Algebra 2” (p. xix). Additional studies find that students who perform better in mathematics and are confident in their mathematical abilities are more likely to attempt and obtain a four-year degree (Chambers & Crumb, 2020). A deeper discussion of the importance of high school mathematics can be found in the section, Secondary Mathematics.

The crucial role of a rigorous high school curriculum filled with mathematical achievement makes teachers an integral part of the predisposition phase. Types of mathematics courses pursued already indicate a predisposition to college as certain courses must be completed in high school for admission to a four-year university. At the same time, students in these courses may be undecided regarding their post-secondary plans and these courses and the teacher could impact those decisions. Teachers must strive to “do no harm” at this phase as students could be undermatched in mathematics placement eliminating future entry into a degree program (Battey, 2013; Battey & Franke, 2015; Battey & Leyva, 2018; Chambers et al., 2016; Faulkner et al., 2014).

Search

Figure 2 outlines the search phase. During the second phase students search for information regarding colleges while colleges search for students. Many students will develop a list of colleges and characteristics which interest them during their sophomore year of high school. This list will form the student’s choice set and typically expands from 2 schools in the



Note. Adapted from Hossler and Gallagher (1987).

Figure 2. Phase Two: Search.

sophomore year to 3 or 4 schools in the junior year (Hossler et al., 1999) as students receive and process more information. The list of school characteristics becomes more fluid between the sophomore and junior years as well.

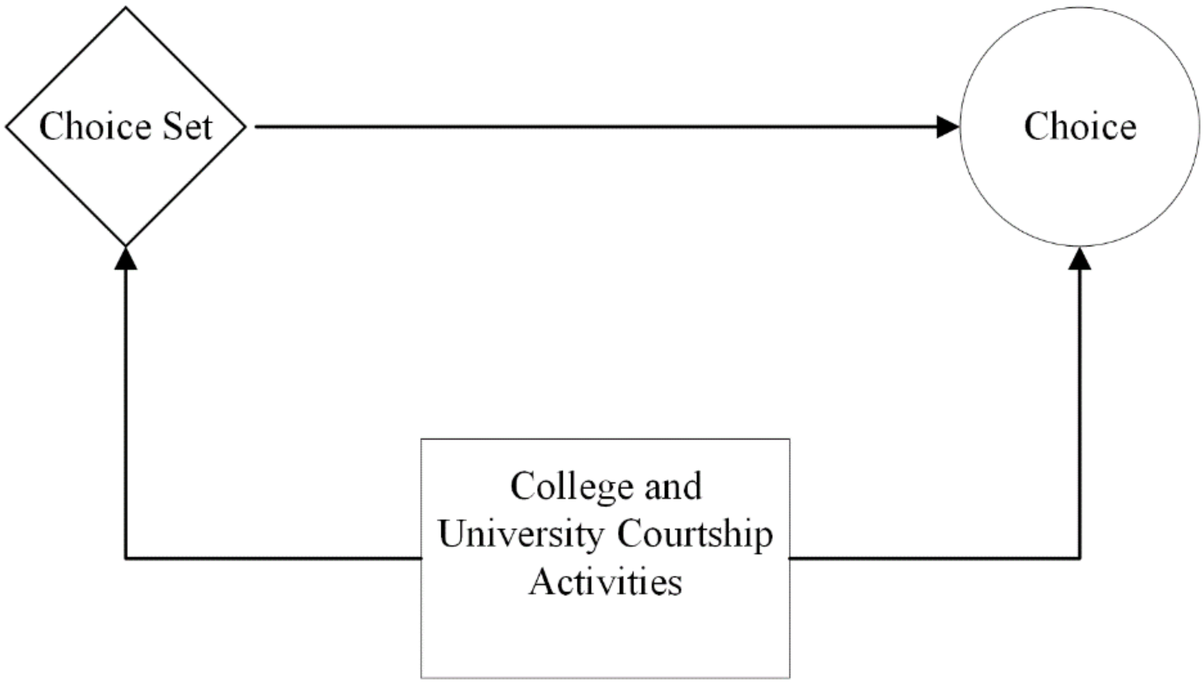
Typical information sources are "parents and siblings, high school teachers and counselors, college admissions personnel, recruitment materials, college guidance and marketing materials, and college fairs and websites" (Hossler & Bontrager, 2014, p. 54) which creates three types of searchers—attentive, active, interactive (Hossler et al., 1999). Attentive searches are passive. The student is not actively seeking information but will pay attention if the topic comes up in conversation, the school holds a college fair, or the student receives recruitment information from the institution. This may lead to an active search where the student purposely seeks discussions regarding their educational options which in turn leads to an interactive search with "student-initiated conversations, with family members, with teachers and counselors, and with college admission representatives. Interactive search also includes sending for information and visiting campuses" (Hossler et al., 1999, p. 60).

Focusing on the search process of rural students, Griffin et al. (2011) found the importance and helpfulness of sources shifts as a rural students move from lower (9-10) grades to upper (11-12) grades with students in the upper grades reporting "school counselors, college resource materials, campus visits, and college representatives as most helpful, whereas students in the lower grades felt that parents or guardians, relatives, or siblings were the most helpful sources of information" (p. 177). Furthermore, sources and their reported usefulness varied based on the rural student's gender, ethnicity, and school differences. Black and Hispanic students were more likely than white students to use teachers as an information source. While Hispanic students were less likely to seek out information from any source and found school counselors to be the least helpful, black students included religious leaders and their communities as sources of information. Overall, the study found that students of color and "students in more rural areas and in schools of lower income were more likely to go to their teachers for information" (p. 178).

Use of teachers, counselors, and community leaders has a potential to harm rural students as some community leaders try to prevent rural "brain drain" where a student does not return to the community after completing their degree (Means, 2018; Petrin et al., 2014). Therefore, rural students may be encouraged to remain in their local community to pursue more traditional employment that does not require a college degree (Bray et al., 2019; Tieken, 2016). More research is needed in this area particularly as applies to rural males (Sowl & Crain, 2021), as rural males have a lower rate of college completion than rural females (Bray et al., 2019). There is a lack of research to determine if this stems from males being encouraged to remain in their community to pursue profitable jobs that do not require an advanced degree. All of these elements lead the student to form a "choice set" of schools which leads to the third phase.

Choice

Figure 3 outlines the choice phase. During the final phase students evaluate and narrow their choice set as they are courted by colleges and universities (Hossler & Gallagher, 1987). The number of institutions students consider changes throughout their high school years. Sophomores are interested in approximately two schools. This interest will increase to four or more schools in the junior year and will stabilize at three schools in the senior year. Of the schools considered, "only about 12% of the first choices in the tenth grade were still the students' first choices when they were seniors. However, 59% of tenth-graders first choices remained in the consideration sets in the twelfth grade" (Hossler et al., 1999, p. 85).



Note. Adapted from Hossler and Gallagher (1987).

Figure 3. Phase Three: Choice.

The shift in number of schools and the ranking of those schools within a consideration set reflects both interaction with colleges and universities and a student's transition from the internal information source of parents and possibly siblings to more external information sources such as "peers, teachers, counselors, and even college marketing material [which] become more influential sources of information" in upper (11-12) grades (Hossler et al., 1999, p. 86).

Changing information sources indicates that lower college attendance by rural students is not merely a message being communicated from parent to child. Especially when studies show students in rural schools are more likely to utilize teachers as their information source than students in small town and higher income schools (Griffin et al., 2011). Rural students are also "less likely to attend any postsecondary education within two years of completing high school, … less likely to attend four-year institutions, more-selective institutions, and those that confer graduate degrees" (Koricich et al., 2018, p. 294).

Mathematics and College Choice

Researchers from the 1920s and 1930s were reviewing the link between high school mathematics and college performance (Douglass & Michaelson, 1936; Harris, 1940; Odell, 1927). Questions such as

> … do any of the data which are fairly readily obtainable concerning high school graduates provide a satisfactory, or even a helpful, basis of foretelling scholastic success in college? If so, which of these data are most valuable for this purpose and how much confidence should be placed in their use? (Odell, 1927, p. 8)

were asked almost a hundred years ago. This research continues with more recent research finding that completing Algebra II significantly increases the probability of attending college (Adelman, 2002; Adelman, 2006; Kim et al., 2015).

Building on previous research, there is a question regarding how many studies account for the self-selective nature of the populace (Kim et al., 2015). That is a student completing advanced high school mathematics may already have college in mind. If a student waits until their senior year of high school to decide to attend college, they may no longer be eligible for a four-year institution for failure meet the high school mathematics admission requirements (Hossler et al., 1999).

Secondary Mathematics and Rural Students

For "both urban and rural students with mediocre/poor high school records are less likely to continue their education than suburban students with the same records" (Adelman, 2002, p. 46-47). In this vein, the proportion of students who do not continue their education despite strong high school records does not differ by urbanicity. The real differences in educational "fate," by urbanicity of origin, are seen only at the bachelor's degree level. As found by Chambers (2020), mathematics proficiency influences whether rural African American male students attend a two- or four-year postsecondary institution but does not influence postsecondary education enrollment overall. This is further compounded by a lower initial mathematics placement as African American students have lower odds of being placed into an Algebra class by eighth grade regardless of their ability (Faulkner et al., 2014).

A rural student's access to mathematics in high school impacts their success in college (Chambers, 2020a). Adelman (2006) observed that the quantity and rigor of mathematics coursework at the secondary level is the greatest predictor of college enrollment. As he observed,

> It is not merely getting beyond Algebra 2 in high school any more: The world demands advanced quantitative literacy, and no matter what a student's postsecondary field of

> study—from occupationally-oriented programs through traditional liberal arts— more than a ceremonial visit to college-level mathematics is called for. (Adelman, p. 108)

Since Adelman's observation, state level education systems of education have increased the intensity of mathematics curriculum at the primary and secondary education levels. While these policy developments, have led to overall increases in the number of mathematics courses and mathematics proficiency among students in the United States, these gains did not address equity gaps in access to rigorous mathematics coursework (Kim et al., 2015).

Within rural contexts, access to differentiated mathematics coursework, particularly at higher levels of rigor, is attenuated. With teaching shortages particularly in mathematics (Aragon, 2016) and the need to provide the most mathematics courses for the most students, rural high schools must match demands for higher quality mathematics course work with the supply of educators (Lavalley, 2018; Shuls, 2018). This can mean limiting mathematics coursework to what is merely necessary to meet state standards and is substantiated by findings that rural high school students begin high school at a lower level of mathematics (Anderson, R. & Chang, 2011; Barshay, 2021) and graduate with less mathematics credits than non-rural graduates (Anderson, R. & Chang, 2011) and have less access to Advanced Placement mathematics courses (Anderson, R. & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018).

The discrepancy in access to advanced mathematics is staggering with half of students who attend schools in rural areas and small towns having access to only one to three advanced mathematics classes while "fifty-eight percent of students in urban schools and 41 percent in suburban and large-town schools can choose from as many as seven or more courses in advanced mathematics" (Graham, 2009).

While not all students need multiple advanced mathematics courses this removes many rural students from the pathway to a STEM career even if they were interested when entering high school (Barshay, 2021; Graham, 2009). One effort to correct these inequities is the introduction of the Rural STEM Education Act. This bipartisan bill seeks to create grants to provide training to STEM teachers in rural schools, research barriers faced by rural students in STEM education, and create partnerships between rural high schools and community colleges (Federal Depository Library Program, 2020).

Summary

There are numerous quantitative definitions used to specify rural populations. Mere use of the term brings qualitative imagery that depends on the reader and the researcher. Clear definitions of rurality are imperative as such this dissertation utilizes the classification system adopted by the NCES in collaboration with the U.S. Census Bureau when the former began selecting schools for the HSLS:09 which divides rurality into three subcategories—fringe, distant, and remote—based on the territory's distance from an urbanized area. While the diversity of the individuals in these groups is recognized, rural students face many of the same challenges which impacts their college choice and leads to a lower rate of college attendance among rural students despite a higher rate of earning a high school diploma (Brand & Xie, 2010). These challenges include lower parental education level and expectations (Byun et al., 2012; King, 2018; Li, 2019; Sowl & Crain, 2021; Tieken, 2020), lower socioeconomic status (Byun et al., 2012), decreased access to Advance Placement courses (Anderson, R. & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018), and pressure to remain in or return to their local community (Petrin et al., 2014; Tieken, 2016).

Using the Hossler and Gallagher (1987) model for college choice—predisposition, search, and choice—coupled with data gathered from the HSLS:09 this dissertation seeks to examine the impact of high school mathematics coursework on rural student college choice because access to and completion of advanced mathematics courses in high school are strong predictors of college enrollment (Adelman, 2006) and impacts college success (Chambers, 2020a). This is a great challenge to rural students who have considerably less access to advanced mathematics courses than non-rural students (Anderson, R. & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018).

CHAPTER 3: METHODOLOGY

The purpose of this dissertation is to determine the impact of a rural student's high school mathematics coursework on college choice. A quantitative methodology will be used in a secondary data analysis of the High School Longitudinal Study of 2009 (HSLS:09). The research questions are as follows:

Research Questions

There are three research questions guiding this study. My research questions are:

1. What is the relationship between secondary mathematics courses and enrollment in any postsecondary institution for rural students?
2. What is the relationship between secondary mathematics courses and enrollment in a four-year postsecondary institution for rural students?
3. What is the relationship between secondary mathematics courses and enrollment in a two-year postsecondary institution for rural students?

Data Source

NCES conducted a stratified two-stage sample design for the HSLS:09. Schools were selected in the first sampling round and students within those schools were selected in the second sampling round. The schools targeted for the base year were "regular public schools, including public charter schools, and private schools in the 50 States and the District of Columbia providing instruction to students in both the 9^{th} and 11^{th} grades as of the fall of 2009" (Ingles et al., 2013, p. 33).

Schools for the initial base-year were selected from NCES databases. Public schools were selected using the 2005-06 Common Core of Data (CCD), while private schools were selected using the 2005-06 Private School Universe Survey (PSS). To expand coverage of the population of interest, additional schools were selected before recruitment from the updated 2006-08 CCD and 2007-08 PSS.

HSLS:09 was originally a national design to be representative of ninth-grade grade students across the United States. This was achieved by utilizing 48 first-stage sampling strata that included considerations of the geographic region and location at the school. The inclusion of these variables provides a representative data set for my study as it allows for the comparison of rural subgroups such as rural students living in the southeastern United States versus those living in the Pacific Northwest.

NCES received a request from the National Science Foundation for representative estimates within certain states which revised study objectives for 10 states and added schools to the sample in eight of those states. This yielded a total of 1,973 sample schools for the recruitment phase where 84 schools were then identified as ineligible. In the end, 944 schools participated in the base-year study with 26,305 students being randomly selected from those schools.

The random sampling of students was conducted using a stratified systematic sampling procedure from base-year enrollment lists provided by school administrators. Of those selected students, 1099 were classified as study ineligible and excluded from data collection. The schools would identify an additional 548 students having physical limitations that made the individual unable to complete the student questionnaire. A total of 85.1% of the eligible students responded to the questionnaire for a total of 21,444 HSLS:09 base year student participants.

Student participants were not the only ones to complete questionnaires. Base-year contextual information was collected through the school administrators and counselors. The administrators were contacted by study recruiters to give permission for data to be collected in each selected school, while each school's respective nine-grade student counselor completed a questionnaire. Additional questionnaires were completed by the student's parent or guardian and their science and mathematics teachers.

The inclusion of science and mathematics teachers distinguishes the HSLS:09 from previous NCES longitudinal studies. This STEM focus coupled with representative sampling of both the geographic region and location of the school make the HSLS:09 an excellent fit for researching high school mathematics in rural schools. The longitudinal design then makes the examination of the courses impact on college choice possible.

Sampling Frame

As the focus of this dissertation relates to rural students, the sample population for this study is exclusive to rural students as obtained from the total 21,444 respondents to the HSLS:09. The variable X1Locale characterizes the urbanicity of the participant's base year school as either city, suburb, town, or rural. This results in the unweighted frequencies of 220 schools (23.1%) or 5,559 students (23.65%) as the rural population for my study.

Variables

The HSLS:09 examined over 10,000 variables related to the students participating in their study. This information was gathered from parents, teachers, administrators, and the student using questionnaires, a mathematics assessment given to students in 9th grade and repeated in 11th grade, and subsequent periodic reviews of both high school and postsecondary transcripts. Approximately 10% of these variables address the student's high school mathematical experience.

The central focus of my study is the relationship between the high school mathematics coursework of rural students and the student's decision to enroll in college or not. As seen in the literature review previous studies indicate the completion of Algebra 2 (Adelman, 2006) or higher mathematics as indicators of college success. The HSLS:09 contains variables regarding not only the mathematics courses taken by students but when and why these classes were taken. For example, S1MCLGADM is a variable that indicates a 9th grader is taking a math class because they need it to get into college while S1MCLGSUCC indicates a 9th grader is taking a math course to help them succeed in college.

There are over 1,000 variables in the HSLS:09 that pertain to the student's secondary mathematical experience. To select variables for this study I will first conduct descriptive statistics to ascertain overall mathematical participation and achievement using measures of central tendency and t-tests. Next, I will conduct a multivariate analysis, specifically a forced entry logistic regression, to examine variables associated with college choice. Given the complex design I intend to use the NCES recommended weights in each equation.

Independent Variables

The variables I will initially look at are listed in the Table 4 which address the mathematics courses taken and the performance in mathematics overall. This will establish if there is a relationship between these courses and college choice. At that point, I may add variables to the model such as A2MTHREQ4YR which compares the high school math graduation requirement versus entry requirements for public 4-year college.

While college enrollment is a binary variable, there are many factors impacting college choice which should be accounted for when examining the relationship between the highest high school mathematics course taken and the choice to enroll in a 2- or 4-year college following high school. Many of these factors were discussed in Chapter 2 and corresponding variables in the

Table 4

HSLS:09 Variable Name and Description

Variable	Description
X3T1CREDALG1	X3 At least one credit earned in: Algebra 1
X3T1CREDALG2	X3 At least one credit earned in: Algebra 2
X3T1CREDINTM	X3 At least one credit earned in: Integrated Math
X3T1CREDPREC	X3 At least one credit earned in: Analysis/Pre-Calculus
X3TCREDAPMTH	X3 Credits earned in: AP/IB Mathematics courses
X3T1CREDCALC	X3 At least one credit earned in: Calculus
X3T1CREDGEO	X3 At least one credit earned in: Geometry
X3T1CREDSTAT	X3 At least one credit earned in: Statistics/Probability
X3T1CREDTRIG	X3 At least one credit earned in: Trigonometry
X3TCREDMAT	X3 Credits earned in: Mathematics
X3THIMATH	X3 Highest level mathematics course taken/pipeline
X3THIMATH9	X3 Highest level mathematics course taken - ninth grade
X3TGPAMAT	X3 GPA: Mathematics
X3TGPAHIMTH	X3 GPA: Highest level mathematics course taken
X3TWHENALG1	X3 When student took Algebra I

HSLS:09. For example, expectation plays a large role in college choice and is a variable included in the HSLS:09 through the parent's questionnaire. Other variables which should be accounted for are family SES, scores on mathematical assessments, teacher expectations, math self-efficacy score.

Dependent Variable

Logistic regression is appropriate due to the dichotomous nature of the dependent variables (0, did not attended college, 1 attended college; 0 did not attend a 2-year college, 1 did attend a 2-year college; 0 did not attend a 4-year college, 1 did attend a 4-year college).

Overview of Methodology

I chose to conduct a secondary data analysis for my study because the HSLS:09 is a rigorous and well-funded study which provides a richer sampling than I could obtain as a doctoral student. The sample selection is twofold with the National Center for Educational Statistics making the initial sample of study participants and then a second choice by me as I decided which variables best fit examination to test my research question. A discussion of the primary study participant selection, my selection of HSLS:09 variables, and my data analysis methods are discussed in this section.

Data Analysis

A logistic regression will be performed to analyze the selected variables. These variables will be selected first by descriptive statistics and then followed by forced entry logistic regression to ascertain their impact on college attendance overall. Given the large number of cases included it is anticipated that a parsimonious equation will not be necessary. The data analysis will conclude with a full examination of the odds ratio for each of the independent variables used.

Limitations and Assumptions

Regardless of the size and quality of the study sample there are always limitations to the data and researcher assumptions. A principal limitation of secondary data analytic studies is researcher ability to select variables for inclusion in the study and to conduct interviews with participants.

Data Availability

Public use data is available for immediate download through the NCES Online Codebook and is available in multiple formats for import into various statistical software packages. For this study, I will download the data set formatted for use with SPSS.

While many data values are publicly available there are data values which are restricted in order to protect the anonymity of the study participants. Researchers with institutional support may undergo an application process and pay a fee to gain access to the restricted data set, but it is not feasible for a doctoral student to obtain this information.

Limitations

Restricted variables create a minor limitation to this study. It would be interesting to utilize the restricted variable A1MTHREQS which asks administrators if specific mathematics courses are required by the school for graduation which may address questions of student motivation and potentially demonstrates a nudge toward college based on these requirements. However, there are many publicly available data regarding a student's high school mathematics curriculum which still allow for a rich analysis such as A2MTHREQ4YR which compares the high school math requirements with those of the requirements for a state four-year college.

Another limitation of this study is the inability to conduct student interviews. This is a limitation in any secondary data analysis. The HSLS:09 data set compensates for this limitation by including variables such as S1MREASCLG where a student indicates the intent to take more math classes to help get into college or S2MNOCLGADM which indicates a student is not taking a math class because it will not be needed to get into college. There are many more variables included in this study that allow for examination of the research questions without directly interviewing students and the large number of study participants could prove more advantages than individual interviews.

Assumptions

The largest assumption that must be made in a secondary data analysis is the validity of the data and its source. I feel safe in my assumption that this is a valid data set resulting from a thorough and rigorous study. Part of the mission of the National Center for Education Statistics in conducting longitudinal studies is to provide quality data to researchers and policy makers.

Summary

This study will use the large data set produced by the HSLS:09 to examine the relationship between high school mathematics courses and college choice for rural students. Independent variables will be selected based on a forced entry logistical regression to scrutinize college attendance overall for rural students. Based on the results the need for a parsimonious equation will be ascertained. The analysis will conclude with an inspection of the odds ratio for each independent variable.

CHAPTER 4: RESULTS

Completion of higher-level mathematics courses in high school indicates future enrollment in a bachelor's degree program (Adelman, 2006). While rural students are completing high school at a higher rate than their non-rural peers, they are entering college at lower rates (Chambers, 2020a; Showalter et al., 2019). Furthermore, rural students enter high school at a lower level of mathematics, have less access to rigorous mathematics course, and end their mathematical studies earlier and at a lower level than nonrural students (Anderson& Chang, 2011; Barshay, 2021).

The purpose of this study is to examine the relationship between the quantity and rigor of mathematics courses rural students take in high school and enrollment in a 2-year or 4-year institution upon graduating from high school. The research questions examined in this chapter are:

1. What is the relationship between secondary mathematics courses and enrollment in any postsecondary institution for rural students?
2. What is the relationship between secondary mathematics courses and enrollment in a four-year postsecondary institution for rural students?
3. What is the relationship between secondary mathematics courses and enrollment in a two-year postsecondary institution for rural students?

These questions were analyzed using secondary data analytic statistical techniques utilizing the National Center of Educational Statistics' (NCES) High School Longitudinal Study of 2009 (HSLS:09).

The first sections of this chapter describe the processes used for data collection and data analysis of my dissertation. I then proceed to offer a brief discussion of the demographics of my study. Finally, the results are reported for each research question.

Data Collection

Initial data were collected by NCES as part of the HSLS:09. The study had a stratified two-stage sampling design where schools were selected in the first followed by a selection of students within the school. These students were randomly selected from base-year enrollment lists provided by the schools. There was an 85.1% response rate for a total of 21,444 HSLS:09 base year student participants from 944 schools.

Questionnaires were completed by students, parents, math and science teachers, administrators, and counselors. In addition to the student survey, students also participated in a mathematics test. After the initial year, there were additional surveys, mathematical assesments, and reviews of high school and college transcripts. These surveys, tests, and transcript reviews resulted in over 10,000 variables related to these students and their secondary and post-secondary experiences.

I reviewed all these variables and their descriptions to find the publicly available data that best related to my research questions using the Hossler and Gallagher (1987) college choice framework, with an emphasis on the first phase. The first phase in the framework is predisposition, which is when a student decides they are interested in attending college after high school. Students who enroll in higher level mathematics courses earlier in high school are showing a predisposition to attend college as they complete coursework to meet admissions criteria. Enrolling is one component of predisposition, while success in the course is also of importance. In fact, student achievement follows only parental expectation in impact on the predisposition phase.

Of the 10,000 variables available, approximately 1,000 related to high school mathematics. Using the Hossler and Gallagher (1987) college choice model as a framework, I identified 15 variables for initial analysis to establish a connection between high school mathematics courses and the decision to enroll in college for rural students.

Data Analysis

The data set was downloaded from the NCES Online Codebook and then imported into the software SPSS 28.1 Macintosh edition. SPSS is a statistical processing software made available for download to East Carolina University students and faculty through ECU's site license, and the downloaded NCES file was formatted by NCES for use in SPSS. Once downloaded, the data were cleaned, and descriptive statistics were performed before beginning the logistical regression. More details regarding the data analysis process are included in this section under the appropriate heading.

Cleaning Data and Sample Selection

The original study design planned for the restriction of the data set to rural students only (X1LOCALE=4), which yielded 5,559 participants. However, further investigation of this variable against X4PSENRSTLV, highest level of enrollment in February 2016, showed there would be too many missing and unit non-response data values to yield an adequate sample size. Removing these cases would reduce the sample size to 2,813.

To generate a sufficient sample size while maintaining the intent of the study, students from towns (X1LOCALE=3) are included. A town is defined by NCES based on the proximity of an urban cluster to an urbanized area using the Census Bureaus' designations of urban clusters and urbanized areas. An urbanized cluster requires at least 2,500 people but less than 50,000 people (National Center for Education Statistics, 2022a). Urban areas contain at least 50,000 people. Full descriptions for town classifications are provided in Table 5. Like the rural locale, the town locale has three substrata of fringe, distant, and remote. Expanding the sample to include students from towns is a common practice in rural studies given the varying definitions of rural as discussed in Chapter 2.

Including the additional respondents increased the sample size to 8,347. From these, 32 students with missing X4PSENRSTLV data were removed along with 2,357 marked as unit non-response. Designations of unit non-response means the participant did not complete the survey instrument. An additional 1,771 records labeled as "legitimate skip" and were imputed to the mean for X4PSENRSTLV, which was 1=enrolled in a four-year institution. The final resulting sample size was 5,958. A breakdown by institution type is provided in Table 6. By 2016, 66.2% of rural and town students combined, hereinafter rural students, enrolled in a four-year college or university. Just over 10% (10.4%) enrolled in a two-year college, meaning 76.6% of students enrolled in either a two- or four-year post-secondary institution within three years of graduation for those on a traditional trajectory. This is not to say that these students attained the rank of junior, but that the super-majority of rural students enrolled in some form of post-secondary education within three years of college completion.

High School Mathematics Coursework

Once the data were cleaned, appropriate descriptive statistics were calculated for the variables concerning high school mathematics coursework to understand participants' high school mathematics experiences. The number of mathematic credits earned, X3TCREDMAT, was measured in Carnegie units, with one unit being the equivalent to one year of mathematics

Table 5

NCES Urban Centric Classifications of Towns

Locale	Definition
Town-Fringe	Territory inside an Urban Cluster that is less than or equal to 10 miles from an Urbanized Area
Town-Distant	Territory inside an Urban Cluster that is more than 10 miles and less than or equal to 35 miles from an Urbanized Area.
Town-Remote	Territory inside an Urban Cluster that is more than 35 miles from an Urbanized Area

Note. (National Center for Education Statistics, 2022a).

Table 6

Highest Level of Enrollment in February 2016

Level	Percent
Not Enrolled	22.6%
Enrolled in 4 Year	66.2%
Enrolled in 2 Year	10.4%
Enrolled in < 2 Year	0.6%
Enrolled Level Unknown	0.2%

Note. Missing variables imputed to the mean of “Enrolled in 4 year”.

instruction or roughly one mathematics course. The average number of Carnegie units earned was 3.69, with a standard deviation of 1.23. Over 60% of the students earned four or more high school mathematics credits. Most students earned credits in Algebra 1 (94.7%), Geometry (74.9%), and Algebra 2 (63.1%), with 45% of students taking Algebra 1 as their highest level of math in the 9th grade and approximately 24% taking Algebra 2 as their highest mathematics course taken overall (see Table 7).

Further examination of X3THIMATH, highest mathematics course taken in pipeline, found 18.68% of the students took Pre-Calculus and 14.2% took Calculus as their highest mathematics course. Only 8.56% of students took an Advanced Placement (AP) or International Baccalaureate (IB) Calculus courses as their highest mathematics course. See Table 7. AP/IB are distinctions which imply a more rigorous course. However, this distinction should merely be noted instead of assumed.

It is within the scope of this study to provide a cursory evaluation of grades received for both mathematics courses overall (GPAMAT) and highest mathematics course taken (GPAHIMTH). See Table 7. The average GPA received for the highest mathematics course taken in the pipeline are as follows: Algebra 2 (2.16), Pre-Calculus (2.91), Calculus (3.23), and AP/IB Calculus (3.47). Thus, there is an increase in average mathematics GPA as reported by students, with the progression of mathematics coursework.

Additionally, we can compare the student's highest mathematics course taken in the pipeline to the type of postsecondary institution in which they first enrolled. For students whose highest mathematics course was Algebra 2, 33.82% first enrolled in a 2-year institution and 27.28% first enrolled in a 4-year institution. When examining Pre-Calculus and Calculus as the highest mathematics course, there was a much higher enrollment in a 4-year institution as the

Table 7

Descriptive Statistics Mathematics Course Credits, GPA, and Postsecondary Enrollment

Math Course	Credits	GPA	2-Year Enrollment	4-Year Enrollment
Algebra 1	94.7%	1.45	19.25%	7.92%
Geometry	74%	1.84	24.40%	11.90%
Algebra 2	63.1%	2.16	33.82%	27.28%
Pre-Calculus[a]	18.68%	2.91	25.43%	63.07%
Calculus[a]	14.2%	3.23	12.65%	81.62%
AP/IB[a]	8.56%	3.47	8.82%	88.63%
Mean	3.69	2.34		
Standard Deviation	1.23	1.04		

Note. [a] Highest mathematics course taken in the pipeline.

student's first postsecondary institution. Of the students whose highest mathematics course was Pre-Calculus, 63.07% first enrolled in a 4-year postsecondary institution. For students who took Calculus or AP/IB Calculus as their highest math, those percentages for a first enrollment in a 4-year postsecondary institution were 81.62% and 88.63% respectively (see Table 7).

High School Mathematics Achievement

Additionally, it is possible to review variables related to mathematical achievement other than the average grade earned in a course. The public data set includes some variables related to individual mathematics achievement. Participants were given a mathematics assessment during the base year (2009) and again during the first follow up (2012). For most students, this was the fall of their ninth grade year and the spring of their 11th grade year. The quintile scores for both the base year (X1TXMQUINT) and the first follow up (X2TXMQUINT) are included in the public use file. Both are norm-referenced scores which measure mathematical achievement and divides participants into five equal groups based on their score on the mathematical assessments given in 2009 and 2012. Students in the first quintile have the lowest level of mathematical achievement, and students in the fifth quintile have the highest level of mathematical achievement (see Table 8).

In the base year, rural students are underrepresented in the lowest two mathematics achievement quintiles. This indicates that students at the bottom of the distribution entered ninth grade with slightly higher levels of mathematics ability as their non-rural peers. Rural students are equally represented in the third and fourth quartiles, the middle of the distribution and nearly equally represented with their non-rural peers at the fifth quartile.

In the first follow up, rural representation in the lowest two quintiles and the upper two quintiles increased by approximately one percentage point. Thus, by the time most students are

Table 8

Quintile Distribution of Rural Students Mathematics Achievement

Quintile	Base Year (2009)	First Follow up (2012)
5th Quintile	19.4%	20.2%
4th Quintile	20.2%	20.5%
3rd Quintile	20.2%	18.2%
2nd Quintile	17.5%	18%
1st Quintile	15.9%	16.4%
Missing	6.8%	6.7%

juniors in high school, rural students are equally represented in the top two quintiles. They are also underrepresented in the lowest quintile. Thus overall, rural students demonstrate a mathematics ability comparable to their non-rural peers.

Reasons for Not Attending College

While reviewing the descriptive statistics for variables that would provide a broad academic picture of participants in this study, I examined several variables regarding the reason a participant never enrolled in college. These questions were part of the second follow up and asked respondents to select reasons that they had not attended a college or trade school by February 2016 from a list of reasons. The choice of reasons for never attending college included academic reasons, personal or family reasons, financial reasons, work/military/career reasons, and other reason. Only 2.2% selected the option of "academic reasons" in response to the question regarding why they did not attend college. The specificity of the academic reason was not available, but this low percentage indicates that struggles with mathematics was not a conscious reason for not attending college. In fact, the most frequently selected reasons for not attending college were financial reasons (13.1%) and family or personal reasons (12.3%).

Expectations

The majority of parents expected their child to earn at least a high school diploma (87.55%), with 11.36% of parents who did not know their expectation for their child's level of academic achievement and only 1% of parents expecting less than a high school diploma. In fact, expecting a bachelor's degree was the most common expectation at 33.13%. This was followed by the expectations of a master's degree (15.96%) and a doctorate/advanced professional degree (13.60%). Table 9 provides a breakdown of parental expectations overall and by SES quintile,

Table 9

Percentages of Parent Expectations of Degree Attainment by SES Quintile

Parent Expectation	Overall	1st	2nd	3rd	4th	5th
Less than HS	1.09	0.37	0.29	0.20	0.13	0.10
HS Diploma[a]	7.26	2.15	1.80	1.51	0.96	0.86
Occupational Certificate	5.66	1.19	1.56	1.29	0.99	0.62
Associate's Degree	8.34	1.44	1.863	1.88	1.86	1.30
Bachelor's Degree	33.13	3.37	4.36	5.69	7.00	12.71
Master's Degree	15.96	2.18	2.42	2.72	3.44	5.20
Ph.D/M.D.[b]	13.60	1.91	2.18	2.27	2.75	4.48
Don't Know	11.36	2.92	2.67	2.06	1.91	1.80

Note. [a] Includes GED or alternate high school credential. [b] Includes law degree or other high level professional degree.

with one being the lowest quintile and five being the highest quintile. Parental expectations to start but not finish a postsecondary certificate or degree were excluded for clarity.

Even though the expectation to earn a bachelor's degree has higher percentages in the upper quintiles, it is the highest parental expectation for all SES quintiles. While earning a high school diploma has greater percentages in the lower quintiles, the percentage of parents in the lowest quintile who expected a high school diploma (2.15%) was roughly equivalent to the percentage of parents in the lowest quintile who expected their child would earn a master's degree (2.18%; see Table 9).

Student expectations showed the greatest percentage did not know (28.47%) their educational expectation. These percentages decreased as the SES quintile increased, with the highest percentage of students who did not know their expectation in the lowest quintile and the lowest percentage in the highest quintile. Among students who did know their educational expectation, the highest percentage specified they planned to earn a postgraduate degree (18.38%). The expectation to earn a postgraduate degree had a direct variation to the SES quintiles with the percentage of students expecting to earn a postgraduate degree increasing with each SES quintile. See Table 10 for a full breakdown of student expectations overall and by SES quintile.

Demographics

While the public data set suppresses many variables to protect the identities of the participants, the variables regarding a student's SES quintile, binary sex (biological), and race/ethnicity-composite were not restricted. Similar to the mathematics quintiles, the SES quintiles were calculated in both the base year and first follow up. There were two SES quintiles computed in both years. X1SESQ5 and X2SESQ5 are formed from the quintiles of X1SES and

Table 10

Percentages of Student Expectations of Degree Attainment by SES Quintile

Student Expectation	Overall	1st	2nd	3rd	4th	5th
Less than HS	0.40	0.12	0.10	0.07	0.05	0.07
HS Diploma[a]	11.13	3.15	2.37	1.98	1.51	2.11
Associate's Degree	5.86	1.26	1.16	1.49	1.07	0.87
Bachelor's Degree	15.49	1.78	2.80	3.02	3.21	4.68
Master's Degree	17.51	1.71	2.50	3.17	3.93	6.19
PhD/MD[b]	18.38	1.90	2.89	3.04	3.71	6.85
Don't Know	28.47	5.66	5.49	5.14	5.77	6.41

Note. [a] Includes GED or alternate high school credential. [b] Includes law degree or other high level professional degree.

X2SES, which form a composite of the student's SES based on the parent/guardians' occupation and education, and the family income level. The additional quintiles of X1SESQ5_U and X2SESQ5_U were created from X1SES_U and X2SES_U, which added the consideration of the school locale into the consideration of a student's SES. Results are listed in Table 11.

Like the mathematics quintile scores, there are not a disproportionate number of rural students in the lowest SES quintiles. This indicates that these students do not have a lower SES than their non-rural peers. It is interesting that including the school locale in the calculation of SES increased both the percentage of students in the lowest and highest quintile in the base year. Also of interest is the change in quintiles between 2009 and 2012 when urbanicity is considered. While more information is available in the first follow-up, more research should be done to ascertain the reason for the increase in the fifth quintile (see Table 11).

Regarding binary sex and race/ethnicity-composite, the rural students in my study are 49.1% male and 50.8% female, with data for only 2 students missing. Race/ethnicity-composites were not as equally distributed as sex. White students comprise over half (55.7%) of the sample, which is almost five times more than Hispanic, race specified (12.0%) and approximately six times more than Black/African-American, non-Hispanic (10.2%) rural students. In comparison to public high school graduates for 2012-2013 nationwide, the percentage of white students (56.5%) is roughly the same, while the nationwide percentages of Black (14.6%) and Hispanic (20.2%) are higher than those in this study. The opposite can be said of Asian students, who comprise 5.7% of the 2012-2013 public high school graduates nationwide, but account for 7.5% of the students in this study (National Center for Educational Statistics, 2016). A full breakdown of students' race/ethnicity-composite is provided in Table 12.

Table 11

Student's Socioeconomic Status Quintile

Quintile	2009	2009 with Urbanicity	2012	2012 with Urbanicity
Missing	6.8	6.8	5.7	5.7
First Quintile (lowest)	16.4	17.2	16.2	16.1
Second Quintile	18.5	17.3	18.3	17.9
Third Quintile	19.4	18.4	19.9	18.2
Fourth Quintile	19.1	18.4	19.9	19.9
Fifth Quintile	19.8	21.9	19.9	22.2

Note. Urbanicity refers to the location of the school.

Table 12

Student's Race/Ethnicity-Composite Percentages by Study and Nationwide

Race	Study	Public High School Graduates 2012-13
Missing	3.4	
Amer. Indian/Alaska Native, non-Hispanic	1.1	1.0
Asian, non-Hispanic	7.5	
Black/African-American, non-Hispanic	10.2	14.6
Hispanic, no race specified	1.6	20.2
Hispanic, race specified	12.0	
More than one race, non-Hispanic	8.1	
Native Hawaiian/Pacific Islander, non-Hispanic	0.4	5.7[a]
White, non-Hispanic	55.7	56.5
Two or more races specified		2.1

Note. [a] Includes Asian, non-Hispanic.

Multivariate Analyses

After reviewing the descriptive statistics and demographic data to determine the best variables to include in a logistic regression, I decided to utilize X4PS1LEVEL as the basis for my dependent variable for each model. This variable captured the level of the first postsecondary institution students attended after high school. Responses marked as "legitimate skip, n/a" were assumed to be the equivalent of "never enrolled" since the rate matched that of the responses given for never attending a college or trade school by February 2016. Additionally, I chose X4PS1LEVEL as the majority of those who enrolled in a postsecondary did so in 2013 indicating a traditional enrollment.

Three different versions of X4PS1LEVEL were created to support binary logistic modeling for each of my research questions. This also allowed better confirmation that all assumptions for logistic regression were satisfied for each model. To review, my research questions are:

1. What is the relationship between secondary mathematics courses and enrollment in any postsecondary institution for rural students?
2. What is the relationship between secondary mathematics courses and enrollment in a four-year postsecondary institution for rural students?
3. What is the relationship between secondary mathematics courses and enrollment in a two-year postsecondary institution for rural students?

Results for each question are included in the appropriate following sections. The independent variables chosen are listed in Table 13. These variables were recoded to impute missing values to the mean or median as appropriate. The original study design included testing more variables in the models but were removed for being too highly correlated with other variables in the models.

Table 13

Independent Variables for Logistic Models

Original Variable	Recoded	Description
X3THIMATH	A01MHIGH	X3 Highest level mathematics course taken/pipeline
X3TCREDMAT	A01CREDMAT	X3 Credits earned in: Mathematics
X2SESQ5_U	A01SESQ5_U	X2 Quintile coding composite derived with locale (urbanicity)
X2PAREDEXPCT	A01PAREXPECT	X2 How far in school parent thinks sample member will go
S1EDUEXPECT	A01STUEXPECT	S1 G01 How far in school 9th grader thinks he/she will get

Each independent variable had an overall *p*-value to test the significance of the variable with sub *p*-values to test the subcategories of each categorical variable. A01MHIGH contains 14 different possibilities for highest mathematics course taken in the pipeline. X2SESQ5_U contains quintiles. A01PAREXPECT contains 13 educational expectations, while A01STUEXPECT contains 11 educational expectations. All of these have *p-value* to test significance.

Study Question 1 Results

The first model tested whether the student enrolled in any level of postsecondary education. X4PS1LEVEL was recoded into a new dependent variable A01E, which classified the students as either not enrolled or enrolled in any postsecondary institution. The logistical regression produced a Nagelkerke R square value of 0.343, which indicates that 34.3% of variation in the model can be explained by the highest level of mathematics course taken. The model correctly predicted non-enrollment in a postsecondary institution 46% of the time and correctly predicted enrollment 89.5% of the time, for an overall correct prediction rate of 76.6%.

Both the number of mathematics credits earned and the highest mathematics course taken in the pipeline were found to be significant in Model 1. However not all mathematics courses were significant. Results for the number of mathematics credits earned and highest mathematics courses that were significant in the model are presented in Table 14. Geometry is classified as the course between Algebra 1 and Algebra 2 and did not have a significant *p*-value in this model. All courses above Geometry were significant in Model 1, with odds ratios well above 1, indicating significant positive effect sizes. Likewise, for each additional unit of mathematics credits earned, the odds of enrolling in a postsecondary institution increased by a factor of 1.168.

Table 14

Q1 Results for Significant Highest Mathematics Course and Mathematics Credits Earned

Highest Math	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
No Math			1			<0.001
Algebra 2[a]	0.908	0.295	2.480	1.390	4.424	0.002
Trigonometry	1.475	0.330	4.369	2.289	8.340	<0.001
Other advanced	1.037	0.304	2.820	1.554	5.118	<0.001
Probability/Statistics	1.910	0.355	6.755	3.371	13.536	<0.001
Other AP/IB	2.507	0.527	12.264	4.364	34.465	<0.001
Pre-Calculus	2.214	0.315	9.156	4.940	16.973	<0.001
Calculus	2.699	0.392	14.863	6.891	32.057	<0.001
AP/IB Calculus	3.820	0.455	45.621	18.693	111.337	<0.001
Math Credits Earned	0.155	0.034	1.168	1.092	1.249	<0.001

Note. [a] Geometry is considered below Algebra 2.

SES was significant for the third, fourth, and fifth SES quintiles, which are the middle to highest SES quintiles. The odds ratio for these quintiles is greater than one, indicating positive effects for students who fall in the middle to highest SES quintiles. While these odds ratios do not show as large of an increase in probability from a higher level of SES as completing a higher level of mathematics course in the pipeline, they do indicate that a higher SES quintile signifies a greater probability of enrolling in a postsecondary institution. Students in the third quintile are 1.743 times more likely to enroll in a postsecondary institution than students in the first quartile. This rate increases, as students in the fourth quartile are 2.258 times more likely to enroll in a postsecondary institution than students in the first quartile, and students in the highest SES quartile are almost 2.5 times more likely to enroll in a postsecondary institution than a student in the lowest SES quartile. See Table 15 for results.

Both parent and student expectations showed significant *p*-values for many of the parental and student expectations of educational attainment. The results for parental expectations with significant *p*-values are in Table 16. Student expectations with significant *p*-values are found in Table 17. Results in both tables show odds ratios above one, which indicates positive effects between expectations and enrollment in any level of postsecondary institution. For parents, the highest odds ratio was the expectation of starting an associate's degree. This compares with X4PS1LEVEL, which shows 25.2% of students chose a 2-year college as their first postsecondary institution. For student expectations, the two highest odds ratios related to starting or earning a PhD, MD, law degree, or other professional level degree. The third highest odds ratio for student expectations was earning a bachelor's degree. This compares to XPS1LEVEL, which shows 42.6% of students' first postsecondary enrollment was in a 4-year institution.

Table 15

Q1 Results for SES

Quintile	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
1st			1			<0.001
2nd	.188	.103	1.207	0.987	1.477	0.067
3rd	0.555	0.106	1.743	1.417	2.143	<0.001
4th	0.814	0.109	2.258	1.824	2.795	<0.001
5th	0.903	0.108	2.467	1.997	3.047	<0.001

Table 16

Q1 Results for Parent Expectations

Parent Expectation	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
Less than HS			1			<0.001
HS Diploma[a]	0.684	0.326	1.982	1.047	3.754	0.036
Occupational Certificate	0.771	0.331	2.163	1.130	4.138	0.020
Start Associate’s	1.833	0.483	6.255	2.426	16.127	<0.001
Associate’s Degree	0.955	0.325	2.598	1.375	4.909	0.003
Bachelor’s Degree	0.980	0.313	2.665	1.442	4.925	0.002
Start Master’s	1.103	0.471	3.014	1.198	7.584	0.019
Master’s Degree	1.345	0.321	3.840	2.045	7.210	<0.001
Start PhD/MD[b]	1.097	0.539	2.996	1.041	8.623	0.042
PhD/MD[b]	1.318	0.325	3.736	1.975	7.066	<0.001
Don’t Know	0.785	0.321	2.192	1.169	4.110	0.014

Note. [a] Includes GED or alternate high school credential. [b] Includes law degree or other high level professional degree.

Table 17

Q1 Results for Student Expectations

Student Expectation	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
Less than HS			1			<0.001
Associate's Degree	1.423	0.545	4.151	1.425	12.091	0.009
Start Bachelor's	1.616	0.707	5.034	1.260	20.115	0.022
Bachelor's Degree	1.879	0.539	6.548	2.275	18.850	<0.001
Start Master's	1.762	0.629	5.821	1.697	19.968	0.005
Master's Degree	1.766	0.540	5.848	2.031	16.839	0.001
Start PhD/MD[a]	2.055	0.717	7.804	1.916	31.790	0.004
PhD/MD[a]	1.916	0.540	6.793	2.357	19.581	<0.001
Don't Know	1.304	0.535	3.685	1.292	10.511	0.015

Note. [a] Includes law degree or other high level professional degree.

Parents and students had the option of selecting “Don’t Know” when asked their expectations. NCES coded this variable as the highest option in the list. The lowest parent and student expectation was that the student would earn less than a high school diploma, which made this expectation the reference category. I chose to maintain the NCES coding for this option. The parental expectation of “Don’t Know” had an odds ratio of 2.192, indicating a positive effect. This odds ratio was higher than that for the parental expectation that the student would earn a high school diploma. Students with the expectation of “Don’t Know” had an odds ratio of 3.685, which indicates a strong positive effect on postsecondary enrollment. This was the lowest odds ratio for the statistically significant student expectations. While the parent or student did not know their expectation at the time of survey, they also had not eliminated any of the possibilities either.

Study Question 2 Results

Model 2 tested whether the student enrolled in a 4-year institution as their first postsecondary institution. X4PS1LEVEL was recoded into a new dependent variable A01E4YR, which classified the students as either not enrolled or enrolled in a 4-year postsecondary institution. The logistical regression produced a Nagelkerke R square value of 0.402, which indicates that 40.2% of variation in the model can be explained by the independent variables. The model correctly predicted non-enrollment in a 4-year postsecondary institution 82.1% of the time and correctly predicted enrollment 67.4% of the time, for an overall correct prediction rate of 75.8%.

While mathematics credits earned did not have a significant *p*-value, the highest mathematics course taken in the pipeline did have a significant *p*-value overall in Model 2. However not all mathematics courses were significant. Results for the highest mathematics courses that were significant in the model are presented in Table 18. Geometry is classified as the course between Algebra 1 and Algebra 2 and did not have a significant *p*-value in this model. All courses above Geometry were significant in Model 2, with odds ratios well above 1, indicating significant positive effect sizes. The largest odds ratios are for AP/IB classes, which gives the student the opportunity to earn college credit, and for Calculus, which is the highest mathematics course listed in the data set (see Table 18).

SES was significant for the third, fourth, and fifth quintiles, which are the middle to highest SES quintiles. The odds ratio for these quintiles is greater than one, indicating positive effects for students who fall in the middle to highest SES quintiles. The Model 2 odds ratios for the fourth and fifth quintiles are smaller than all of the odds ratios for the student's highest level of mathematics course taken in the pipeline, indicating advancement in mathematics courses having a higher impact on enrollment in a 4-year institution than having a higher SES. See Table 19 for results.

Both parent and student expectations of educational attainment showed significant *p*-values for a few variables. The results for parental expectations with significant *p*-values are in Table 20. Student expectations with significant *p*-values are found in Table 21. Results in both tables show odds ratios above one, which indicates positive effects between expectations and enrollment in a 4-year postsecondary institution. For parents, the expectations with significant *p*-values all involved completing a 4-year degree or higher. The odds ratio for all three parental expectations were close in value. This compares with X4PS1LEVEL, which shows 42.6% of students chose a 4-year college as their first postsecondary institution.

Table 18

Q2 Results for Significant Highest Mathematics Course

Highest Math	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
No Math			1			<0.001
Algebra 2[a]	1.076	0.452	2.932	1.208	7.114	0.017
Trigonometry	1.763	0.470	5.829	2.322	14.636	<0.001
Other advanced	1.444	0.458	4.237	1.727	10.397	0.002
Probability/Statistics	2.082	0.476	8.021	3.157	20.376	<0.001
Other AP/IB	2.890	0.535	17.995	6.310	51.319	<0.001
Pre-Calculus	2.323	0.459	10.208	4.153	25.091	<0.001
Calculus	3.108	0.482	22.370	8.696	57.544	<0.001
AP/IB Calculus	3.656	0.481	38.724	15.083	99.420	<0.001

Note. [a] Geometry is considered below Algebra 2.

Table 19

Q2 Results for SES

Quintile	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
1st			1			<0.001
2nd	0.129	0.116	1.137	0.906	1.428	0.267
3rd	0.402	0.114	1.495	1.197	1.867	<0.001
4th	0.800	0.111	2.226	1.790	2.767	<0.001
5th	0.989	0.108	2.689	2.175	3.324	<0.001

Table 20

Q2 Results for Parent Expectations

Parent Expectation	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
Less than HS			1			<0.001
Bachelor's Degree	0.976	0.446	2.655	1.108	6.363	0.029
Master's Degree	1.353	0.449	3.870	1.604	9.338	0.003
PhD/MD[a]	1.348	0.452	3.848	1.590	9.313	0.003

Note. [a] Includes law degree or other high level professional degree.

Table 21

Q2 Results for Student Expectations

Student Expectation	Coef (B)	S.E.	Odds Ratio	95% CI		*p*-value
Less than HS			1			<0.001
Start Ph.D./M.D.[a]	1.864	0.861	6.448	1.194	34.831	0.030
PhD/MD[a]	1.548	0.764	4.702	1.052	21.011	0.043

Note. [a] Includes law degree or other high level professional degree.

For student expectations, the only two variables with significant *p*-values related to starting or earning a PhD., MD, law degree, or other professional level degree. The student expectations to earn a bachelor's degree had a *p*-value of 0.101, and the expectation to earn a master's degree had a *p*-value of 0.067, which are not significant for a 95% confidence interval. However, these values are significant for a 90% confidence interval and should be considered for a future study.

Study Question 3 Results

Model 3 tested whether the student enrolled in a 2-year institution as their first postsecondary institution. X4PS1LEVEL was recoded into a new dependent variable A01E2YR, which classified the students as either not enrolled or enrolled in a 2-year postsecondary institution. The logistical regression produced a Nagelkerke R square value of 0.071, which indicates that 7.1% of variation in the model can be explained by the independent variables. The model correctly predicted non-enrollment in a 2-year postsecondary institution 99.7% of the time and correctly predicted enrollment 1.1% of the time, for an overall correct prediction rate of 74.8%. Based on the low Nagelkere R square value and the low accessory of predicting enrollment in a 2-year institution, Model 3 results are inconclusive for answering research question 3.

Even so, I did review the results for Model 3 and found many borderlineresults. For example, mathematics credits earned has a *p*-value of 0.004, which is statistically significant but not pragmatically so. The odds ratio for mathematics credits earned is 1.098, only slightly above one and is not a strong indicator of predicting enrollment. By contrast, the highest mathematics course taken in the pipeline, Pre-Algebra, Algebra 2, trigonometry, other advanced math, probability/statistics have significant *p*-values with odds ratios of approximately 2.5-3.

SES showed an overall significant *p*-value of 0.02 but did not show any specific SES quartile to have a significant *p*-value, and each confidence interval contained one, indicating little change could be seen by including SES. The parental expectations became significant starting and completing an associate's degree, while the only significant student expectation was starting a bachelor's degree. In sum, the effects of SES on enrollments are small across quintiles. Parental expectations matter when considering expectations for highest degree attained beginning at associate's degree attainment. Student expectations are significant beginning with expectations for baccalaureate degree attainment. Results regarding Model 3 are included as an appendix.

Summary

Research question 1 found that overall enrollment in a postsecondary institution was positively affected by the highest mathematics course taken in the pipeline and the number of mathematics credits earned overall. There were also significant positive effects for students in the middle to upper SES quartiles, with parental expectations of a degree, and with personal expectations of earning a degree. Similar results were found for research question 2, which found enrollment in a 4-year postsecondary institution was positively influenced by the highest mathematics course taken in the pipeline, being in the middle to upper SES quartiles, parental expectation of a 4-year degree or higher, and the student expectation of an advanced professional degree. Results for Model 3 were inclusive and therefore no conclusion could be drawn for research question 3 regarding the impact of high school mathematics and enrollment in a 2-year postsecondary institution.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Previous research indicates students who complete mathematics courses beyond Algebra 2 obtain college degrees at a higher rate (Adelman, 2006; Kim et al., 2015) and that rural students with a more rigorous course of studies in mathematics are more likely to enroll in four-year institutions after high school (Chambers, 2020a). It has also been established that rural students complete high school at a higher rate but enroll in college at a lower rate than non-rural students (Brand & Xie, 2010; Showalter et al., 2019) with even lower attendance and completion rates for rural males than females (Bray et al., 2019). At the same time, rural students enter high school at a lower level of mathematics (Anderson & Chang, 2011; Barshay, 2021) and have less access to higher level mathematics courses than non-rural students (Anderson & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018).

This study explored the connection between secondary mathematics courses and enrollment in a 2-year or 4-year college immediately following high school graduation for rural students. Hossler and Gallagher's (1987) three-phase model of college choice was used as the framework. The three phases are predisposition, search, and choice. High school mathematics coursework is important in all three phases. In the predisposition phase, students decide whether they are interested in attending college, and this will impact the selection of their high school mathematics courses. During the search phase, students will examine colleges, and colleges will look for students. Again, mathematics coursework plays a role in college admission requirements and eventual course of study, which leads to the final phase. During the choice phase, students are selecting which institution to attend from their choice set. This selection may be limited by the high school mathematics coursework if it was not rigorous enough to meet admissions requirements or be competitive with other applicants.

Hossler and Gallagher's (1987) framework provides a guide for additional variables that could impact college choice other than high school mathematics courses. Parental expectations and socioeconomic status are factors in college choice and were thus included as variables in the logistic regression equations. Student expectations signal the phase of the student and were included in the model, as a ninth grader who expects to earn a bachelor's degree or higher shows a predisposition to attend college that is not apt to change.

Summary of the Findings

The three research questions for this study examined the impact of high school mathematics on enrollment at any postsecondary institution, enrollment in a 4-year institution, or enrollment in a 2-year institution for rural students. While conducting forward entry step-wise logistical regression to generate a model for each research question, SPSS selected highest mathematics course taken in the pipeline as the first variable each time, which indicates that this was the most significant variable impacting the choice of postsecondary enrollment.

Research question 1 examined the influence of high school mathematics course work on enrolling in any postsecondary institution. This included enrollment in vocational training programs that may require less than a 2-year degree such as basic law enforcement training. High school mathematics credits earned and the highest mathematics course taken in high school were found to increase the odds of enrolling in a postsecondary institution. While students in the middle to highest SES quintiles were more likely to enroll in a postsecondary institution than a student in the lowest SES quintiles, the increased odds were not as great as a student completing a higher level mathematics courses in the pipeline. Similar results were found for both parental and student expectations for level of educational attainment. The parental expectation for their child to earn an associate's degree made the student 2.598 times more likely to enroll in a postsecondary institution than a parent who expected their child to earn less than a high school diploma. Increased odds were even seen for students when parents did not know what expectations they had for their child. This parental expectation showed the student 2.192 times more likely to enroll in college than if the parent expected less than a high school diploma. Student expectations show that those who expected to earn an associate's degree were 4.151 times more likely to enroll in a postsecondary institution than a student who expected to earn less than a high school degree. Those students who did not know their expectations were 3.685 times more likely to enroll in a postsecondary institution than a student who expected to earn less than a high school degree. This indicated the degree of openness ninth graders have to being influenced in their future academic and career choices (Chambers, 2020b).

Research question 2 examined the impact of high school mathematics courses on enrollment in a 4-year postsecondary institution. Number of mathematics credits was not significant in this model. However, all mathematics courses of Algebra 2 or higher were significant, with the largest odds ratios for AP/IB courses and Calculus. AP/IB courses give high school students the opportunity to earn college credit. Again, SES quintiles were significant for middle to upper levels, but did not show the same level of increased odds as increasing the level of the highest mathematics course taken in the pipeline. Students in the highest SES quintile were 2.689 times more likely to enroll in a 4-year institution than students in the lowest SES quintile. Parental expectations were significant for attainment of a bachelor's, master's, or postgraduate degree. Student expectations were significant for those students who expected to start a postgraduate degree.

Research question 3 examined the impact of high school mathematics course on enrollment in a 2-year postsecondary institution. However, the accuracy of model 3 was low and only predicted enrollment in a 2-year institution 1.1% of the time, with approximately 7% of the variability in the model explained by the independent variables. For these reasons, results were considered inconclusive to effectively answer research questions 3. This stands to reason as community colleges are open access institutions as such preparation and predisposition for entry are minimal. Chambers (2000a) similarly found that among African American males, no difference in the academic preparation of those who attended a 2-year institution as compared to those who did not attend. A preliminary review of the results did find SES to be insignificant in predicting enrollment at a 2-year institution. Significance with a positive odds ratio was found for the parental expectations of starting and earning an associate's degree. Results for Model 3 are available in Appendix B.

Interpretation of the Findings

Stereotypical views of rural America see the inhabitants as poor, white, and agrarian (Goetz et al., 2018). This bias is often reflected in the literature. A systematic literature review of 134 research publications regarding college access and college choice for rural youth between 2000 and 2020 found an emphasis on Appalachia being utilized to characterize all rural areas as poor communities with little to no educational aspirations (Sowl & Crain, 2021). The rural disadvantage narrative was challenged by Li's (2019) study, which used the HSLS:09 data set, and found that rural students reported "a significantly smaller proportion of families in poverty than did urban students a significantly larger proportion of families with income levels between $75,000 (median) and $175,000 (90%) than did urban and town students" (p. 7). Similar results were found when reviewing the SES quintiles in my study even with the inclusion of the town students in the sample. These students have lower percentages in the lowest two SES quintiles and have higher percentages in the highest SES quintile than compared to the HSLS:09.

Expectations

Previous research indicated that rural parents had lower expectation for their child to obtain a four-year degree than non-rural parents (Byun et al., 2012; King, 2018; Li, 2019; Sowl & Crain, 2021; Tieken, 2020). However, data gathered in the base year indicated that 70.8% of the parents and 73.8% of the students in this study expected the student to start or earn a bachelor's degree or higher, with 16.0% or parents and 17.5% of students expecting the completion of a master's degree. Expectations of completing a Ph.D, M.D., law degree, or higher professional degree were 13.6% for parents and 18.4% for students. Therefore, low parental or student expectations should not be presumed, and students with their families should be engaged in college conversations throughout the high school years (Chambers, 2020b).

Inclusion of SES quintile data still showed high expectations from both parents and students. The expectation of earning a bachelor's degree was the top parental expectation in every SES quintile. While the percentage of parents expecting a high school diploma was highest in the first SES quintile (2.15%), this number was roughly equivalent to parents in the first SES quintile who expected their child to earn a master's degree (2.18%). Students also held high expectations for themselves regardless of their SES quintile. While 3.15% of students in the first SES quintile expected to earn a high school diploma, 6.65% of students in the first SES quartile expected to earn an associate's degree or higher. SES is not a barrier to rural students' or parents' collegiate expectations. Indeed, the probability of rural student enrollment is significantly enhanced by the increasing rigor of mathematics courses taking.

Secondary Mathematics

The literature indicates that completing Algebra II significantly increases the likelihood of attending college (Adelman, 2002; Adelman, 2006; Kim et al., 2015), and the quantity and rigor of mathematics coursework at the secondary level is the greatest predictor of college enrollment (Adelman, 2006) for all students. The impacts of urbanicity are seen only at the bachelor's degree level. Chambers (2020a) found that mathematics proficiency influences whether rural African American male students attend a two- or four-year postsecondary institution. However, it does not influence postsecondary education enrollment overall and is further compounded by a lower initial mathematics placement, as African American students have lower odds of being placed into an Algebra class by eighth grade regardless of their ability (Faulkner et al., 2014).

Additionally, research found that access to differentiated mathematics coursework, particularly at higher levels of rigor, is attenuated for rural students due to teaching shortages (Aragon, 2016), as the demand to provide mathematics courses is impacted by the supply of educators (Lavalley, 2018; Shuls, 2018). Rural students enter high school at a lower level of mathematics (Anderson & Chang, 2011; Barshay, 2021) and graduate with fewer mathematics credits than non-rural graduates (Anderson, R. & Chang, 2011). They also have less access to Advanced Placement mathematics courses (Anderson, R. & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018), with half of students who attend schools in rural areas and small towns having access to only one to three advanced mathematics classes, whereas "fifty-eight percent of students in urban schools and 41 percent in suburban and large-town schools can choose from as many as seven or more courses in advanced mathematics" (Graham, 2009).

In this study, over 60% of the students earned four or more high school mathematics credits. Most students earned credits in Algebra 1 (94.7%), Geometry (74.9%), and Algebra 2 (63.1%), with 45% of students taking Algebra 1 as their highest level of math in the 9th grade and approximately 24% taking Algebra 2 as their highest mathematics course taken overall.

However, 55.5% of students reported a highest mathematics course that was above Algebra 2, with 9.77% completing an AP/IB mathematics course.

Data regarding the availability of advanced mathematics courses at specific schools are not part of the public data set. These findings would suggest, however, that there is a benefit to higher rigor mathematics courses for rural students. These findings can be used by leaders to encourage school counselors to direct students towards higher levels of mathematics (Chambers, 2020b). This should include conversations with families (Agger et al., 2018) as well as infrastructure to support any stresses or academic needs associated with increased levels of challenge.

Limitations of the Study

The homogeneity of the students in this study is a limitation. Most of the students in this study were white (55.7%). In fact, there were six times more white students than Black students (10.2%) and almost six times more white students than Hispanic students (12.0%). SES quintiles show an underrepresentation in the lower SES quintiles and a slightly higher representation in the middle to upper SES quintiles. The majority of the students were enrolled in a postsecondary program (70.3%) in 2013, with 66.2% of students being enrolled in a 4-year institution by February 2016. This latter finding may be a function of how the data were cleaned, utilizing the fourth follow up variable X4PSENRSTLV, highest level of enrollment in February 2016. This may result in an upward bias of results.

While the publicly available data set was robust, restricted variables were a limitation for this study. For instance, geographical locale was a restricted variable, which eliminated the possibility to compare rural students in different regions of the country. Also, SES was limited to an examination of quintiles, which led to a lighter analysis of the situation.

Another limitation of this study is the ability to judge the availability and rigor of mathematics classes available to the individual student. Previous research found rural students entered high school at a lower level of mathematics and had less access to higher level of mathematics courses than non-rural students (Anderson & Chang, 2011; Barshay, 2021; Graham, 2009; Lavalley, 2018). However, this information is unavailable in the public data set and thus excluded from this study.

Implications of the Findings for Educational Leadership

The findings from this study have a wide-range policy and curricular implications for contemporary leadership issues across local, state, and national conversations. For example, Math Pathways, now the work of the University of Texas at Austin's Charles A. Dana Center, began with a graduate student's question regarding the varying success rates for students entering freshmen calculus at Berkley (University of Texas Dana Center, 2023b). This question led Uri Treisman, educated as a research mathematician, into a professional career of undergraduate mathematics education that would propel him into a policy and leadership platform that focuses on dismantling barriers in education systems.

In North Carolina, Math Pathways Projects began in 2017, spearheaded by the UNC System Office to enumerate recommendations that would facilitate collegiate student success by removing roadblocks for students in mathematics. Implementation of these recommendations vary across our UNC system institutions, yet an important framework was established. Current efforts are expanding to build partnerships with high school education systems through a project called the Launch Years Initiative, which "supports the scaling of mathematics pathways from high school through postsecondary education and into the workplace, aligned to students' goals and aspirations. Twenty states are joining this work, along with national organizations and leaders in mathematics education and educational equity” (University of Texas Dana Center, 2023a, p.1). An equity issue the Launch Years Initiative is addressing is the barrier mathematics may present in college admissions. The work in this study can help deepen our understanding of potential barriers for rural students as they transition from high school into a post-secondary choice, thus contributing to ongoing leadership and policy initiatives in mathematics education.

Implications of the Findings for Practice

The results of this study have implications that impact current practice for high school and colleges alike. Providing opportunities to pursue mathematics courses beyond Algebra 2 is important for all students. Rural educators should encourage all students to pursue courses beyond Algebra 2. If there are limited opportunities to take advanced coursework at the school or through a local community college, then educators can introduce students to massive online open courses (MOOC). Harvard offers free online courses in statistics, probability, calculus, and data science. MIT’s OpenCourseWare provides free courses such as mathematics for computer science. Teachers and high school guidance counselors should be keenly aware and communicate this need to the parents. After all, the parents in this study had high expectations for their child, with most parents expecting their child to earn a bachelor’s degree. This study found that earning credit in Algebra 2 or higher greatly increased the odds that the student would enroll in a 4-year institution upon graduating from high school.

Colleges should look to high school mathematics courses as a place to recruit and nurture future alumni. For example, East Carolina University partnered with community colleges and schools throughout Eastern North Carolina (ENC) for the program Tech Math. This program was funded through a grant from the National Science Foundation (NSF). Middle and high school mathematics teachers toured businesses, organizations, and industries throughout ENC to see what mathematics were being used in the workplace, and what qualifications were required for the job. Teachers then partnered with a representative from a business, organization, or industry to develop a module for their classroom. ECU provided guidance in the development of the modules, and final products were shared through the NSF and the North Carolina Council of Teachers of Mathematics (NCCTM). Students were then able to learn about local career opportunities for well-paying jobs, which required an associate's degree.

Tech Math is one of many programs working to increase student awareness of college choice. An additional program is Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP), which is a national college access initiative funded by the U.S. Department of Education. GEAR UP has three program initiatives—increase academic performance and preparation for college, increase high school graduation rates and participation in postsecondary education, and increase educational expectations and awareness of postsecondary opportunities. The University of North Carolina System was awarded a seven-year GEAR UP grant in 2019, which engages students starting in the sixth grade. A national goal and project objective that is fundamental to GEAR UP NC is to

> Increase the percentage of students taking and successfully completing the following courses: Pre-Algebra by the end of 8th grade, Algebra I by the end of 9th grade, and two years of math beyond Algebra I by the end of 12th grade. Increase the percentage of students who have knowledge of and demonstrate academic preparation for college and who enroll in college without the need for remedial coursework (The University of North Carolina System, 2022, p. 1)

This study supports the objectives of GEAR UP NC and provides evidence to reach further by encouraging mathematics beyond Algebra 2 before the end of high school.

Recommendations for Practice

Completion of higher level mathematics courses in high school leads to greater rates of enrollment in college for rural students. Efforts should be made to provide these opportunities to all students. Teaching shortages in mathematics are particularly acute (Sutcher et al., 2019). Supply and demand can be met if the level of mathematics is increased for all students at the middle school and high school levels. Instead of 45% of rural students taking Algebra 1 in the 9th grade, those students should have the opportunity to complete Algebra 1 in the 7th or 8th grade. This would allow them to enter high school at the Geometry or Algebra 2 level and complete high school with at least a Pre-Calculus credit which will increase the odds that they enroll in college.

Providing this opportunity would require that middle school mathematics teachers be certified to teach Algebra 1. Teaching certifications vary by state. In North Carolina, middle school teachers may have a K-6, 6-8, or even a 6-12 teaching certification. Algebra 1 requires the teacher to have at least a 6-8 certification. However, there are opportunities to take mathematics courses through the North Carolina Virtual Public High School (NCVPS). These courses are offered in partnership with the student's school or homeschool (NC Virtual Public Schools, 2023).

NCVPS is a good example of increasing opportunities for rural students by increasing access to mathematics. Additional partnerships between high schools, community colleges, and universities could be instrumental in mitigating the challenge of access faced by rural communities. For example, dual enrollment courses allow students to earn both high school and college credit through North Carolina's Career and College Promise (CCP) program. This is a tuition-free program for qualified high school students offered through the community college system. CCP offers students a choice of three pathways—college transfer (CTP), career and technical education (CTE), and cooperative innovative high schools. CTP course credits can be applied to an associate's degree or transferred to any of the universities in the UNC system. CTE courses provide toward a certificate, diploma, or state or industry-recognized workforce credential (NC Community Colleges, 2023). There are 134 cooperative innovative high schools in North Carolina. They are a partnership between a local education agency (LEA) and their local postsecondary institution to jointly provide expanded learning opportunities to students who are at-risk of dropping out. Of these 134 partnerships, 118 high schools are partnered with a community college, 11 high schools are partnered with a public university, and five high schools are partnered with independent colleges (North Carolina Department of Public Instruction, 2019).

Recommendations for Future Study

This study is a good preliminary study for the impact of high school mathematics courses and college enrollment. Future studies should build on this work and take a more in-depth look at the availability and rigor of rural high school mathematics. This is of a special interest as the COVID-19 global pandemic vastly changed the learning landscape to open remote learning opportunities and installed infrastructure that did not previously exist. Any future work should take these developments into consideration. One way that the impacts of COVID can be explored in a related study is the next NCES longitudinal study which is now underway. The High School and Beyond Longitudinal Study of 2022 (HS&B:22) includes students who entered ninth grade in the fall of 2022. Parents, teachers, school administrators and guidance counselors are also included in the study. Like the HSLS:09, the HS&B:22 includes mathematics assessments, which makes the continuation of the work in this study possible.

While this study looked at overall enrollment in college, enrollment in a 2-year institution, and enrollment in a 4-year institution, future studies should extend to examine differences between enrolling in a 2-year institution versus a 4-year enrollment to determine whether high school mathematics influenced this decision for rural students. Do 2-year institutions provide an additional avenue for students who decided to pursue a bachelor's degree later in high school to meet the necessary requirements for admission and success?

College success is another natural extension of this study. This study found that higher rates of overall college enrollment and enrollment in 4-year institutions were positively impacted by high school mathematics courses. Does this translate into college success and persistence for rural students?

Conclusions

The link between high school mathematics and college enrollment for rural students is an important aspect of educational leadership studies. What happens in high school is keenly important to postsecondary institutions as high school students are progressing through the three phases of college choice as they decide between entering the military, workforce, or higher education after high school (Hossler & Gallagher, 1987). Providing access and opportunities to mathematics courses for rural high school students is a way for higher education institutions to remove barriers to college and increase access, as this study found increased college enrollment rates overall and at 4-year institutions for rural students who completed mathematics courses in Algebra 2 and beyond. This study also found increasing the level of the highest mathematics course taken in high school increased the odds of college enrollment more so than a student having a higher SES quintile. These finding support many current state and national leadership initiatives such as Math Pathways, The Launch Years, GEAR UP, and CPCC.

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APPENDIX A: INSTITUTIONAL REVIEW BOARD WAIVER

Subject: Issue in ePirate
Date: Tuesday, January 3, 2023 at 9:56:14 AM Eastern Standard Time
From: Barakat, Susan
To: Howard, Susan Hope

Good morning,

I received the issue below. Since you don't have access to identifiable information and you are not interacting with participants, your study does not meet the definition of Human Subject Research and does not fall under the purview of the IRB.

My dissertation uses the publically available data set for the HSLS:09. Anyone can download the data from https://nces.ed.gov/onlinecodebook

This is a secondary data analysis. All data is already anonymized and I will have zero contact with participants.

My dissertation chair, Crystal Chambers, asked me to obtain a letter from IRB stating the study is indeed exempt. How do I do this?

Best,
Susan

Susan Barakat, CIP
University Program Specialist
East Carolina University
University and Medical Center Institutional Review Board
4N-64 Brody Medical Sciences Building
600 Moye Boulevard
Mailstop 682
Greenville, NC 27834
(252) 744-5371

APPENDIX B: SPSS OUTPUT FOR MODEL 3

Logistic Regression

Notes

Output Created		03-APR-2023 12:28:26
Comments		
Input	Data	/Users/howardsu/Library/CloudStorage/OneDrive-EastCarolinaUniversity/003 Dissertation Stuff/Ch 4/Adapted Data Sets/Data Set April 1.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	5958
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing
Syntax		LOGISTIC REGRESSION VARIABLES A01E2YR /METHOD=ENTER A01MHIGH A01CREDMAT A01SESQ5_U A01PAREXPECT A01STUEXPECT /CONTRAST (A01MHIGH)=Indicator(1)

		/CONTRAST (A01SESQ5_U)=Indicator(1) /CONTRAST (A01PAREXPECT)=Indicator(1) /CONTRAST (A01STUEXPECT)=Indicator(1) /CLASSPLOT /PRINT=GOODFIT CI(95) /CRITERIA=PIN(0.05) POUT(0.10) ITERATE(20) CUT(0.5).
Resources	Processor Time	00:00:03.14
	Elapsed Time	00:00:03.00

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	5958	100.0
	Missing Cases	0	.0
	Total	5958	100.0
Unselected Cases		0	.0
Total		5958	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value

Not enrolled in a 2-year postsecondary	0
Enrolled 2-year postsecondary	1

Categorical Variables Codings

		Frequency	Parameter coding (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Highest HS Math Course	No Math	90	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Basic math	32	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Other math	55	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Pre-algebra	52	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Algebra I	265	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	Geometry	504	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000
	Algebra II	1654	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000
	Trigonometry	274	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000
	Other advanced math	782	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000
	Probability and statistics	223	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000
	Other AP/IB math	72	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000
	Precalculus	1113	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000
	Calculus	332	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000
	AP/IB Calculus	510	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000
Parent Expectation	Less than high school completion	65	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Complete HS diploma/GED/alternative HS credential	433	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Start, but not complete certificate/diploma from school providing occ training	21	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Complete certificate/diploma from school providing occupational training	337	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Start, but not complete Associate's degree	47	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000	
	Complete Associate's degree	497	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000	
	Start, but not complete Bachelor's degree	47	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000	
	Complete Bachelor's degree	1974	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000	
	Start, but not complete Master's degree	60	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000	
	Complete Master's degree	951	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000	

	Start, but not complete Ph.D./M.D./law degree/high level professional degree	39	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000	
	Complete Ph.D./M.D./law degree/other high level professional degree	810	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000	
	Don't know	677	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000	
Student Expectation 9th Grade	Less than high school	24	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000			
	High school diploma or GED	663	1.000	.000	.000	.000	.000	.000	.000	.000	.000	.000			
	Start an Associate's degree	46	.000	1.000	.000	.000	.000	.000	.000	.000	.000	.000			
	Complete an Associate's degree	349	.000	.000	1.000	.000	.000	.000	.000	.000	.000	.000			
	Start a Bachelor's degree	22	.000	.000	.000	1.000	.000	.000	.000	.000	.000	.000			
	Complete a Bachelor's degree	923	.000	.000	.000	.000	1.000	.000	.000	.000	.000	.000			
	Start a Master's degree	62	.000	.000	.000	.000	.000	1.000	.000	.000	.000	.000			
	Complete a Master's degree	1043	.000	.000	.000	.000	.000	.000	1.000	.000	.000	.000			
	Start Ph.D/M.D/Law/other prof degree	35	.000	.000	.000	.000	.000	.000	.000	1.000	.000	.000			
	Complete Ph.D/M.D/Law/other prof degree	1095	.000	.000	.000	.000	.000	.000	.000	.000	1.000	.000			
	Don't know	1696	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.000			
SES Quartile with urbanicity	First quintile (lowest)	958	.000	.000	.000	.000									
	Second quintile	1066	1.000	.000	.000	.000									
	Third quintile	1087	.000	1.000	.000	.000									
	Fourth quintile	1187	.000	.000	1.000	.000									
	Fifth quintile (highest)	1660	.000	.000	.000	1.000									

Block 0: Beginning Block

Classification Table[a,b]

Observed			Predicted: Q3: Enrolled in a 2-year postsecondary: Not enrolled in a 2-year postsecondary	Predicted: Q3: Enrolled in a 2-year postsecondary: Enrolled 2-year postsecondary	Predicted: Percentage Correct
Step 0	Q3: Enrolled in a 2-year postsecondary	Not enrolled in a 2-year postsecondary	4454	0	100.0
		Enrolled 2-year postsecondary	1504	0	.0
	Overall Percentage				74.8

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.086	.030	1325.247	1	<.001	.338

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	Highest HS Math Course	180.410	13	<.001
		Highest HS Math Course(1)	.142	1	.707

	Highest HS Math Course(2)	3.367	1	.067
	Highest HS Math Course(3)	.078	1	.779
	Highest HS Math Course(4)	5.287	1	.021
	Highest HS Math Course(5)	.205	1	.651
	Highest HS Math Course(6)	67.616	1	<.001
	Highest HS Math Course(7)	1.960	1	.161
	Highest HS Math Course(8)	5.940	1	.015
	Highest HS Math Course(9)	1.111	1	.292
	Highest HS Math Course(10)	2.841	1	.092
	Highest HS Math Course(11)	.024	1	.876
	Highest HS Math Course(12)	29.545	1	<.001
	Highest HS Math Course(13)	79.685	1	<.001
	Math Credits Earned	2.970	1	.085
	SES Quartile with urbanicity	37.918	4	<.001
	SES Quartile with urbanicity(1)	6.555	1	.010
	SES Quartile with urbanicity(2)	11.338	1	<.001

	SES Quartile with urbanicity(3)	.106	1	.745
	SES Quartile with urbanicity(4)	32.002	1	<.001
	Parent Expectation	61.538	12	<.001
	Parent Expectation(1)	.022	1	.881
	Parent Expectation(2)	1.341	1	.247
	Parent Expectation(3)	2.786	1	.095
	Parent Expectation(4)	9.485	1	.002
	Parent Expectation(5)	29.713	1	<.001
	Parent Expectation(6)	.002	1	.964
	Parent Expectation(7)	.180	1	.671
	Parent Expectation(8)	.307	1	.580
	Parent Expectation(9)	5.222	1	.022
	Parent Expectation(10)	.182	1	.669
	Parent Expectation(11)	15.655	1	<.001
	Parent Expectation(12)	.000	1	.992
	Student Expectation 9th Grade	44.560	10	<.001
	Student Expectation 9th Grade(1)	.050	1	.823

	Student Expectation 9th Grade(2)	.662	1	.416
	Student Expectation 9th Grade(3)	9.213	1	.002
	Student Expectation 9th Grade(4)	.506	1	.477
	Student Expectation 9th Grade(5)	7.400	1	.007
	Student Expectation 9th Grade(6)	4.665	1	.031
	Student Expectation 9th Grade(7)	6.029	1	.014
	Student Expectation 9th Grade(8)	.513	1	.474
	Student Expectation 9th Grade(9)	17.556	1	<.001
	Student Expectation 9th Grade(10)	2.702	1	.100
Overall Statistics		268.246	40	<.001

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	291.664	40	<.001
	Block	291.664	40	<.001
	Model	291.664	40	<.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	6440.793[a]	.048	.071

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.466	8	.707

Contingency Table for Hosmer and Lemeshow Test

Q3: Enrolled in a 2-year postsecondary = Not enrolled in a 2-year postsecondary	Q3: Enrolled in a 2-year postsecondary = Enrolled 2-year postsecondary	Total

		Observed	Expected	Observed	Expected	
Step 1	1	550	546.825	46	49.175	596
	2	502	513.089	95	83.911	597
	3	489	478.633	107	117.367	596
	4	452	462.075	146	135.925	598
	5	443	447.319	154	149.681	597
	6	442	434.518	154	161.482	596
	7	428	423.026	168	172.974	596
	8	416	409.938	181	187.062	597
	9	386	392.372	212	205.628	598
	10	346	346.205	241	240.795	587

Classification Table[a]

			Predicted		
			Q3: Enrolled in a 2-year postsecondary		
Observed			Not enrolled in a 2-year postsecondary	Enrolled 2-year postsecondary	Percentage Correct
Step 1	Q3: Enrolled in a 2-year postsecondary	Not enrolled in a 2-year postsecondary	4441	13	99.7
		Enrolled 2-year postsecondary	1488	16	1.1
	Overall Percentage				74.8

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Highest HS Math Course			137.062	13	<.001			
	Highest HS Math Course(1)	1.064	.536	3.947	1	.047	2.898	1.014	8.279
	Highest HS Math Course(2)	.133	.535	.062	1	.804	1.142	.400	3.259
	Highest HS Math Course(3)	.974	.478	4.156	1	.041	2.650	1.038	6.761
	Highest HS Math Course(4)	.564	.392	2.068	1	.150	1.758	.815	3.793
	Highest HS Math Course(5)	.705	.383	3.394	1	.065	2.024	.956	4.283
	Highest HS Math Course(6)	1.105	.378	8.544	1	.003	3.020	1.439	6.338
	Highest HS Math Course(7)	.928	.401	5.350	1	.021	2.530	1.152	5.555
	Highest HS Math Course(8)	.925	.386	5.758	1	.016	2.522	1.185	5.370
	Highest HS Math Course(9)	.878	.409	4.600	1	.032	2.406	1.079	5.366
	Highest HS Math Course(10)	.215	.497	.187	1	.665	1.240	.468	3.284
	Highest HS Math Course(11)	.777	.388	4.019	1	.045	2.176	1.018	4.652

	Highest HS Math Course(12)	-.100	.422	.056	1	.813	.905	.396	2.070
	Highest HS Math Course(13)	-.428	.418	1.045	1	.307	.652	.287	1.481
	Math Credits Earned	.094	.033	8.269	1	.004	1.098	1.030	1.170
	SES Quartile with urbanicity			11.626	4	.020			
	SES Quartile with urbanicity(1)	.084	.103	.660	1	.416	1.087	.888	1.331
	SES Quartile with urbanicity(2)	.166	.103	2.612	1	.106	1.181	.965	1.445
	SES Quartile with urbanicity(3)	.015	.104	.022	1	.883	1.015	.828	1.245
	SES Quartile with urbanicity(4)	-.143	.103	1.934	1	.164	.866	.708	1.060
	Parent Expectation			39.329	12	<.001			
	Parent Expectation(1)	.390	.354	1.214	1	.271	1.477	.738	2.958
	Parent Expectation(2)	-.370	.717	.266	1	.606	.691	.170	2.815
	Parent Expectation(3)	.591	.358	2.729	1	.099	1.805	.896	3.638
	Parent Expectation(4)	1.402	.451	9.650	1	.002	4.062	1.677	9.836
	Parent Expectation(5)	.890	.350	6.469	1	.011	2.435	1.226	4.835
	Parent Expectation(6)	.436	.478	.835	1	.361	1.547	.607	3.946
	Parent Expectation(7)	.512	.342	2.245	1	.134	1.668	.854	3.260
	Parent Expectation(8)	.736	.449	2.689	1	.101	2.088	.866	5.032
	Parent Expectation(9)	.397	.347	1.310	1	.252	1.487	.754	2.936
	Parent Expectation(10)	.862	.501	2.964	1	.085	2.367	.887	6.315
	Parent Expectation(11)	.294	.350	.705	1	.401	1.341	.676	2.663
	Parent Expectation(12)	.461	.348	1.754	1	.185	1.586	.801	3.140

	Student Expectation 9th Grade			22.188	10	.014			
	Student Expectation 9th Grade(1)	.841	.636	1.747	1	.186	2.318	.666	8.067
	Student Expectation 9th Grade(2)	1.126	.710	2.512	1	.113	3.082	.766	12.400
	Student Expectation 9th Grade(3)	1.101	.641	2.953	1	.086	3.007	.857	10.555
	Student Expectation 9th Grade(4)	1.108	.785	1.992	1	.158	3.027	.650	14.093
	Student Expectation 9th Grade(5)	1.068	.635	2.829	1	.093	2.910	.838	10.099
	Student Expectation 9th Grade(6)	1.489	.686	4.709	1	.030	4.431	1.155	17.003
	Student Expectation 9th Grade(7)	.799	.635	1.580	1	.209	2.223	.640	7.724
	Student Expectation 9th Grade(8)	.599	.764	.615	1	.433	1.821	.407	8.144
	Student Expectation 9th Grade(9)	.742	.636	1.364	1	.243	2.101	.604	7.303
	Student Expectation 9th Grade(10)	.929	.633	2.158	1	.142	2.533	.733	8.749
	Constant	-3.613	.785	21.183	1	<.001	.027		

a. Variable(s) entered on step 1: Highest HS Math Course, Math Credits Earned, SES Quartile with urbanicity, Parent Expectation, Student Expectation 9th Grade.

Predicted Probability is of Membership for Enrolled 2-year postsecondary

The Cut Value is .50