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The purpose of this qualitative research study was to examine the aspects of Lumbee Indian community that supports the algebraic achievement of high-achieving Lumbee Indian Algebra 1 middle school students. The study was conducted in a stable, rural Lumbee Indian community in North Carolina. I interviewed 14 parents, 3 teachers and 10 students for this study. Students also participated in the focus group sessions, during which students solved mathematics problems, and completed a reflection of the problem-solving process. The data analysis performed involved data reduction, data display, and conclusion drawing/vertification utilizing Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988) social capital framework. Meanings of teaching and learning mathematics based on the experiences, expectations, resources and goals of the research subjects were determined. The results show the meanings that the community shares about teaching and learning of mathematics center around the common vision of ensuring that students receive the necessary support to aid in their academic success. Additionally, the historical sense of community and closure that is present in the community enables the development of trust because "everybody knows everybody." Therefore, the social networking system within the community aids in the establishment of trust between the parents, teachers, and students. As a result of the trust that exists between the community members, the members trust that the various members will work together to provide the support necessary for students to be successful.

ASPECTS OF A LUMBEE INDIAN COMMUNITY THAT SUPPORT SUCCESSFUL ALGEBRA ONE STUDENTS ACADEMICALLY IN MIDDLE GRADES

by

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To my mother, Eva Mae Locklear, whose sacrifices have enabled her children to become the people they are today.

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

> *I'm proud to be a Lumbee Indian. Yes, I am. When I grow up into this world I'm gonna be just what I can. I could be a doctor, or a lawyer, or an Indian chief. Yes, I can. When I grow up into this world I'm gonna be just what I can. My mother and my father are proud of me. They want me to be free. Free to be anything I want to be. (Willie French Lowery, 1979, Track 1)*

Statement of Research Problem

When I was in elementary school, we listened to this song on a regular basis. All these careers of doctor, lawyer, or Indian chief incorporate the fundamental principles that are established in mathematics. The need exists to examine the mathematics education of Native American students to ensure they have the mathematics foundation to pursue these careers or any other career of their choice. Among Native American students in North Carolina, retention rates and mathematical achievement are lower than those of majority students. Native American people are classified as indigenous people whose ancestors inhabited regions the United States, to include Alaska and Hawaii, prior to the time of Columbus (Crawford, 1998). They are typically made up of distinct tribes. Retention rates are defined as the number of students that earn a high school diploma by completing traditional high school and mathematical achievement classified as obtaining a level 3 or 4 on standardized state tests for grades 9-12.

History of Lumbee Indians

According to the U.S. Census Bureau (2002), Native Americans make up less than 1% of the population. However, in Robeson County, North Carolina, the Lumbee tribe of about 53,800 members makes up approximately 39% of the population of Robeson County and is the largest tribe east of the Mississippi River (Bryant & LaFromboise, 2005; Smith, 1990). The majority of Lumbee Indians live in Robeson County, and the surrounding counties of Cumberland, Hoke, and Scotland, and these counties are considered by the Lumbee Tribal Council to be the tribe's home territory (Stilling, 2006). The origins of the Lumbee Indians are very complex because they adopted many of the "white man's" ways many centuries ago. They no longer find strong remnants of the Lumbee Indian culture, such as, dances or a native language (Dial & Eliades, 1996). According to Dial and Eliades (1996):

> The Lumbee Indians are the product of an environment that produced a swamp-surrounded island of land, which in turn afford isolation and protection and brought together in one community, remnants both of "the Lost Colony" and several Indian tribes, of which the Hatteras and various Eastern Siouan people were the most prominent. (p. 24)

The Lost Colony was composed of settlers who arrived in the New World in 1587, because Sir Walter Raleigh with backing from Queen Elizabeth I, wanted to possess the rights to land in the New World. After his first attempt to settle the New World was unsuccessful, he sent a second group under the leadership of John White. However, after realizing they did not have enough supplies to last through winter, John White returned to England to obtain more supplies. When he returned to the area where

he left the colonists, they had disappeared, leaving behind John White's possessions and the letters "C.R.O." carved on a tree and the word "CROATOAN" on a gatepost (Dial & Eliades, 1996).

Regardless of the debates surrounding their history, the Lumbee Indians do not claim to be anything other than Indian. They have never lived on reservations or been wards of the state or federal government, and they began to own private property by obtaining titles for land as early as the 1730s (Dial & Eliades, 1996; Smith, 1990). As a result of the undocumented history, the Lumbee Indians have struggled to gain the federal recognition that most tribes throughout the United States possess. The Lumbee tribe received state recognition from the State of North Carolina in 1885. However, since 1888 they have sought full federal recognition from the United States Government without success. The United States Congress passed the Lumbee Act of 1956, which recognized the Lumbees as Indians, but it did not allow the tribe to receive the full benefits that come along with recognition (Lumbee Tribe of North Carolina, n.d.). The tribe is still pursuing full federal recognition today.

The Lumbee Indians are often viewed as an acculturated tribe because they maintain different religious practices, customs, and beliefs compared to many federally recognized tribes (Bryant & LaFromboise, 2005). During 1875 through 1885, the Lumbee Indians in Robeson County were denied the right to an education. As a result, they petitioned the North Carolina legislature, with the sponsorship of Hamilton McMillian, to establish a normal school in Robeson County (Dial & Eliades, 1996). The normal school started with fifteen students and remained a high school-junior college

until 1939.The state legislature recognized the school in 1941, and opened the school enrollment to other ethnic groups in 1945.The normal school is the historical site and foundation of the present-day University of North Carolina at Pembroke (Smith, 1990).

The Lumbee Indians practice Christianity and it is not known when they lost their ties to Native American religion (Dial & Eliades, 1996). According to Dial and Eliades, the first formal religious organization began by the Lumbee Baptists in 1880 to advance the principles and achieve the objectives of Christianity. The organization is currently known as the Burnt Swamp Association of North Carolina. The second largest denomination among the Lumbee Indians is the Methodist Church. The Prospect community now has the largest Native American church facility anywhere (Smith, 1990). Great emphasis was placed on education in the early church. Dial and Eliades (1996) noted from the Burnt Swamp Association *Minutes:*

> Education implies a knowledge of books and how to reduce their content to practice . . . Viewing the subject of general education through avocations of life we notice it terminates with success. Education is needed at the bar, in the cornfield, in the domestic business of the household, in conducting the affairs of government, in carrying on the cause of Christ, and in fact it is needed in every business avocation of life. (p. 116)

Education and religion are crucial influences to the history of the Lumbee Indians. With the limited resources and advantages the accomplishments of the Lumbee Indians are noteworthy. Dial and Eliades (1996) state, “When compared with other Indian tribes throughout the country, the Lumbees rate at the top of the scale politically, socially, and economically” (p. 173).

In Robeson County, agriculture is still a principal economic activity. There are 1,500 farms and 72% of them are less than 180 acres (Stilling, 2006). More Lumbee Indians own more land today than since the Europeans arrived in the 1730s. As a result of the climate in the area, tobacco, soybeans, cotton, corn, and wheat are the main agricultural crops grown in Robeson County. Lumbee Indian farmers are more knowledgeable concerning the various government programs that affect farming including, techniques for improving productivity and sustaining soil fertility (Dial & Eliades, 1996).

Rationale

The history of the Lumbee Indian is crucial to understanding the people that they are today. Therefore it is necessary to obtain background information about the achievement the student experience within school today. Currently, on the North Carolina Eighth grade End-of-Grade tests for mathematics and Algebra I tests, the state average for all students is 69.9% for EOG and 69.0% for Algebra I; the district average for Robeson County is 55.9% for EOG and 54% for Algebra I. However, at one school in Robeson County with a large Native American population the Eighth grade End-of-Grade test results are 68.4% and greater than 95% for Algebra I (North Carolina Department of Public Instruction, 2008).

This school also has a low teacher turnover rate of 10%, while the district average is 26% and the state average is 21%. Located in a predominantly Lumbee Indian community the school has a Native American student population of almost 95%. The

majority of the teachers in this school grew up in this community attending grades K-8 in this school.

The Robeson County communities of Pembroke, Prospect, Union Chapel, Fairgrove, and Magnolia traditionally have been Lumbee Indian (Lumbee Tribe of North Carolina, n.d.; Stilling, 2006). Each community consists of large extended families linked by marriages and families. Research is necessary in order to determine why the achievement gap is narrowed for some of these Lumbee Indian communities and not others. I propose to study successful Lumbee Indian middle school students within one of these communities to better understand cultural factors affecting the narrowing of the achievement gap in mathematics.

One of the important mathematical concepts that is crucial to the success of students during middle school is the development of algebraic reasoning. Algebraic reasoning is defined in various ways. Carraher and Schliemann (2007) define algebraic reasoning as "psychological processes involved in solving problems that mathematicians can easily express using algebraic notation" (p. 670). Algebraic reasoning is also defined as the process that enables students to represent, analyze, model, solve, and justify generalizations about mathematical ideas, and express these generalization in progressively more formal and age-appropriate ways through the use of verbal, graphical and symbolic representations (Ball, 2003; Blanton & Kaput, 2005; Lannin, 2005).

Algebraic reasoning plays a crucial role in a student's mathematical development because it is the foundational knowledge that enables success in the pursuit of higher-level mathematics and also plays a role in restricting entry into further education and

expanded career opportunities (Ball, 2003; Kaput, 1999, 2008; Kaput & Blanton, 2000). It is often referred to as a gatekeeper for the following reasons: algebraic functions serve as a language system which enables concepts related to quantity and space to be understood; algebra is the foundation to all branches of mathematics; algebra has a prominent place in the organization of the educational system, school curriculum, and various subjects extending beyond mathematics; and Algebra separates students into groups within drastically different learning opportunities.

The place of mathematics in the curriculum for the United States has been very turbulent. Before 1700, algebra was absent from the school curriculum, but included in colleges and universities (Kilpatrick & Izsák, 2008). Algebra began to enter the curriculum of the major post-secondary institutions during the eighteenth century. As the mathematics requirements increased in the school curriculum, algebra became a requirement for entry into college during the nineteenth century. Over the course of the nineteenth century, algebra eventually became a part of the secondary curriculum. The face of the United States was changing because industrialization, urbanization, and immigration resulted in the rapid expansion of the high school and the number of students entering college (Donoghue, 2003). One of the problems that arose during this time period was an increase in the school population, as shown in Table 1.1. However, during 1890 more than 45% of high school students were taking algebra. The amount of students rose to almost 57% in 1910. “Algebra was fast becoming a major source of failure in school” (Kilpatrick & Izsák, 2008, p. 7). As a result, enrollment eventually decreased to below 25% in the 1950s. Table 1.1 shows the increased in high school enrollment,

therefore, enrollment decreased in algebra decreased because more students went to high school in the 1940s. During the mid 1950s through the mid 1970s, the emergence of the new math came about, which changed school algebra from generalized arithmetic to systemic structure. The back-to-basics movement emerged, after what many believed to be the failure of the new math.

Table 1.1. ***Enrollment in American High Schools and Attendance and Graduation Rates for Selected Years***

Year	Enrollment	14- to 17-year-olds in school (%)	17-year-olds graduating from school (%)
1890	359,949	6.7	3.5
1910	1,115,398	15.4	8.6
1940	7,123,009	73.3	49.0

Note: Adapted from "The Growing Crisis in Mathematics Education in the Early Twentieth Century," by G. M. A. Stanic, 1986, *Journal of Research in Mathematics Education, 17*(3), 194.

During the 1980s, concern was raised about how the future workforce would be able to tackle the changes in the skills of employees because of the tremendous increase in technology. The global market was experiencing many changes; therefore, America had to be ready to deal with these changes in order to compete in the global economy. Steen (1989) said "mathematical preparation is a key to leadership in our technological society, uneven preparation in mathematics contributes to uneven opportunity for economic power" (p. 18). About twenty years ago, algebra was viewed as a relatively intangible course that was only appropriate for students considered to be developmentally ready and planning to attend college (Chazan, 2008). As a result, the percentage of

students from certain ethnic groups and lower socio-economic groups of students were not enrolled in algebra. The implementation of algebra into the school curriculum, as a set of rigid rules and procedures, not connected to other mathematical knowledge resulted in an inability of students to relate material to their lives (Kaput, 1999). Kaput (2008) says that the computational approach to school arithmetic, in combination with the inaccessible and shallow approach to algebra had resulted in "teacher alienation and high student failure and dropout, especially among economically and socially less advantaged populations" (p. 6). The traditional approach to algebra has aided in promoting inequality because of its role in academic tracking (Kaput & Blanton, 2000). Measures have been implemented into the school curriculum in North Carolina to require that all students take algebra to fulfill graduation requirements.

The Second International Mathematics Study (SIMS) raised a lot of concerns about the mathematics education system. The results indicated that the average Japanese performed at a higher proficiency level than the top 5% of American students. The results from the study prompted national concern about American students' ability to be prepared to deal with the challenges that arise in order to ensure that America remains competitive in the global economy. Mathematics reform was implemented to hold schools responsible for students developing the mathematical proficiency to effectively transition into college and the workplace (Chazan, 2008; Dossey, Mullis, Lindquist, & Chambers, 1988; Steen, 1989). As a result of all students not having equal opportunities to pursue algebra and the detrimental effects that a lack of mathematical proficiency has on their future, algebra has become a "gatekeeper" course and higher levels of

mathematics have traditionally been reserved for the elite. To ensure that the diverse ethnic groups and socioeconomic classes of American students' are afforded the opportunity to develop mathematical proficiency, a national movement developed that stressed the importance of all students taking algebra. In response to the call for change, the National Council of Teachers of Mathematics (NCTM) drafted a set of standards to bring about reform to the mathematics curriculum. The *Curriculum and Evaluation Standards (Standards)* served "as a set of recommendations and principles directed at providing curricular and pedagogical support for students as they engage in mathematical thinking and problem solving" (Research Advisory Committee, 1988, p. 341). The *Standards* offered the following goals to help students achieve the proficiency to function in the global economy: to value mathematics, to reason mathematically, to communicate mathematics, to solve problems, and to develop confidence (Steen, 1989). NCTM developed the *Standards* as a guide for various educational organizations across the United States to use to ensure a high level of quality, consistent goals, and innovation in mathematics curriculum (NCTM, 2000). NCTM developed the *Principles and Standards for School Mathematics* (*PSSM*) to build on and strengthen the vision for all students to have a general foundational knowledge of mathematics. NCTM's purpose for *PSSM* is the following (NCTM, 2000):

- Provide a comprehensive and consistent set of goals for mathematics
- Serve as a resource for various educational and political institutions to utilize in the continuous process of increasing and maintaining the quality of mathematics

- Guide the establishment of curriculum frameworks, assessments, and instructional materials
- Encourage ideas and continuing dialogue at the various levels of government to ensure that constant progress is made towards the development of mathematical proficiency for students (in Role and Purpose of Document in Vision Section)

NCTM has developed standards for four different categories of students: pre-k through second grade, third grade through fifth grade, sixth grade through eighth grade and ninth grade through twelfth grade. The recommendations in algebra for students in the middle grades (sixth-eighth grades) will be examined. NCTM (2000) suggests that middle grades students' interest in mathematics will be promoted if high-expectations and support is prevalent in the classroom, which will help the students to look at mathematics with enthusiasm, and see the practical and innovative nature of the subject. Algebra is a critical area of focus in the middle grades, because of the significant role that the development of algebraic reasoning has on the future success of students. Over the course of the three years of middle school, the experiences that students are engaged in should foster an understanding of the basis that algebra provides for an extensive amount of mathematical content. The mathematics curriculum that students are exposed to in school should equip them with the ability to effectively use algebraic reasoning and meet a specified set of expectations for middle school. Table 1.2 shows what students should be able to do with the algebraic reasoning and the expectations:

Table 1.2. ***NCTM's Concepts and Competencies for Middle Grade Students for Algebra***

Mathematic Curriculum Should Enable All Students to:	**Expectations for All Students in Grades 6-8**
Comprehend the ideas associated with patterns, relations, and functions	• Represent, analyze, and generalize a variety of patterns with various graphical, symbolic and verbal representations • Examine the connections between different forms of representation for a relationship; • Recognize linear and nonlinear functions and understand the characteristics that each possesses
Represent and analyze mathematical situations and structures using algebra symbols	• Construct a basic conceptual understanding of various applications for variables • Investigate the connections between symbolic expressions and graphs, to determine the meanings of slope and intercepts • Utilize algebraic symbols to model and solve particular examples • Identify, product, and solve algebraic expressions or linear equations that may represent the same quantity
Use mathematical models to represent and understand quantitative relationships	• Understand how to develop representations for problems and situations that are relevant to everyday experiences
Analyze change in various contexts	• Explore how the characteristics of linear relationships change by utilizing graphical representations

Note: Adapted from NCTM, 2000

When students investigate patterns and relationships, examples that connect patterns to linear functions should be utilized to give the students a variety of opportunities to employ verbal, graphical and symbolic expressions. Students are often required to have the ability to transition between these various representations and have

an understanding of which representations work best for the relationship that they wish to examine. It may be necessary to construct a table, use a graphing calculator to produce a graph of the data or give a verbal explanation of the relationships that exist between the data so that the teacher can understand the students' thinking and enable a connection to be established between students' natural language and the terminology associated with algebra (NCTM, 2000).

In the middle school curriculum, students are expected to develop the ability to comfortably work with variables and equations in a variety of problem situations. NCTM (2000) emphasizes the importance of giving students ample opportunities to interpret the relationships between variables and symbolic expressions because students' understanding of the meanings and uses associated with these concepts develop over time. When students work with equations, they need a substantial amount of experience in working with the equivalences of algebraic expressions because the knowledge they gain can increase their fluency in transforming and solving equations. By the end of the eighth grade students need to possess the ability to solve multi-equations with variables on both sides, utilize formulas, understand the slope-intercept equation $y = mx + b$ and how changing the values for the slope (m) and y-intercept (b) affects the line.

An additional goal in the middle school curriculum offered by NCTM is the development of students' proficiency with using patterns and functions to develop representations for problems and situations that are relevant to everyday experiences. The use of calculators should be implemented to give students the opportunity to produce graphical and tabular representations and solve complex calculations, which in turn,

enables students to concentrate on the functions that correspond to changes in the patterns. Students need to have numerous chances to deal with problems that involve situations that can be adapted to the form of the direct variation equation y = kx, where the changes in the situations vary by a constant amount k. These situations also can allow the implementation of ideas related to the proportionality of various quantities. Students are also able to use the calculator to develop scatterplots and line of best fit to model the trends and develop prediction equations for the data. Students also need exposure to nonlinear functions, such as exponential growth and decay, and investment problems that involve compound-interest concepts.

The final goal for algebra that NCTM recommends is examining the change in various situations by exploring how the characteristics of linear relationships change by utilizing graphical representations. Students need to work problems that involve examining the relationships in graphical representations and learn to differentiate rate of change from accumulation (total amount of change) (NCTM, 2000). NCTM discusses utilizing special computer software that enables students to modify the quantities for the horizontal and vertical axis for graphs and observe the analogous changes in graph and symbolic representations for the relationship.

In order for students to be able to meet the expectations set forth in *PSSM*, the commitment and support for the implementation of these goals need to be carried out by administrative leaders within the school system (NCTM, 2000). They have to construct a long-term plan for improving the ability of schools and middle school teachers to achieve these goals. Effective professional development needs to be implemented to help teachers

with the content and pedagogical knowledge. Teachers also need to understand and utilize research on mathematics learning to effectively implement changes in classroom practices that provide continuous improvement in the quality of instruction and practices that keep students achieving and being able to become closer to the desired level of mathematical proficiency (NCTM, 2000). Middle school teachers have the difficult task of balancing between the world of elementary and secondary mathematics education. Teachers have to possess knowledge related to adolescent development, pedagogical strategies, and interdisciplinary approaches, and have the mathematical knowledge that is fundamental to middle school student success.

The RAND Mathematics Study Panel (Ball, 2003) was formed to offer recommendations that can help improve the quality and relevance of mathematics education research and development, so that the mathematical proficiency of students is increased for all students. Typically in the United States, advanced levels of mathematical proficiency is not achieved and the large difference in the achievement continues to exists between white students and/or middle-class students compared to students of color and low-socioeconomic students. Ball (2003) examined the social, personal, cultural and economic aspects of teaching mathematics in schools. Mathematics equips an individual with the knowledge to examine and make judgments about issues and policies that arise in a democratic society. Mathematics broadens the possibilities that are available to people in their personal and professional lives, which can increase the standard of living that people are able to achieve. Mathematics is a powerful subject that aids in the acquisition of knowledge and creation of new developments in science and technology,

by “providing powerful tools for analytic thought and the concepts and language for creating precise quantitative descriptions of the world” (Ball, 2003, p. xx). Equity constantly emerges as an important issue when addressing mathematical proficiency for all. How our education system is established has resulted in disproportionate results, because most students do not develop mathematical proficiency. Ball (2003) determined, through the examination of the results from national assessments, that children of poverty, students of color, and ESL learners make up the majority of students who do not develop mathematical proficiency. In addition, the 2000 National Assessment of Educational Progress (Kloosterman, Lester, & National Council of Teachers of Mathematics, 2004) showed that only 5% of African-American students achieved proficiency, however, white students obtained 34% proficiency. Algebra is the subject area of focus when examining mathematics education research and development because of the role it plays in restricting entry into further education and expanded career opportunities (Ball, 2003). The reasons that algebra is considered by many to be the “gatekeeper” is the following: algebra functions serves as a language system which enables concepts related to quantity and space to be understood, algebra is the foundation to all branches of mathematics, algebra has a prominent place in the organization of the educational system, school curriculum, and various subjects extending beyond mathematics, and algebra separates students into groups within drastically different learning opportunities.

No research exists that examines the mathematical achievement of Lumbee Indian students. Previous studies address the difficulty that arises when one solution is proposed

to help improve Native American students' mathematics achievement, because of the tremendous diversity that exists in the Native American culture (Cheek, 1984; Demmert, McCardle, Meie-McCarthy, & Leos, 2006). As a result of the diversity among the Native American culture, the problems that exist in achieving mathematical proficiency are not consistent across the various tribes in different geographical regions. House (2001) says, "Cultural differences and instructional materials that are not appropriate have combined to result in lower mathematics achievement of American Indian students" (p. 289). Currently, students may also experience a lack of connection with the mathematics curriculum, because of not seeing the relevance of mathematics in their everyday lives (House, 2001; Latham, 1999; Ramirez & Mather, 1997). Two of the issues that emerge as a result of a lack of connection are the shortage of role models in mathematically related fields, and the lack of opportunities to engage in mathematical practices that are authentic to their experiences. Therefore, Native American students do not have the opportunity to experience equity in mathematical pedagogy (Apthorp & Mid-Continent Regional Educational Lab, 2004; Booker, 2006; Fuson et al., 2000; Marchand, Pickreign, & Howard, 2005; Ramirez & Mather, 1997). Additionally, the research does not address the Lumbee Tribe, but focuses on other Native American tribes (Apthorp & Mid-Continent Regional Educational Lab, 2004; Davidson & Miller, 1998; Lipka, Sharp, Brenner, Yanez, & Sharp, 2005). Various researchers focus on the severe need for additional research on Native Americans in mathematics (Cheek, 1984; Demmert et al., 2006; House, 2001).

Purpose Statement

The purpose of this study is to examine the aspects of community that support the algebraic achievement of Lumbee Indian middle school students. As a result of the lack of research related to Lumbee Indians, I seek to gain an understanding of why there exists a narrowed achievement gap in mathematics in a particular Lumbee Indian community by examining the meanings of teaching and learning mathematics. Wenger (1998) defines meaning as "a way of talking about our (changing) ability—individually and collectively—to experience our life and the world as meaningful" (p. 5). Therefore, I will look at the experiences, expectations, resources, and goals of community members to understand these meanings. There are three components of the meanings of teaching and learning mathematics that inform the study: (a) mathematics teaching and learning; (b) the students; and (c) the social networking in the community.

As a result of the nature of the study, which is an examination of the meanings of mathematics in the community, a qualitative study will provide an opportunity for me to examine the beliefs and values that the teachers, students and parents possess about mathematics (Creswell, 2007). The meanings of mathematics influence: (a) the instructional practices that are used in the classroom to promote student understanding; (b) the expectations the teachers and parents have for students' success in the mathematics classroom; and (c) the level of support the teachers and parents provides to ensure success.

Theoretical Considerations of Meanings of Mathematics Teaching and Learning

During the course of my examination of the literature, Yackel and Cobb (1996) expanded the interpretive framework to account for the broader influences that the school and societal levels have on the development of student's mathematical learning. As a result, the expansion of the framework will give me a theoretical framework for examining the aspects of the community that support the algebraic achievement of Lumbee Indian middle school students. The framework was developed out of a need to examine the broader contexts that were accounted for at the classroom level. While conducting research, Yackel and Cobb (1996) encountered instances in which the interpretive framework was not an adequate tool to examine what was occurring within their teaching experiments. The need to expand the framework to look at the school level became apparent when conducting research in two locations. One of the research sites was located in a rural/suburban area and the other was comprised of a predominantly inner-city population. The goal of the research was to work in coordination with the teachers to make the strong reliance on the textbook during instruction problematic because this would help them to understand the need to alter their instructional practices to ensure that students' learned with understanding. They experienced success when working with the rural/suburban sites.

When the researchers began their study in the inner-city site, the approach they used in the rural/suburban was not effective because the beliefs and values of the teachers at this site were aligned with the traditional views of mathematic instruction. Several of the teachers adopted the instructional practices that the researcher felt promoted students'

understanding; however, there were distinct differences in the ways that the teachers at two research sites adopted these practices. After carefully examining the observations made at the inner-city site, the researchers found that there were differences in what counted as intellectual and social-welfare of students within these two settings. To deal with the differences, the researcher developed the notion "that what it means to be a child in school" is restructured by the members of a learning community as they take part in the practices within the school. The general school norms are not developed in terms of individuals but from the collective and individual's beliefs about what constitutes being a student within the school community. The psychological constructs, such as what an individual's beliefs about their role and others' role in school, emerge as the students take part in and contribute to the practices of the school community.

The need emerged to expand the interpretive framework to the societal level because Cobb and Yackel (1995) wanted to add to the prior studies on mathematical achievement of Asian and American students by comparing the learning of arithmetic of students in Taiwan and the United States. While examining the two countries they realized that the students were participating in distinctly different learning activities and the activities were also structured around the cultural practices at the societal level. The two countries included the following differences in general societal norms: teachers' and parents' expectations for the process that students will go through to learning, the level of proficiency students will reach, and the amount of support that teachers and parents will provide to students. From the social perspective at the societal level, the development of students' mathematical understanding is based on their participation in the learning

activities on the cultural practices of the society. The psychological perspective treats the culture as a group of factors that influences an individual's intellectual development in mathematics.

The interpretive framework is used to examine the classroom level analysis of the development of student's understanding while participating in the local classroom community. My study will look at the school and societal/community level to determine how they influence the development of student's understanding in algebra. Examining the sociomathematical norms enables the researcher to determine the beliefs and values that are specific to mathematics. The social norms aspect allows the researcher to determine how the teacher and students interact in the classroom and how mathematics activity is positioned within the classroom. The school and societal aspects of the expanded framework provide a way to analyze how the school (teacher component) and societal/community (parent component) support the algebraic achievement of students. The societal aspect of the framework will be adapted to look at the community as the unit of analysis.

In the examination of mathematics teaching and learning, and students' perceptions, goals, and motivations, Cobb and Yackel's (1996) framework provides a useful tool for investigating these two components through the meanings of mathematics teaching and learning. To understand the third component of mathematics teaching and learning, I will need to examine social networking from the social capital perspective.

Pierre Bourdieu (1986) and James Coleman (1988) analyze the concept of social capital in two principle ways. Bourdieu defines social capital as "the aggregate of actual

or potential resources linked to possession of a durable network of essentially institutionalized relationships of mutual acquaintance and recognition" (as cited in Dika & Singh, 2002, p. 33). Lin (2001) explains how social capital is thought of from two differing perspectives: the individual and the group. He says that the individualistic perspective is analyzed based on how the individuals access and draw on assets embedded in social networks to gain help to advance themselves or how the individual provides resources in the social networks; and the group perspective looks at how the cooperative parts and processes of the group are based on the construction and continuation of the collective asset. According to Lin (2001), Bourdieu views social capital from class perspective because social capital is "the investment of the members in the dominant class (as a group or network) engaging in mutual recognition and acknowledgement as to maintain and reproduce group solidarity and preserve the group's dominant position" (p. 10).

Dika and Singh (2002) discuss how social capital from Coleman's perspective involves analyzing it from the viewpoint of norms and social control. Coleman says social organization is the foundation to social capital because it supports the networks. He emphasizes social organization because the interconnected nature (members of the community know the extended family) of the networks fosters the development of norms (Dika & Singh, 2002). Coleman's theory of social capital looks at the positive contributions that it can have on the opportunities that students have to become successful. The connections between the networks in social capital are persevered due to closure, which Coleman (1988) explains as a means monitoring each component of the

system to ensure that it is working effectively for the common good. Lin (2001) discusses how closure also exists in Bourdieu's view of social capital because the resources are allotted and utilized by the individuals within a particular social group or class.

The concept of social capital was applied in a study that examined the differences in development of students who are considered at-risk (Furstenberg & Hughes, 1995). They define at-risk as having the potential to live a life with limited economic opportunities, therefore, resulting in limited resources to provide for the basic needs of life. The study had three different stages:

1. Three years after the completion of a 20-year longitudinal study, the researchers established a baseline by looking at the bivariate relationships between the students' current achievement and the measures of social capital.
2. Introduced two measures of human capital, mother's education and the socioeconomic status of the family, as control variables.
3. Expanded model to introduce controls for each of the other measures of social capital from three years earlier with the associated outcomes presently in the students.

Furstenberg and Hughes were able to determine that social capital has an influence on helping youth navigate out of poverty.

Goddard (2003) conducted a study to build on the theoretical foundation for relational networks, norms, and trust as functional and structural tools of social capital that can be utilized to increase student achievement. The study was conducted at elementary schools in a large urban district, involved surveying teachers at schools that

had at least five participants, and consisted of collecting student achievement and demographic data for each school that participated. Goddard concluded that schools described as having a high level of social capital had increased proficiency levels on their state-mandated tests. When the teacher-student and teacher-parent relationships are classified as having trust and the schools possessed norms and social relations that supported academics then the foundation is laid that enables students to experience academic success.

Summary

Typically in the United States, advanced levels of mathematical proficiency is not achieved and the large difference in the achievement continues to exists between Caucasian students and/or middle-class students compared to students of color and/or low-socioeconomic students. Algebra is the subject area of focus because of the role the subject plays in restricting entry into further education and expanded career opportunities (Ball, 2003). The reasons that algebra is considered by many to be the “gatekeeper” is the following: algebra functions serves as a language system which enables concepts related to quantity and space to be understood, algebra is the foundation to all branches of mathematics, algebra has a prominent place in the organization of the educational system, school curriculum, and various subjects extending beyond mathematics, and algebra separates students into groups within drastically different learning opportunities. To effectively utilize the fundamental principles of algebra, the development of algebraic reasoning has to occur. Investigating aspects of the community provide an understanding of the activities, practices, beliefs, and values that promote the development of algebraic

reasoning. By examining a community in which the achievement gap is lowered for Lumbee Indian students, the study provides the researcher with the opportunity to investigate what factors within the community facilitate the success of students in mathematics. Therefore, the following research questions are proposed for the study:

1. What are the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community that promotes mathematics achievement in the middle grades?
2. How does mathematics teaching and learning emerge during an examination of the community?
3. How does the social networking system within the community promote the mathematics achievement?
4. How does the community support teaching and learning?

CHAPTER II

REVIEW OF LITERATURE

Diversity of Native Americans

Among Native Americans there exists a tremendous diversity. Cheek (1984) examines possible solutions to increase Native Americans' participation in mathematics. She reports that because there are over 400 different tribes the cultural diversity among Native Americans is a major obstacle in studying the problem. Cheek states, "Programs designed for members of one tribe or group of tribes may not be appropriate for members of other tribes" (p. 107). In a review of research on Native American students in mathematics, Cheek presents the following solutions for increasing achievement: higher expectations, culturally based programs in mathematics, and improved mathematical pedagogical methods. Cheek also discusses a study conducted by Scott (1983), that showed how the Pueblos performed higher compared to white students on the measurement proportion of a mathematics achievement test, because the measurement questions were applications of real-world problems. However, they scored lower on the arithmetic portion, which was highly symbolic and could be completed using rote memorization instead of conceptual understanding. Based on the findings of the study, Cheek suggested that future studies need to be conducted to determine the impact of linking real-world problems to the development of Native American students understanding of mathematics.

Demmert et al. (2006) also discuss the issue of diversity when conducting research on Native Americans. The researchers say,

> It is clearly recognized that not all Native American groups are the same. Even within the subcategories of American Indian, Alaska Native, and Native Hawaiian, there are subgroups with distinct cultures, traditions, and languages. Any research would need to take this into account. (p. 100)

In order to have a foundation to examine the educational issues faced by Native American students, Demmert et al. (2006) expanded on the research addressed by the committee that helped to develop *Indian Nations at Risk: An Educational Strategy for Action* (Department of Education, 1991). The following are the four areas of focus that the committee felt were essential for increasing Native American students academic success: (a) Develop culturally, linguistically, and developmentally appropriate programs in the early grades; (b) Support the use of students' tribal language and culture within the school environment; (c) Provide adequate training to Native American teachers in order to bring to the forefront quality instruction for students; and (d) Provide the foundation necessary to strengthen communities and provide support to ensure that students are prepared to attend four-year colleges and universities. These researchers also used data from workshop participants, research colleagues, and focus groups to determine the areas that are critical in order to address the need for research on the issues faced by Native Americans. The following are the results from the input:

- Increasing the number of Native American researchers.
- Increasing the extent to which research on Native American students is community-based, participatory research, and ensuring the inclusion of a variety (where possible a combination) of research methodologies.

- Defining, examining, and addressing the achievement gap.
- Examining the effectiveness of culture-based education in comparison to existing instruction.
- Focusing on early childhood development. (p. 104)

Algebra

One of the important mathematical concepts that are crucial to the success of students during middle school is the ability to learn and understand the fundamental concepts of algebra. Views of algebra are shaped by its implementation into school mathematics throughout the history of United States education system. The traditional view of algebra is based on simplifying algebraic expressions, working out equations, and becoming proficient at manipulating symbols based on a predetermined set of rules, which lead to a disconnection with mathematics knowledge and real world applications (Kaput, 1999). Kaput's definitions of algebra are in the following approaches (Carraher & Schliemann, 2007; Kaput, 2008):

- The study of structures and systems abstracted from computations and relations that arise from generalized arithmetic and in quantitative reasoning
- Algebra as the study of functions, relations, and joint variation
- Algebra as a cluster of specific modeling languages to express and support reasoning about situations being modeled

Algebra is also characterized by using variables to develop polynomial and rational expressions, through representing or modeling concrete examples from real-world situations, utilizing the Rules of Arithmetic, the Laws of Exponents and multiplicative nature of fractional powers in combination with the fundamental concepts

involving in working with equations (Carraher & Schliemann, 2007). Ball (2003) looked at algebra as the basis for mathematics reform in the United States because of the major influence that Algebra has on the school mathematics curriculum. Algebra is the foundation that enables the development of tools that are critical to representing, analyzing, modeling, solving, stating and proving generalizations; which can then be transferred in peoples' everyday lives. Kaput (2008) makes a distinction between algebra and algebraic reasoning. He characterizes the view that some people have of algebra as sustainable body of knowledge, which in turn views algebra as a cultural artifact; and the ability to do algebra is a matter of genetics. However, algebraic reasoning looks at algebra as an activity that people engage in by "doing, thinking and talking about mathematics" (p. 9).

Algebraic Reasoning

To effectively utilize the fundamental principles of algebra, the development of algebraic reasoning has to occur. In a review of the literature on algebra and algebraic reasoning, the terms algebraic reasoning and algebraic thinking are used to indicate the same idea. Smith (2008) looks at two kinds of algebraic thinking: representational thinking and symbolic thinking. Representational thinking explains the psychological processes that an individual develops to situate meaning for a particular representational system. Symbolic thinking is then associated with the way one interprets and utilizes a symbol system and the rules associated with it. Smith argues that examining how people create their individual mathematical certainty is critical to representational thinking and needs to be focused on because it can enable mathematics to be more unified, more

general, and clearer. Through the use of functions as a basis, Smith developed an approach to the introduction of algebraic and functional concepts that utilizes contexts for students to build functional relationships, which links actions with the representational system that allows the construction of mathematical certainty between the actions and the representational system.

Carraher and Schliemann (2007) conducted a review of the literature on algebraic reasoning for students' ages 6 to 12, which is classified as early algebra. They define algebraic reasoning as "psychological processes involved in solving problems that mathematicians can easily express using algebraic notation" (p. 670). Early algebra is considered to be the bridge between arithmetic and algebra. Carrahar and Schliemann view arithmetic as a part of algebra instead of two distinct areas of mathematics. By focusing on the relationship between arithmetic and algebra, students have an increased chance of generalizing mathematical ideas, understanding functions and variables and using algebraic notation. All three of these aforementioned processes are prominent components throughout the elementary mathematics curriculum. The research also focuses mainly on mathematics learning and to a smaller degree teaching, and uses educational policy, epistemology and curriculum design to facilitate and enrich the discussion related to algebraic reasoning.

Blanton and Kaput (2005) view algebraic reasoning as "a process in which students generalize mathematical ideas from a set of particular instances, establish those generalizations through the discourse of argumentation, and express them in increasingly formal and age-appropriate ways" (p. 413). Algebraic reasoning can assume different

forms as described by the following: utilizing arithmetic (generalized arithmetic) or modeling as a domain for expressing and formalizing generalizations, generalizing numerical patterns to describe functional relationships (functional thinking), and generalizing about mathematical systems abstracted from computations and relations (Blanton & Kaput, 2005; Carraher & Schliemann, 2007; Kaput, 1999, 2008). In order to examine how algebraic reasoning is promoted in the classroom through the strategies utilized by the classroom teacher, Blanton and Kaput (2005) conducted an in-depth study of one particular teacher after a year in the "Generalizing to Extend Arithmetic to Algebraic Reasoning" (GEAAR) project. The project focused on developing teachers' aptitude for recognizing and thoughtfully adding to students' experiences about reasoning algebraically. The project also utilized existing and supplemental instructional resources to create support for realistic classroom activities. The class was observed twice a week, with the teacher writing reflections and collecting student work for 19 additional classes. The classroom instruction and interactions were evaluated to determine the diversity in types of algebraic reasoning, their frequency and form of integration, and the techniques of teaching practices by which algebraic reasoning would flourish. The algebraic reasoning was separated into spontaneous and planned algebraic reasoning teaching episodes. These episodes were broken down further into thirteen categories. Teacher effectiveness in integrating planned and spontaneous algebraic reasoning tasks on a daily basis into mathematics instruction resulted in growth in students' algebraic reasoning skills.

Different studies have taken the various components of algebraic reasoning and conducted studies to determine if they can effectively increase students' ability to utilize these components while completing algebraic tasks (Billings, 2008, Gay & Jones, 2008; Lannin, 2005; Smith, 2008; Steele & Johanning, 2004). Students' ability to build upon the mathematical activities and generalize this information in an effective mathematical representation of proposed solutions to the tasks appeared to be the unifying theme of the research focus of the various studies.

Steele and Johanning (2004) conducted a study with a seventh grade pre-algebra mathematics class to determine if the students could develop effective schemas, which are defined as a mechanism in the memory that enables the student to effectively connect similar experiences together, that could be used to do the following:

- Make connections between quantities in algebraic problem situations
- Use verbal and symbolic expressions to denote relationships
- Examine problem-solving strategies developed by students as they solved linear and quadratic problems.

The schemas were classified as either partially formed schemas or well-connected schemas. To examine students' schema development, problem contexts were used that looked at size, shape, growth and change, so that students had the opportunity to develop a pattern generalization to aid in students' understanding of the various relationships that existed between the various problems. Building-up and subtracting out schemas were most often used in the problem's context. They concluded that there appears to be a link between the generalizations that students created and the schemas they developed. The

researchers explain that the “students extend their schemas to assimilate the new particular case into an existing general schema or accommodate their existing general schema to incorporate the new particular case” (Steele & Johanning, 2004, p. 88). The students create schemas they feel are effective for them. They are able to explain how they utilize these schemas in new problem contexts. This demonstrates they are learning to generalize.

Various researchers use patterns as the context for exploring generalizations (Lannin, 2005; Richardson, Berenson, & Staley, 2009; Smith, 2008). Lannin (2005) focuses on the importance of the linked relationship between generalization and justification. Generalization is a mathematical statement that characterizes the context for any value in the specified domain of the variable(s). Justification is the argument that links the mathematical statement to a general relation that is present in the context of the problem. In the study, the researcher introduced students to algebra by using patterning activities by beginning with a context that aids the students in understanding the different representations used in the activities. The researcher assumed the role of teacher in a class of 25 sixth graders that had varying range of ability levels, over a ten-day period. Four of the students were selected as the focus of the study because they were representative of class as a whole. Four mathematical tasks were selected to engage the students in algebraic reasoning and promote reflection on the challenges and advantages of the different strategies the students developed. The students utilized two types of justifications: empirical justification and generic example. Students that used generic examples were able to connect their understanding of the general relation in the various

problems to related problem situations. The students that used to empirical justification resulted in the use of guess-and-check strategies that hindered successful generalizations of the task.

Proportional Reasoning

Proportional reasoning has such a significant role in a student's mathematical development that is has been called a central concept, a basis of higher mathematics, and the capstone of elementary concepts (Lamon, 1993; Lesh et al., 1988). The development of proportional reasoning helps students effectively deal with concepts related to ratios and proportions that are connected to the various situations they will encounter in mathematics and science and on a daily basis (Karplus et al., 1983). Various researchers have looked at the types of reasoning that students use to solve the different cognitive levels of proportional reasoning problems (Ben-Chaim et al., 1998; Karplus et al., 1983; Lamon, 1993; Norton, 2005, 2006).

The concepts of ratio and proportion are the critical components in the development of proportional reasoning, and are commonly used in everyday situations. Tourniaire and Pulos (1985) conducted a review of the literature on proportional reasoning to determine the types of approaches used to solve proportions and the things that impact performance on proportion problems. They determined that the development of proportional reasoning is often complex; therefore, they draw the following conclusion: the methods used to solve proportions problems develop with age and experience, and increasingly difficult proportion problems are solved. Karplus et al. (1983) conducted a study to the type of comparison and types of strategies that eleven

and thirteen year-old students. Comparison proportion problems and missing value problems were used to determine whether students between, within, and other approaches to reason through the problems. The comparison problems involved comparing the rates of two items. The missing value problems involve using the known data and relationships to determine a rate for the specified item. Table 2.1 shows examples that are representative of comparison and missing value problems. The type of comparisons and types of strategies used to solve the problems was affected by the context and the numerical content of the problem, and the type of task they performed in the previous problems.

Table 2.1. ***Comparison and Missing Value Problems***

Type of Problem: Example
Missing Value Problem: A car is driven 240 miles in 4 hours. How far will it travel in 10 hours at the same speed?
Comparison Problem: Car A is driven 140 miles in 2 hours. Car B is driven 325 miles in 5 hours. Which car was driven faster?

(Adapted from Karplus et al., 1983)

Lamon (1993) (based on a review research), says, “It has been implicitly understood that proportional reasoning consists of being able to construct and algebraically solve proportions” (p. 41). Lamon conducted a study with 138 sixth graders to examine the students’ use of critical mathematical components related to proportional reasoning. The following four types of semantic problems typically involve the use of proportions: well-chucked measures, part-part-whole, associated sets, and stretchers and

shrinkers. Well-chucked problems involve the comparison of two measures to determine a rate. Part-part-whole problems examine two sets of the same objects, with each set containing two types of items and comparing the number of items from each set in relation to each other. Associated sets are proportion problems in which "the relationship between two elements is unknown or unclear unless their relationship is defined within the problem situation" (Lamon, 1993, p. 42). Stretchers and shrinkers problems involve enlarging and reducing objects with a fixed ratio. Table 2.2 shows examples of types of problems that involve the use proportions.

Table 2.2. ***Four Types of Semantic Problems***

Semantic Problem Type Example
Well-Chucked: The student is shown a page from a soft drink distributor invoice book, showing the various price that different stores paid for various amount of drinks. The various stores purchased 10, 15, 22 and 35 cases of drinks for $22, $30, $35, and $50. Did the stores purchase the cases of soft drink for the same amount?
Part-Part-Whole: The student is shown a picture of two boxes of cupcakes, one box containing a dozen cupcakes (7 chocolate to 5 vanilla) and the other containing 1½ dozen cupcakes (10 chocolate to 8 vanilla). Which box contains more chocolate cupcakes to vanilla cupcakes?
Associated Sets: The student is shown a picture of 9 girls with 4 pizzas and 6 boys with 2 pizzas. Who gets more pizza, the boys or the girls?
Stretchers/Shrinkers: The student is shown a picture of two trees. Tree A is 10 feet high and tree B is 14 feet high. This picture was taken 6 years ago. Today, tree A is 18 feet high and tree B is 22 feet high. Over the last six years, which tree's height has increased the most?

(Adapted from Lamon, 1993)

The students had not received any previous instruction related to ratio and proportion. The students' ability to engage in higher-order thinking skills that were involved in some of the semantic types was strongly related to the ability to use relative thinking and utilization. Lamon was able to determine that teachers can help to improve relative thinking and utilization by giving students the opportunity to engage in problems that can be approached using multiple strategies.

Problem-Solving

As human beings we encounter various types of problems in our everyday lives. Von Glasersfeld (1995) says "students will be more motivated to learn something, if they can see why it would be useful to know it" (p. 177). Schoenfeld (1992) discusses the three main themes proposed by Stanic and Kilpatrick (1988) about the use of problem solving. The first theme is "problem solving as context" and the five roles that problems play:

1. As the reason for mathematics instruction.
2. To provide specific motivation for mathematical concepts.
3. As leisure.
4. As a way to expand new skills.
5. As practice.

The second theme is the skill aspect problem solving as skill, and the final theme is the art aspect of problem solving. Schoenfeld also discusses Halmos's argument that students' mathematical experiences should prepare them for tackling challenges. Students

should engage in real problem solving, learning during their academic careers to work problems of significant difficulty and complexity.

"Problem difficulty is not so much a function of various task variables as it is the characteristics of the problem solver, such as traits, dispositions, and experiential background" (Lester, 1994, pp. 664-665). Lester (1994) presents the following results based on the problem-solving literature: (a) Students must solve numerous problems to improve on problem solving capability, (b) Problem solving develops over time, (c) Students need to believe that their teacher thinks problem solving is important, (d) Problem solving needs to be planned for students to receive the maximum benefit, and (e) Teaching students about problem solving strategies does not make significant improvement in their ability to solve mathematic problems. English (1996) reports that when children are given the opportunity to actively engage in the development of their own solutions to problems and acquire important mathematical concepts in the process, these factors play a large part in the development of "children's mathematical power" (p. 82). English conducted a study that looked at students' production and analogical transfer of mathematical knowledge during new problem solving opportunities. The tasks involved hands-on and written activities that were selected to cognitively challenge the students and promote the development of the student's own ideas about the problems. The strategies that students use to solve the problems are based on the not planning, transitional, and odometer stage of development. Two students' responses, James and Kerry, were closely analyzed. James was considered to be a high-achieving student in mathematics who determined his solutions to the problems mentally. He did not make

any significant improvements in the development of the solutions to the problems because he only progressed to the transitional stage of development. He employed trial-and-error techniques and guessing to solve the problems. Kerry was thought of as a low-achieving student. She used trial-and-error on the first problem. On the second problem Kerry used a technique that involved holding some of the items constant and rotating the other items in the selection process, which enabled her to reach the transitional stage of development. On the final problem, Kerry reached the odometer stage of development.

Lesh and Harel (2003) conducted a study to examine the similarities and differences that students go through during modeling cycles and the stages of development. Lesh and Harel state “the kinds of problem solving situations that we emphasize are simulations of real life experiences where mathematical thinking is useful in the everyday lives of students, or their friends or families” (p. 158). The students were also required to explicitly explain the thought process they engage in to solve the problems. Three problems were given to the students’ to solve: the Sears catalog problem, the Big Foot problem, and the Quilt problem. Lesh and Harel (2003) determined that the characteristics of the model-eliciting process were similar to the corresponding general stages of development. Student’s stage of development frequently differed depending on the task, and across the modeling cycles for the task. Students switched back and forth between the various ways of thinking about the problem-solving situation. Thus demonstrated the concept that one student may be at different developmental stages at different places in the math problem.

Real-World Application

Blum and Niss (1991) define real world as "the rest of the world outside mathematics, i.e. school or university subjects or disciplines different from mathematics, or everyday life and the world around us" (p. 37). During the applied problem solving process, the results were acquired from economic items, normative models and descriptive models, were solved using mathematics and retranslated back into the real-world to be analyzed in terms of the original problem. Boaler (1993) conducted a study to determine the difference in the transfer of students' mathematical understanding across different contexts. Fifty students were selected to participate in the study and were placed in two different groups. One group was exposed to a mathematical learning environment that promoted the use of open-ended problems to enable the integration of various mathematical components and processes. The other group came from a traditional mathematical environment that promoted the acquisition of knowledge from the teachers and the textbook. The students were given six questions that addressed a variety of content and contexts. The results showed that students from the traditional school displayed the same types of solutions sequenced across the variety of problems they encountered, whether their solutions were correct or incorrect. The students in the other group displayed a variety of techniques when solving the problems. The context of the problem either aided in students understanding or created a mental image to the students so that a clearer understanding of the problem situation developed. Boaler (1993) explains, "School mathematics will only become meaningful to students when it reflects this complexity and requires some application and negotiation: not in order to replicate

real world situations but in order to develop understanding and to replicate real-world demand" (p. 370).

Using the schools from previous studies, Boaler (1998) examined how the different learning environments fostered the development of different types of knowledge. The Phoenix Park School used the traditional, textbook approach to teaching. The Amber Hill School promoted the use of open-ended, project-based instruction. The students at Phoenix Park worked hard, however, they did not fully engage in the mathematics content because they appear to not have any desire to go beyond the rule-based view of mathematics. The students were unable to reason through the problems and determine how to apply the knowledge they acquired in the classroom. The students at Amber Hill were exposed to an environment that promoted the acquisition of mathematical knowledge in situations that were realistic and meaningful to them. The students had acquired the ability to reason through and modify and change their knowledge to deal with different situations they encountered.

Stillman and Galbraith (1998) conducted a study of the problem-solving activity of female students in high school. The students were given the opportunity to use application and modeling to develop a greater understanding of the mathematical content. However, many of the students encountered problems making connections between the data in their representations. The following are the factors that Stillman and Galbraith say contributed this problem: inadequate comprehension skills, inability to control unproductive responses, lack of understanding of the mathematical content, and insufficient algebraic manipulative skills. Stillman and Galbraith (1998) stated, "It is

crucial that students enhance their abilities to focus on the selection of relevant information, the construction of feasible model, and the testing of that model, and well as the employment of monitoring and verification strategies" (p. 187).

Equity in Mathematics Education

One of the focuses in the educational community is ensuring equity in mathematics education. The policies that are currently implemented only examine increasing students' opportunities to learn advanced levels of mathematics and the need for all students to learn mathematics and not focus on the underlying factors that result in the inequity developing (Diversity in Mathematics Education Center for Teaching and Learning, 2007). The Diversity in Mathematics Education Center for Teaching and Learning feels that it is critical to examine how the cultural histories and social structures within communities in order to understand these underlying factors.The importance of mathematics education, and the expanded career and academic opportunities that are available to students with strong mathematics backgrounds helps to understand why equity issues related to mathematics are critical in education.

Boaler and Greeno (2000) determined that students are more likely to participate in mathematics if the classroom structure promotes mathematical problem solving, emphasizes multiple approaches to solving mathematic problems, and encourages students to justify their solutions. Equity is promoted within the mathematics classroom that allow students to participate in discussion by providing them with opportunities to become more connected with mathematics which can increase the chance that students will pursue careers related to mathematics. The traditional approaches to teaching algebra

which include: a lack of relevance to everyday applications, not having an opportunity to make a connection to their previous experiences, and not having a learning environment that supports the development of their mathematical knowledge by engaging in discourse with others, has promoted the inequalities that exist in mathematics (Kaput, 1999). Algebra has serves as a gateway to higher levels of mathematics, because historically many students have not been able to pass through the gateway which has resulted in limited academic and career opportunities (Ball, 2003; Kaput, 1999, 2008; Kaput & Blanton, 2000).

During an examination of Native American students' and Alaska Native students' academic performance in mathematics when compared to other groups of students, Freeman and Fox (2005) found these students were almost three times as likely to score in the lowest mathematical proficiency level when compared to Caucasian peers. Freeman and Fox found similar results when looking at standardized test scores, graduation rates, and other measures of academic success. To ensure the success of Native American students in mathematics, equity needs to exist in mathematical pedagogy (Apthorp, 2004; Fuson et al., 2000; Marchand et al., 2005; Ramirez & Mather, 1997). Ramirez and Mather (1997) suggest that Native American students' performance is impacted by the lack of role models in educational or mathematic positions; and students have few opportunities to learn mathematics through classroom practices that involve group work, manipulatives, games, or computers. In order to address the issues associated with improving Native Americans' performance in math, Ramirez and Mather made the following recommendations: implement classroom practices that are innovative

to address student; encourage students to enter math or science related fields; expose students to successful Native American role models in math or science related areas; provide additional support for students due to lack of help students often receive at home; and identify and utilize mathematics teachers who possess necessary characteristics that promote success of students.

Fuson et al. (2000) further reinforce these recommendations by allowing understanding of how students need assistance in order to see themselves in the math world. If students are able to see themselves within the math world, it will help them to see the relevance and connections that mathematics has on their lives. “In academically successful and culturally and linguistically diverse schools and classrooms, teachers and school leaders adapt practices and structures to students’ interests and cultures and students feel a sense of belonging” (Apthorp, 2004, p. 5). Marchand et al. (2005) also agree that mathematics teaching practices need to incorporate concepts that promote active learning, emphasize American Indian culture, and learning environments. These environments must be conducive to learning and help make mathematics accessible to students. To ensure the success of Native American students in mathematics, traditional instruction needs to be reevaluated to incorporate mathematics pedagogy that increases the learning of students. Students need to be able to see the relevance of mathematics to their own lives and culture which can in turn help them see how mathematics is a tool that can be used to solve real-world problems.

Cultural Congruence

Cultural congruence instruction offers opportunities for the students to connect to school because the instructional practices in the school are more in line with their cultural norms and values (Au & Kawakami, 1994). Cultural congruence instruction has also been called culturally compatible, culturally relevant, and culturally responsive instruction. The instruction is not intended to match the home or community practices because of the distinctly different purpose between the home and school, but to adapt the practices of the school to make it more align with the cultural norms of the home or community. The goal of cultural congruence instruction is to provide students' with educational experiences that will enable them to be more prepared to transition into the work force or college. Research has shown that adapting teaching practices to be more congruent with students' cultural norms shows improvement in academic achievement (Deyhle & Swisher, 1997; Grant & Gillespie, 1993; Vogt, Jordan, & Tharp, 1993).

Students sometimes experience difficulties in mathematics because it is often taught through abstract and isolated concepts and does not afford students the opportunity to make connections with prior knowledge that they may possess (Clearly & Peacock, 1998). Culturally responsive teaching enables the teacher to recognize the disconnection between students' natural language and mathematics language. Therefore, teachers must be clear, explicit and direct about the terminology used in mathematics, because the terms used in mathematics often have different interpretations than their everyday meanings (Clearly & Peacock, 1998). Culturally relevant teaching "provides a structure for the curriculum that systemically builds on the students' culturally embedded background

knowledge" (Davidson & Miller, 1998, p. 260). By implementing instruction into the classroom that enables students to make connections between their experiences at home, students are allowed to see how learning within a classroom environment has application to real-world experiences.

A number of studies examine students' use of mathematics in the home environment with the ability to transfer knowledge and skill into context within the school setting (Carraher, Carraher, & Schliemann, 1985; Lave, Murtaugh, de la Rocha, 1984; Saxe, 1988a, 1988b). In a study examining young Brazilian street vendors' use of mathematics in selling fruit, Carraher et al. (1985) found that students were not able to transfer the mathematical ability that existed in these everyday settings to the mathematics classroom. The students were not able to establish a connection between the same problem types and the problem solving process that is involved between these two settings. Another study conducted by Lave et al. (1984) examined the ability of grocery shoppers to transfer the problem solving skills they exhibited in shopping to written tests. They determined that the additional resources put in place by the supermarkets to enable effective calculations of cost for desired goods were not in place on the written tests. Saxe's (1988a) research involved examining the relationship between students' mathematical learning in school with the mathematical practices they used in everyday life. Saxe found that students who sold produce used the strategies they employed in these settings to solve the arithmetic problems they encountered in school. These studies demonstrated how important the context of the problems aid in the individuals' ability to perform mathematics calculations with accuracy and show how everyday applications of

mathematics and the opportunities that students have to learn mathematics in school is misaligned (Diversity in Mathematics Education Center for Learning and Teaching, 2007).

Culturally relevant teaching provides a tool to enrich the learning environment for students by placing importance on the students' culture (Davidson & Miller, 1998; Lipka et al., 2005; Ladson-Billings, 1995). Davidson and Miller (1998) argue that if mathematics is taught with regards to only one culture, then other cultures are placed at a disadvantage. To ensure that equitable learning occurs across different cultural groups, students need to see how the experiences and knowledge the students bring from their culture has importance on the classroom curriculum. However, Davidson and Miller say, "many times in efforts to be culturally sensitive, nonnative teachers not grounded in culture overreact to the perceived needs of the American Indian student" (p. 262). Any teacher of Native American students needs to develop a clearer view of the needs of their students. Measures need to be taken to help Native American communities create learning environments that are effective in increasing the sense of belonging and security available to Native American students (Marchard et al., 2005). Developing a better understanding of the culture the students come from will help the teacher meet the educational needs of the students. To develop a better understanding of the culture, educators need to work in conjunction with Native American leaders to determine how mathematics can be used to reflect the culture of Native American students through the development of activities that help to increase mathematics learning of students (Marchard et al., 2005). To ensure that equitable learning occurs across different cultural

groups, students need to see how the experiences and knowledge they bring from their culture has importance in the classroom curriculum. Likpa et al. (2005) suggests that culturally relevant instruction will need to be more clearly defined for certain teachers in specific situations and teaching particular content areas. As a result, teachers will need to be willing to adapt their teaching in order to make instruction effective for Native American students. Darling-Hammond and Bransford (2005) say that teachers need to possess the following: Broad set of teaching strategies for working with diverse children, ability to learn the backgrounds of students, make connections between classroom and students' experiences, and concentrate on entire child, and believe in the ability of every child to succeed.

One of the key components to culturally relevant teaching involves emphasizing the academic excellence of the students (Ladson-Billings, 1995; Lipman, 1995). Lipman's (1995) findings show that high standards are important ingredients for students to achieve academic success. She says that teachers also need to create interactions that foster trust and concern for students and families, which will help make learning more accessible for students. Culturally relevant teachers provide a critical link between the issues faced by minority students and making educational experiences more empowering (Lipman, 1995). Ladson-Billings (1995) extend the concepts involved in culturally relevant teaching to include helping students develop a social consciousness that enables them to evaluate the cultural components in society. Ladson-Billings showed how teachers instill in the students a desire to succeed and developed relationships that extended outside of the classroom. In order to have a clear understanding of how cultural

relevancy is developed in the classroom, Benson (2003) evaluates four different aspects of culturally relevant practices of teachers' classrooms. Benson's findings include: using oral expression to gain an understanding of students' background and allow students to share personal and cultural knowledge while other students listen, and emphasizing the social aspect of schooling which helps in students' social development by allowing them to interact and have fun together which fosters a sense of belonging within the classroom. Benson says,

> The teachers' attempt to connect what they do in the classroom to the students' cultural backgrounds by helping students understand themselves and others, structuring social interactions, and recognizing culture as a strength to draw upon within the schooling context. (p. 21)

If students never have the opportunity to see the relevance of school to their future success, it may result in their becoming disconnected and eventually dropping out of school. Voelkl (1997) says, "Students who fail to identify with school may be predisposed to a pattern of negative school behaviors and eventually withdrawal from school" (p. 295). It is especially critical that the school environment is set up to foster a sense of belonging in minority students. Booker (2006) says that negative interactions and experiences with the majority can inhibit the development of belonging to school.

Castagno and Brayboy (2008) conducted a review of culturally responsive schooling for Indigenous people (American Indian and Alaska Native students) in order to provide knowledge that can be used to make learning opportunities for American Indian and Alaska Native students more equitable. Community involvement and support was one of the critical issues that aids in the academic achievement of students. The

studies emphasize the need for teachers and community members to work in cooperation to support students' academic development. Teachers provide support by learning about local language issues and cultural practices, building a relationship with community members by participating in the activities, inviting community members into the classroom to provide support to students, utilizing the resources of the community and trying to develop an understanding of the norms that are associated with the community. However, Castagno and Brayboy's (2008) examination of the research determined that the responsibility is not to be placed solely on teachers, because parents and the community also have a duty to ensure the students are provided support. The parents and community members have the ability to assist students in transiting and navigating the culture of the school. They also provide reinforcement about the importance of school and the critical need for students to extend opportunities in their lives by pursuing higher educational goals.

Cai, Moyer, and Wang (1997) conducted a study in order to examine the parts that parents play in the development of students' mathematical understanding. The researchers categorized the kinds of parental roles that help students develop mathematical understanding and determine whether there was evidence that parental support increased students' chance of success and improved their attitudes towards mathematics. The study involved 220 middle school students and the researchers gave the students a questionnaire for the parents to complete. The questionnaire was designed to classify the parents' level of support into five categories: motivator, resources provider, monitor, content adviser and learning counselor. The majority of parents completed the

questionnaire, and the researchers determined that there was a relationship between the level of support that students received at home and their attitudes about mathematics. The students whose parents demonstrated a higher level of parental support were shown to have a higher level of mathematics achievement and a better attitude towards mathematics when compared to students whose parents demonstrated lower levels of support. The researchers were also able to determine that parental support roles that were classified motivators, resource providers, and monitors were found to be good predictors in determining students' mathematics achievement.

Cultural Mismatches

One of the major issues facing the educational system today is the lack of diversity among the teaching force (Latham, 1999). Latham (1999) says, "It is only natural for teachers to filter the curriculum through their own cultural experiences and teach much in the same way they were taught" (p. 84). As a result, he says that the cultural mismatch can create a lack of connection with the curriculum for the students and cause them to not see the relevance of the learning to their everyday lives. Lack of diversity occurs because students are not able to see parts of themselves within the positions of power in the educational setting. Various researchers emphasize the importance of the teaching force developing cultural competence (Diller & Moule, 2005; McCarty & Watahomigie, 2004). Diller and Moule (2005) define cultural competence as "mastering complex awareness and sensitivities, various bodies of knowledge, and a set of skills that taken together, underlie effective cross cultural teaching" (p. 5). When the development of cultural competence is promoted within teacher education programs, the

non-diverse teaching force is equipped to deal with diversity issues that promote learning in the classroom. The following measures have been shown to cultivate cultural competence in the teaching force: teachers learning about the communities that their students live in, teachers becoming involved in community activities, and partnering with community members on projects inside and outside of school (McCarty & Watahomigie, 2004).

Ladson-Billings (2005) conducted a study to examine issues related to the lack of diversity in teaching profession. She examines issues related to increasing the standards for entrance into teacher education programs. Ladson-Billings addresses that the lack of success experienced by students of color in the K-12 educational settings results in a limited amount of opportunities at the post-secondary level. A lack of diversity can exist within the teachers in educational community. However, if the curriculum is never restructured to incorporate the inclusion of culture in schools, a lack of diversity can occur in the learning of minority students. Lack of diversity occurs because students are not able to see parts of themselves within the positions of power within the educational setting. Freng, Freng, and Moore (2007) conducted a study to examine students' perceptions of cultural inclusion within the classroom and explore the nature of the inclusion. Peer interviewing was used to gather data for study. Peer interviewing entailed preparing other Native Americans students to conduct the interview. This research method was used because the researchers felt that "respondents' willingness to provide answers would be compromised had the researchers (Non-Indians) personally conducted the interviews" (p. 46). The majority of students stated that they did not have the

opportunity to be taught about their culture. This was true for students on and off of reservations. In the cases that cultural inclusion was found to exist within the academic setting, the following are the classifications for this inclusion: general “Indian” pride, mismatched specific tribal information, negative/stereotypical information, student initiative, and parent, family, and/or community involvement. The researchers determined that educators have a large impact on the cultural inclusion aspects of Native American students’ education, and that there is a severe need for more Native American teachers within these Native American communities.

Another obstacle that arose when conducting research within Native American communities was the cultural mismatch between the researchers and the subjects within the study. Brayboy and Deyhle (2000) state, “sometimes researchers are blocked by participants who decide they are unworthy or not to be trusted with local insider information” (p. 163). The researchers conducted a study to examine the issues that arise when “an insider,” such as Brayboy, a Native Indian, conducts research in Native American communities; and “an outsider,” Deyhle, a Native American, conducting research in another tribe’s community. Brayboy perceived that he needed to develop a rapport and a relationship with the subjects in his study; however, he had to make his various roles (Indian and researcher) explicit to his subjects. “There seems to be no real way to balance these two, and when faced with a limited choice, he has opted toward the side most familiar to him—the Indigenous side” concluded Brayboy (p. 165). Deyhle faced other issues when conducting research on Navajos because of the “outsider” label she was given. Deyhle was prevented from access to certain information. She was told

"Don't ask questions. We'll tell you what you need to know" (p. 167). Brayboy and Deyhle summarize, "Those who conduct research must be aware of their positionality in relation to their research participants, their lack of objectivity in getting, analyzing, and reporting data and how 'traditional' methods may influence their work" (p. 168).

Meanings of Teaching and Learning Mathematics

After reviewing the literature, the need exists to utilize a framework that will enable the study of the meanings of teaching and learning mathematics within a community where the achievement for a particular group of Lumbee Indian students exceeds expectations. Cobb and Yackel's (1996) interpretive framework using the social norms and sociomathematical norms will be utilized to analyze the mathematics teaching, learning, and student components of the framework. In addition, Coleman's (1988) social capital framework will be utilized to analyze the social networking component. Figure 2.1 represents the proposed framework that will be utilized to examine the aspects of the community.

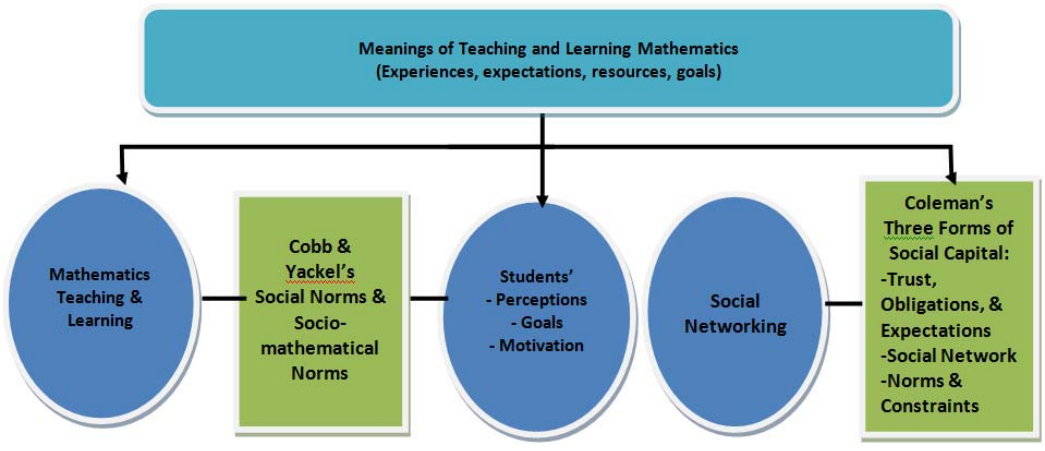


Figure 2.1. ***Conceptual Framework of Meanings of Teaching and Learning Mathematics***

Conceptual Framework

The interpretive framework developed by Cobb and his colleagues occurred by continuously refining theoretical concepts over the course of a 13-year period, which enabled them to have a framework that supported and organized students' mathematical learning. Yackel and Cobb (1996) perceived that focusing solely on the analysis of the components that individuals brought to class limited the ability of the researchers to examine how students' mathematical learning evolved. Therefore they searched for methods that considered the social component within the classroom that contribute to students' mathematical learning. The framework has two perspectives, social and psychological, that work in coordination with each because the perspectives have diversely different ways of looking at and making sense of what is going on in the classroom (Cobb, 2007; Cobb & Yackel, 1995).

The social perspective is the ways of acting, reasoning and arguing that occur naturally with the activities in the classroom community. Students' reasoning is viewed as an act of participation within these activities and referred to as taken-as –shared ways of talking and reasoning. To develop the social perspective that is used within the interpretive framework, ideas are adapted from sociocultural and ethnomethodology and symbolic interactionism theories. For example, when looking at classroom mathematical practices, sociocultural theorists view cultural practices as having emerged over an extensive period of time and regard mathematics as a complex human activity that looks at the socially accepted ways of behaving in the classroom. However, the traditional sociocultural view of mathematics does not consider the influence of teachers and

students in the classroom (Cobb, Jaworski, & Presmeg, 1996). The theory is adapted to view mathematical practices that have developed during the interactions between the teachers and the students, which results in the practices being an emergent phenomenon instead of a preexisting system of reasoning and communicating that students are then initiated into. The ethnomethodology and symbolic interactionism aspect of the perspective views knowledge as shared between individuals through thoughtful representations to help others develop an understanding of the concepts, and the learning process they are engaged in entail the negotiation of meaning with students expressing different explanations for various concepts (Cobb, 2007; Cobb et al., 1996, Cobb & Bauersfeld, 1995). Cobb concludes that the theory needs to be modified to ensure that examination of students' learning occurs, which enables the learning to be supported in specific areas.

The psychological perspective looks at the individual student's or teacher's activity as they participate in and contribute to the development of collective classroom practices; also interpreted as the diverse ways that students participate in the taken-as-shared activities. Constructivism and distributed accounts of intelligence theories are adapted in the interpretive framework to construct the psychological component. When looking at the mathematical practices, distributed accounts of intelligence traditionally would discount methodical approaches that give a considerable attention on the nature of individual student's reasoning (Cobb, 1998; Cobb, Stephan, McClain, & Gravemeijer, 2001). The researchers adapted the theory to include the tools and symbols that students use as essential to their participation in the classroom, instead of being separated from the

individual. The constructivists look at knowledge construction as information processing or the development of internal representations involved in individual students' construction of knowledge. Instead of evaluating the internal construction of knowledge approach to the analyzing the development of mathematical understanding, the researchers look at how knowledge emerges during the activity by examining how the students modify their participation in the mathematics classroom (Cobb, 1994; Cobb & Bowers, 1999).

In the social and psychological perspectives, the use of differing theoretical views supports the interpretive framework developed by Cobb and his colleagues. Because the researcher is not able to examine particular components within the classroom setting however, the alternative view enables these components to be analyzed. Therefore, it appears they support each other by providing a comprehensive picture of the development of students' mathematical learning with the local classroom culture. Table 2.3 presents the theories that make up the social and psychology perspective of the interpretive framework, the traditional view of the related to mathematical practices, and the adaptations that Cobb and his colleagues make to the theory to make them more useful in examining students' mathematical learning within the local classroom community.

The social and psychological perspectives are used in the development of the interpretive framework because the coordination between these two alternative perspectives provide ways of looking at and making sense of what is going on in the classroom. The interpretive framework summarizes the way Cobb, Stephan, McClain and

Gravemeijer (2001) sort out the analysis of what is going on in the classroom. The researchers look at the following three aspects of the local classroom community (microculture) that is developed during the interactions between the teacher and students: classroom social norms, sociomathematical norms, and classroom mathematical practices.

Table 2.3. ***The Adaptations of the Social and Psychological Theories that Make the Perspectives***

Perspectives	Theory	Traditional View of Mathematical Practices	Adaptations to Enables More Effective Examination of Students' Mathematical Learning in the Classroom
Social Perspective	Sociocultural Theory	Cultural practice (ex. mathematical practice) emerges over an extend period of time and practices of the discipline existed apart from teachers and students	The mathematical practices of the local classroom community emerge during the interactions between the teacher and students
	Ethnomethodoloy and Symbolic Interactionism Theories	Negotiation of meanings and ways of participating in the local classroom culture during the interactions between teacher and students	Examination of students' learning in the development of classroom mathematical practices
Psychological Perspective (Emergent Approach that coordinates the two theories)	Constructivism	Mathematical understanding emerges through the development of internal representations within students'	Looks at the quality and the development of individual student's reasoning as participates within the classroom community
	Distributed Accounts of Intelligence	Discount methodical approaches that gave a considerable attention on the nature of individual student's reasoning and looks at the tools and symbols used by students are external to the development of understanding	Tools and symbols that students use as essential to their participation in the classroom and learning involve the reorganization of the student's reasoning during interactions between the teacher and other students (Yackel & Cobb, 1996)

The first aspect of the framework is the classroom social norms, which are the collaboration between the teacher and students of agreed upon responsibilities and expectations for classroom participation. Instances of classroom social norms include providing reasoning and the rationale for solutions, trying to understand the explanations of others and whether they agree or disagree with the explanations. In addition, questioning and trying to resolve differences in interpretations when they arise are also part of classroom social norms (Bowers, Cobb, & McClain, 1999; Cobb et al., 2001; McClain & Cobb, 2001a).

Social norms are not developed in terms of individuals but from the collective and individual's beliefs about what constitutes being a student within the classroom community. They appear as patterns that emerge during group participation in the classroom activities. The psychological constructs emerge during the processes that teachers and students go through during the establishment of social norms. The reason these constructs occur is because the beliefs have to be restructured about the part that each person and teacher plays in the classroom community. Beliefs about the characteristics involved in mathematical activity must also be restructured (Cobb & Yackel, 1995). The social and psychological components coexist together because the restructuring of students' beliefs are seen as facilitating or restricting the development of social norms.

Social norms are seen as evolving during group participation in the variety of subject areas in the local classroom community; therefore, they do not adequately address the patterns that emerge during activities which are specific to mathematics. The second

aspect of the interpretive framework was developed to address the norms that are explicitly mathematical, referred to as sociomathematical norms. Examples of sociomathemtical norms involve what is regarded as a different mathematical solution, a sophisticated mathematical solution, and an acceptable mathematical explanation (Cobb & Yackel, 1995; McClain & Cobb, 2001a; Yackel & Cobb, 1996). Table 2.4 explains the distinct difference between sociomathematical norms and social norms:

Table 2.4. ***Difference between Social and Sociomathematical Norms***

Social Norms	Sociomathematical Norms
Agreement that student are expected to explain and provide the reasoning and the rationale for solutions	Understanding what regarding as an acceptable mathematical explanation
Trying to understand the explanations of others and whether they agree or disagree with the explanations	Judging when it is appropriate to make mathematical contributes
Questioning and trying to resolve difference in interpretations when they arise	Understand what is characterizes a mathematical difference (Cobb & Yackel, 1995; McClain & Cobb, 2001a; Yackel & Cobb, 1996)

The sociomathematical norms are viewed through the inquiry-based approach that the teachers developed during mathematics activity. During the interactions that develop when students offer a variety of justifications to different mathematical solutions and this enables the teacher and students to navigate through the development of sociomathematical norms in the classroom. They make judgments about what is an acceptable mathematical explanation, what characterizes a mathematical difference, what are the requirements for sophisticated, efficient, or easy mathematical solutions. The

negotiation of sociomathematical norms presents opportunities for the teacher and the students to learn. The teacher gives the variety of solutions, explanations, and judgments creditability, therefore, increasing the teacher's and students' knowledge of what constitutes sociomathematical norms. The progressive increase in the students' participation in the mathematical practices in the classroom aids in the development of intellectual autonomy. The students' ability to determine appropriate explanations is supported within the inquiry based approach to justifying and reasoning through explanations and solutions. During participation in the renegotiation of process of the sociomathematical norm in the classroom community, students create beliefs and values that are specific to mathematics, which is the psychological perspective of this aspect of the framework.

The third aspect of the interpretive framework is mathematical practices. The evolution of mathematical practices seems to relate to what teachers and students' do when they are establishing sociomathematical norms in the classroom. However, the mathematical practices are not looking at the justification and appropriateness of mathematical solutions, but the ways teachers and students represent, talk about, or justify specific problems and solutions. To examine the evolution of mathematical practices, the researchers document the actual path taken to learn specific concepts during the interactions that occur within the classroom community. The framework looks at the reorganization of an individual student's mathematical reasoning and actions, while also examine how their participation within the classroom is a result of the collective mathematical practices of the classroom community.

Social Capital

Coleman (1987) explains social capital during children's growth and development as the norms, the social networks, and the relationships that exist between adults and children that are important to the child's development. He also discusses the presence of social capital in the community; for example, the attention that an adult pays to the activities of another person's child. Coleman also discusses how social capital in the family and community creates human capital in the next generation. Human capital is defined as "changes in persons that bring about skills and capabilities that make them able to act in new ways" (Coleman, 1988, p. S100). The concept of community social capital is addressed in a study conducted by Israel, Beaulieu, and Hartless (2001). Community social capital "develops from resident's action to improve the local economy, provide human and social services, and express local cohesion and solidarity" (Israel et al., 2001, p. 46). The strength of the community social capital is dependent upon the interactions and relationships developed between the community members. If members of the community constantly change, the reduction and erosion of the social capital occurs. The most important component of the community social capital suggested by Israel et al. (2001) are the adults' interactions which produces a supportive environment in which a collective support structure is established for students in the community and results in the adults' seeking to ensure the highest level of success possible for the students in the community. Coleman (1990) characterizes social capital as the collection of resources that exist in family relationships and community social structure and can be utilized in the cognitive and social development of children within the family or

community. Coleman (1988) says that social capital can exist in three forms: level of trust, which can emerge as the obligations and expectations, social network utilized to communicate information, and norms and constraints that put the concerns of group over individual interest.

Trustworthiness, Obligations, and Expectations

Coleman (1988) describes how trustworthiness, obligations and expectations build social capital between individuals when they engage in interactions that involve them being reliant on each other. He discusses the emergence of these elements as being like credit slips because if an individual assists another then there is an expectation and obligation that developments and the level of trust among the individuals ensures that the when the credit slip is turned in it will be repaid. The number of credit slips that individuals accumulate is dependent upon the degree that a person is self-sufficient. For example, if a person is more dependent upon others, then the individual will accumulate a larger number of credit slips. Kao (2004) explains how an individual may babysit for a neighbor, in turn the individual may ask the neighbor to feed the pets or water the flowers while they are on vacation. Coleman (1988) says that such a system would not survive in a social system that does not possess trustworthiness because the individuals who cashed in on their credit slips could possibly not meet their obligations and expectations to the other members of the systems who still had credit slips that needed to be fulfilled. In the examination of the aspects of the community that support students academic success community social capital allows for an understanding of how obligations, expectations, and trustworthiness enable the members of the community to work together to ensure that

the students receive every opportunity available to them. Coleman (1987) notes the community plays a critical role in the success of the students by aiding in the reducing dropouts among students at risk.

Information Channels

The second form of social capital that is emphasized by Coleman's social capital framework is an information channel. An individual's information channel component is dependent upon the individual's social networking system. The information that people acquire involves them not only in paying attention, but also utilizing the social relations that they have in place (Coleman, 1988). Information channels can be a valuable means for individuals to gain knowledge about particular subject matter; however, it requires the individuals to seek out people within the social network who possess the particular knowledge they are looking to acquire. The acquisition of information requires the individuals with the network to take some type of action. The value of the information that people obtain is based on the purpose and type of relationship that individuals are involved in (Coleman, 1990). According to Goddard (2003), "individuals engaged in relationships characterized by high levels of social trust are more likely to openly exchange information and to act with caring and benevolence toward one another than those in relationships lacking trust" (p. 60). When parents have relationships with other parents who know the necessary plans and processes required to advance their children's educational outcomes, then the information acquired can have a positive impact on the students' academic success (Kao, 2004).

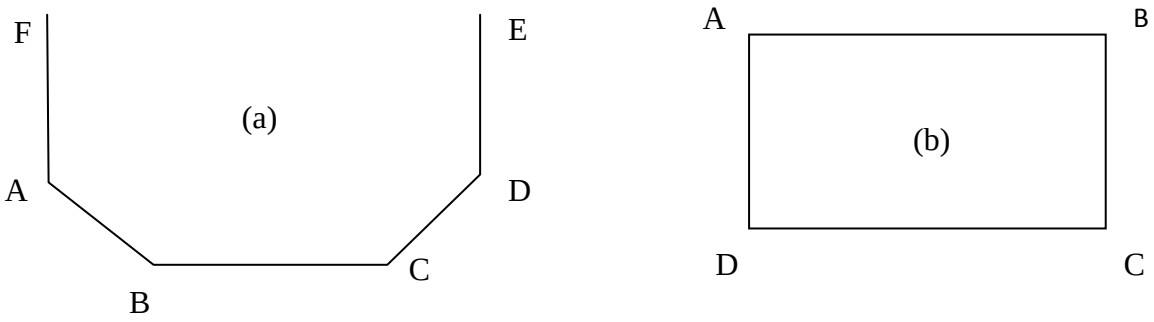
Norms and Effective Sanctions

The third form of social capital mentioned by Coleman (1988) is norms and effective sanctions. Norms emerge to enable group members to have a certain amount of control over the actions of other members of the group when the actions of the individuals directly affect the group (Coleman, 1990). Norms promote the collective interest over the interest of individuals, which can result in certain aspects of individual's development to be constrained and in the individual not reaching their full potential. Effective norms are also a valuable tool that enables schools to foster academic success among students by managing their behavior (Kao, 2004). According to Goodard (2003), "if most individuals with whom a child interacts believe that schoolwork and learning are important, the press to perform will be accompanied by social sanctions for those who do not" (p. 61). If social norms promote academic tasks, such as studying, completing homework and staying on task in the classroom, the students' opportunities to obtain academic success are enhanced.

Closure of Social Networks

Coleman (1988) also discusses the importance of closure to social capital structure system because it works as a means of checks and balances that enables each component of the system to work effective for the common good. Closure allows behavior to be monitored and steered in appropriate direction, enables the development of effective social norms, and increases the sense of obligations and expectations within the system. The presence of closure also enables the creation of trustworthiness because the members of the social structure have the opportunity to gain knowledge about the

individual, which results in the other members making decisions about the type of interactions they will engage in (Coleman, 1988). Figure 2.2 illustrates the concept of closure in terms of the social relations that exist in the social networking system. In the system (a) is a social network that does not have closure, because person A, B, C and D are connected, but the connection is broken between E and F. However, in the structure (b) shows the existence of closure because the connections are maintained between person A, B, C and D, without a break in the system. Therefore, the actions of each individual in (b) can positively or negatively affect each other.



(a) Network without closure (b) Network with closure
Adapted from Coleman's (1988) Illustration of Closure

Figure 2.2. ***Illustration of Closure***

Summary

The purpose of the study is to understand the factors that affect the academic success of students within a Lumbee Indians community where the achievement gap for mathematics is narrowed or even higher than the average achievement of Caucasian students. As cited throughout the review of literature, the factors that influence the

success of Lumbee Indians are complex; therefore my objective is to utilize Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988) social capital framework to examine the meanings of teaching and learning within the community. The frameworks serve as a tool which enables the examination of the mathematics teaching and learning, student and social networking components to be analyzed to determine why the achievement gap is lowered and see what factors within the community impact the success of the students. The literature related to social norms and sociomathematical norms demonstrates why the framework is an effective tool that enables extraction of the factors related to mathematics teaching and learning and student's perceptions, goals and motivation (Cobb & Yackel, 1996). The literature related to social capital provides examples of how the establishment of social capital within a community can serve to enhance students' opportunity to achieve academic success (Coleman, 1988; Goodard, 2003; Kao, 2004). Due to the lack of research related to Lumbee Indians, the research presented in the literature review can serve as a starting point to understand the factors that enhance students' academic success.

CHAPTER III

METHODOLOGY

The purpose of this study is to examine the aspects of community that support the algebraic achievement of Lumbee Indian middle school students. As a result of the lack of research related to Lumbee Indian students mathematical achievement, I seek to gain an understanding of why there exists a narrowed achievement gap in mathematics for a particular Lumbee Indian community by examining the meanings of teaching and learning mathematics. Therefore, I will be looking at the experiences, expectations, resources, and goals of community members to understand these meanings. There are three components of the meanings of teaching and learning mathematics that inform the study: mathematics teaching and learning, students, and social networking in the community. This chapter describes the design of the study, research site and subjects, data collection methods, data analysis procedures, and issues related to validity and ethics. By examining a community in which the achievement gap is narrowed for Lumbee Indians students, the study provides the researcher with the opportunity to investigate what factors within the community facilitate the success of students in mathematics. Therefore, the following research questions are proposed for the study:

1. What are the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community that promotes mathematics achievement in the middle grades?

2. How does mathematics teaching and learning emerge during an examination of the community?
3. How does the social networking system within the community promote the mathematics achievement?
4. How does the community support teaching and learning?

Design of the Study

The research design utilized for the study is a case study. Yin (2009) explains that case study research adds to our knowledge of individual, group, and social phenomena and enables the researcher to maintain the holistic and significant features of events related to individuals' lives. Creswell (2007) distinguishes the case study method based on the intent; therefore this study utilizes the instrumental case study because the researcher concentrates on a particular issue related to a community and uses a bounded case to understand the issue. This study focuses on a particular Lumbee Indian community in which the achievement gap is narrowed for mathematics in eighth grade, therefore; the subjects are selected in order to gain an understanding of what aspects of the community contributes to this issue.

This study utilizes a qualitative research methodology. According to Creswell (2005), interviewing is an effective qualitative method to employ when the researcher is not able to directly observe the participants in the school setting and it gives the interviewee the opportunity to have detailed personal accounts that will enrich the study. The participants will be interviewed using protocols developed for the teachers, the students and the parents. Qualitative research methods were used for the following

reasons: to understand the meanings for particular actions of the participants, to examine the context of the study, to understand how a particular phenomenon can enrich practice within the educational setting, and to discover issues that occur within these various settings (Maxwell, 2005). Using a quantitative approach to the study would not enable the researcher to gain an in depth understanding of the beliefs and values of the community. The nature of the quantitative research looks at specific variables that the researcher wishes to examine and does not afford an opportunity to conduct in-depth examination of the aspects of the community that can aid in understanding the norms that are promoted within the classroom, school and community.

Subjects

Study participants will include three middle-grade mathematics teachers (current seventh-grade teacher, current eighth-grade teacher, and previous eighth-grade teacher), nine students from eighth and ninth grade, and the parents of these students. Purposeful sampling is used to select research student participants who are of Lumbee Indian heritage and considered to be successful in mathematics at the middle grades level based on the input of local school and community leaders. Consequently the parents of the student subjects will participate in the study. Likewise, the teachers of these students will be included in the purposeful sampling. These participants will aid in the understanding of the research questions in the study using purposeful sampling as recommended by Creswell (2005). The research subjects live in a community located in Robeson County, which has a Lumbee Indian population greater than 90%. The pseudonym, Hill Community, is used in this study to denote this community. The subjects are selected

because the students in the community typically perform at proficiency level comparable to the state average on End-of-Grade mathematics test and Algebra 1 End-of-Course test.

Sources of Data

All interviews were videotaped to provide visual information, extending the scope of the data to include the interactions between research participants during focus group sessions. Audio data was transcribed and pseudonyms were used in place of subjects' names on these transcripts. A master list of subjects' names and corresponding pseudonyms were in a locked file cabinet in the researcher's home office. Artifacts produced during the interviews were included in the body of evidence.

Instruments

The interview questions were developed with the purpose of carrying out semi-structured, open-ended interviews. The interviews are semi-structured because I probed as needed, affording the research participants the opportunity to elaborate and ensure the most complete answer to the question (Creswell, 2005). The participants were interviewed using three different interview protocols developed for students, parents, and teachers (see Appendix A). The interview questions were developed with the purpose of carrying out a semi-structured, open-ended, audio-taped and video-recorded interview. The interview questions address experiences related to the research participants' interactions in the community, beliefs and values related to mathematics and algebra, and the roles of the teachers and parents in the success of the students in the algebra classroom.

Detailed accounts related to how the teachers teach particular concepts related to algebra were used in the data collection process and enabled me to examine the norms that are established in the mathematics classroom. The students completed the *Proportional Reasoning Assessment Instrument* (see Appendix B). The instrument was developed by Allian (2000), a graduate student at North Carolina State University using problems discussed in the research of Karplus et al. (1983), Noelting (1980), Lamon (1993), and Lesh et al. (1988). Allian (2000) developed the questions by trying to ensure that as many questions as possible involved contexts that were familiar to the students. Karplus et al. (1983) conducted a study using missing value and comparison. Noelting (1980) research involved comparison problems that focused on mixtures. Lamon (1993) researched proportional type problems that looked at four types of semantic problems: well-chunked, part-part-whole, associated sets, and stretchers and shrinkers. Item 1 of the instrument is a comparison problem that asks the student to identify which girl, based on the given information, and purchased chewing gum for the cheaper price (Karplus et al., 1983). The solution to the problem can be obtained by determining the price each girl paid for each piece of gum.

Item 2 is a missing value problem that is discussed in research conducted by Karplus et al. (1983). The problem involves asking the student to identify how many cups of coffee can be made from 12 cups of water, if 8 cups of water can make 14 cups of coffee.

Item 3 is an associated sets problem that involves the student determining who gets the most pizza between a group of girls and a group of boys (Lamon, 1993). In order

to determine the solution, students are required to use a written explanation instead of a symbolic representation (Allian, 2000).

Item 4 is a part-part-whole problem that involves two cartons of eggs taken from research (Lamon, 1993). One carton contains 12 eggs and the other contains 18 eggs, with brown and white eggs in each carton. Allian (2000) requires that students are given a written explanation and a picture showing each carton and they must determine which carton contains more brown eggs compared to white eggs.

Items 5, 6 and 7 involve evaluating two different amounts of orange juice and water to determine which mixture has the strongest orange juice taste or taste the same. Noelting's (1980) research on mixture problems was used in the development of these problems. The students were given a picture and ordered pairs to represent the two amounts of orange juice and water for each item (Allian, 2000). Item 5 has one part orange juice to two parts water versus one part orange juice to five parts water. Item 6 has four parts orange juice to one part water versus one part orange juice to four parts water. Item 7 has two parts orange juice to three parts water versus four parts orange juice to six parts water.

Item 8 is a graph that is divided into three time intervals on the x-axis versus different distance on the y-axis. The problem involves a girl riding a bike and requires students to compare the relationship between distance and time by determining how fast the girl was traveling for each time interval.

Item 9 and 10 are stretcher problems that were developed based on the research of Lamon (1993). The problem involves two trees that were measured five years earlier.

One tree was 8 feet tall and the other tree was 10 feet tall initially. The trees were than measured after five years with the first tree being 14 feet tall and the second 16 feet tall. The students are required to determine which tree's height increased the most during the five-year period. Item 10 differs from Item 9 because the objects do not increase in a linear manner. Allian (2000) presents the problem using a written description and table using a given length, height and area of flag 1 and the length of flag 2.The problem requires that student to determine the amount of cloth necessary to construct a flag if you increase the length and height of the flag by three feet and still maintain the same ratio between the length and height.

Analysis

Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988) social capital framework were utilized in the development of the interview protocols in order to examine the meanings of mathematics teaching and learning within the community. One framework served as an analysis tool that enabled the examination of the participants' beliefs concerning mathematics teaching and learning. The other framework was used to understand how the student and social networking components affect the achievement gap and student achievement of the Lumbee Indian participants.

The researcher examined the data to determine the meanings of teaching and learning mathematics based on the experiences, expectations, resources and goals of the research subjects. These data were analyzed based on the Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988)

social capital framework. Miles and Huberman (1994) define “analysis as consisting of three concurrent flows of activity: data reduction, data display, and conclusion drawing/vertification” (p. 10). During the data reduction process the interviews were transcribed, coded, and the major themes emerging from the data were identified. Coding was completed until saturation is reached, which means that in the coding process no new information is emerging that will aid in understanding the themes. The themes that emerged from the social norms and sociomathematical norms enabled the researcher to understand the mathematics teaching and learning, and students’ components of the framework. Coleman’s (1988) social capital framework was used to understand the social networking component. My study looked at the community level to determine how it influenced the shared meanings of mathematics teaching and learning and the extent to which these meanings were shared across subjects. The framework guided the coding process by enabling me to determine the experiences, expectations, resources, and goals that were specific to students’ academic success at each level. The following shows the initial codes that were used to analyze the data.

- Beliefs about math
- Classroom social norms
- Sociomathematical norms
- Expectations/Obligations
- Social networking system
- Trust
- Norms/Constraints

- Historical sense of community
- Closure

The next step in the data analysis process involved the development of data displays (matrices, graphs, charts, networks) (Miles & Huberman, 1994). Miles and Huberman say the data displays organize information in a manner which enables the researcher to determine "what is happening and either draw conclusions or move on to the next step of analysis the display suggests may be useful" (p. 11). The researcher began the data analysis process as soon as transcripts were available during data collection and continued until throughout the process. The final step of the analysis process involved triangulating the results, finding common themes and drawing conclusion and verification. The meanings which emerged from the data have to be tested for their validity, which involves noting patterns and themes, clustering, counting, making contrasts/comparisons, and building a logical chain of evidence (Miles & Huberman, 1994).

During the *Proportional Reasoning Assessment Instrument* students' responses were analyzed to examine the level of cooperation that students exhibited between each other. The students' responses also will be evaluated to determine how many of the students asked and answered questions. After completing the focus group session, during which students solved mathematics problems, the students completed a reflection of the problem-solving process. The students' reflected on the problem-solving process by answering questions related by describing how the groups worked together to solve the problems, providing examples that supported their views of their group, and giving an

explanation on whether they would rather work in a group or work alone to solve difficult problems. The researcher worked in collaboration with colleagues and committee members to ensure that the codes that emerged during the analysis of the data were consistent across researchers.

Validity Threats

One of the first validity issues that I was aware of was researcher bias. As a result of having personal relationships with various people in the community that I was researching, I made sure that my perceived ideas and views did not influence my perspectives of what I observed during the interview process. I also made sure that my views, as a mathematics teacher, did not influence the interpretations of the data. Ensuring that I considered all aspects of the research process and not take any findings for granted or consider them insignificant was a concern. Making sure that I was aware of how researcher bias could arise I needed to go into the research process with an open mind and made sure that my colleagues verify my results.

Another validity issue in my study was to determine if the research participants were providing me with truthful information. I reassured all the participants that their identities would remain anonymous in any information that was reported and that the video records would not be viewed by anyone other than me. I made sure that the students understood that I only wanted their truthful and sincere responses. To ensure the information provided by the teachers was valid, I collected a variety of data sources to include in the interviews, accounts of how they teach particular concepts and student's

responses to mathematics tasks to determine the aspects of the school and community that promoted an understanding of the mathematics.

The last validity issue in my study was to make sure that triangulation occurs within my study. I considered triangulation to be a validity threat because of the homogeneity of the research participants. I dealt with the triangulation issue by interviewing a variety of subjects, using a mixture of types of data such as interview transcription, and accounts of teaching particular mathematics concepts, and collecting data using a variety of data collection sources to include field notes, audio-taped and video-taped transcriptions. A variety of perspectives were used to refine or corroborate interpretation of data from any source. Member checks were conducted, including the teachers involved in research and others on-site who could validate the accuracy of the data and interpretations. All of the consent forms and interview protocols were developed based on the guidelines outlined by the Institutional Review Board (IRB). Additionally, the IRB guidelines were also utilized in the data collection procedures.

Ethics

Creswell (2005) states that ethical issues involve respecting the rights of the research participants, honoring the research location the researcher visits, and giving accurate and full accounts of the research. To ensure the rights of the research participates are protected, the audio data were transcribed and pseudonyms were used in place of subjects' names on the transcripts. A master list of subjects' names and corresponding pseudonyms were kept in a locked file cabinet in the researcher's home office. The research focus of the study was to look at the positive aspects of the

community and utilized successful mathematics students to ensure that the researcher was not looking at the community from a deficit perspective. The issue of the accuracy of the data reported was addressed in the research design through the use of member check, triangulation of data, and peer review.

Summary

This chapter describes the research methods that I used to study the aspects of community that supported the algebraic achievement of Lumbee Indian middle school. Investigating aspects of the community provided an understanding of the activities, practices, beliefs, and values that promote the development of algebraic reasoning. By examining a community in which the achievement gap is narrowed for Lumbee Indians students, the study provided the researcher with the opportunity to investigate what factors within the community facilitate the success of students in mathematics. First, I described the instrumental case study design. Next, I described the subjects, sources of data and the instruments and outlined the analysis procedures. Finally, I described the validity threats and ethical issues related to this study.

CHAPTER IV

RESULTS

The purpose of this study is to understand the aspects that affect the academic success of students within a Lumbee Indian community. The achievement gap in this community for mathematics is narrowed or even higher than the average achievement of Caucasian students. The factors that influence the success of Lumbee Indians are complex; therefore my objective was to utilize Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988) social capital framework to examine the meanings of teaching and learning within the community.

Cobb and Yackel's framework has two perspectives, social and psychological, that work in coordination with each because the perspectives have diversely different ways of looking at and making sense of what is going on in the classroom (Cobb, 2007; Cobb & Yackel, 1995). The social perspective is the ways of acting, reasoning, and arguing that occur naturally with the activities in the classroom community. The students' reasoning is viewed as an act of participation within these activities, often referred to as taken-as-shared ways of talking and reasoning. The psychological perspective looks at the individual activities of the student or teacher as they participate in and contribute to the development of collective classroom practices. The diverse ways that students participate in the taken-as-shared activities serve as a vehicle for interpretation of such activities. The social and psychological components coexist together because the

restructuring of students' beliefs are seen as facilitating or restricting the development of social norms.

Coleman (1990) characterizes social capital as the collection of resources that exist in family relationships and community social structure. Social capital can be utilized in the cognitive and social development of children within the family or community. Coleman (1988) says that social capital can exist in three forms:

- Level of trust, which can emerge as the obligations and expectations
- Social network utilized to communicate information
- Norms and constraints that put the concerns of group over individual interest.

The findings of this study will be presented in the form of answering each research question. The research questions for this study are listed below:

1. What are the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community that promotes mathematics achievement in the middle grades?
2. How does mathematics teaching and learning emerge during an examination of the community?
3. How does the social networking system within the community promote mathematics achievement?
4. How does the community support teaching and learning?

This study focuses on a particular Lumbee Indian community in which the achievement gap is narrowed for mathematics in eighth grade; therefore, the subjects were selected in order to gain an understanding of what aspects of the community

contribute to this issue. This study utilizes a qualitative research methodology to gain an understanding of the meanings for particular actions of the participants, to examine the context of the study, to understand how a particular phenomenon can enrich practice within the educational setting, and to discover issues that occur within these various settings. Interviews were employed because the researcher was not able to directly observe the participants in the school setting and they give the interviewee the opportunity to have detailed personal accounts that will enrich the study.

Research Question One

What are the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community that promotes mathematics achievement in the middle grades? The psychological perspective of Cobb and Yackel's framework was utilized during the examination of the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community. Social norms are not developed in terms of the individual but from the collective and individual's beliefs about what constitutes being a student within the classroom community. They appear as patterns that emerge during group participation in the classroom activities. The psychological constructs emerge during the processes that teachers and students go through during the establishment of social norms. This is due to the restructuring of beliefs they have about the part that each person and teacher plays in the classroom community and the characteristics involved in mathematical activity (Cobb & Yackel, 1995).

The participants' beliefs about the roles and nature of mathematical activity and the individuals' mathematical beliefs and values, from the psychological perspective of

the framework, served as the analysis tool to examine the meanings. Three major themes were identified: beliefs about the purpose of math, beliefs about the importance of math, and meanings of working in groups.

Beliefs about the Purpose of Math

During the examination of the beliefs about the purpose of math, the participants expressed various views about the usefulness of math. The individuals' responses about the usefulness of math typically fell into three categories: everyday uses, application to career, or a combination of everyday uses and career. Some of the participants also identified more specific applications of mathematics within these categories. Table 4.1 shows the participants that discuss the everyday uses of mathematics, the everyday uses/application to career, identified applications to career, and identified specific careers.

Additionally, the participants typically referred to obtaining the amount of discount when items are on sale when discussing the everyday uses of mathematics. However, Parent Ms. Jessica offers the following examples:

> . . . math is something she's going to use every day, whether she's a math major or not. Math is something we all use in everything we do in life. It can be cooking, it can be hanging a curtain, it can be hanging a picture. Math is something we all use every day.

The teachers discuss mathematics in terms of its applications to everyday life, which could be attributed to the fact that they have to explain to students on a regular basis why they need to learn mathematics. Teacher Mr. Matthew gives the following explanation for why it is important to learn mathematics:

> For example, let's say that you decide to build a deck on your house, and it's not even known commonly to carpenters, but they use it, the Pythagorean Theorem—A squared plus B squared equals C squared—that's how they decide that a platform is perfectly squared, but they may not know that's what they're doing. And I teach that concept to my kids and there are quite a few other concepts that they can apply in life that is taught in Algebra, so it is used in life, even though they may not understand that it's used in life.

Table 4.1. ***Participants Who Identified Purpose of Mathematics***

Purpose of Mathematics	Participants		
	Students	**Parents**	**Teachers**
Everyday Uses of Mathematics	Kevin Jada Nicole	Ms. Amanda Ms. Jessica Ms. Molly	Mr. Caleb Mr. Matthew Ms. Melissa
Everyday Uses/Applications to Career	Gabriel Jasmine	Ms. Julia Ms. Amber Ms. Marissa Ms. Evelyn Ms. Andrea Mr. Steven Mr. Joseph	
Identified Applications to Career	Jacob Rachel Deanna David Erin	Mr. Timothy Ms. Lauren Mr. Luke Ms. Leah	
Identified Specific Careers	Gabriel (Designing and Engineering) Erin (Banking and Surgeon) David (Scientific Career) Deanna (Pharmacist) Jasmine (Forensics Science) Rachel (Lawyer)	Ms. Amber (Doctor and Nurse) Ms. Julia (Pharmacist) Mr. Timothy (Police Officer) Ms.Lauren (Veterinarian and EMT) Mr. Joseph (Electrician) Ms. Marissa (Electrical Engineering) Ms. Andrea (Doctor) Ms. Evelyn (Forensics Science)	

The participants also talked about mathematics in terms of the applications to careers. Sixteen of the eighteen participants mention a specific career when explaining the application of mathematics to a career. For example, a lawyer determining the fees

that a client pays, the numbers of years that an individual could be sentenced to, liability cost, or a surgeon who is calculating the amount of medicine to administer to a patient. However, two participants were able to offer very sophisticated explanations. Student Gabriel exhibits a high level of understanding of what mathematics is and it's applications in many different areas:

> Most anything you do with life has math, proofs, standard set of rules. And of course finding the problem itself, these mathematical equations . . . when you design a computer, that's pretty much binary code. Designing, engineering, that type of stuff, you have to have Algebra for that. If you didn't have Algebra, you wouldn't have computers and you wouldn't have skyscrapers. I mean, they used math, Algebra back even in the Ancient Egyptian times, as far as I can tell, or a basic kind of math.

Parent Mr. Timothy also has a clear ability to give relevant examples on how he applies mathematics in the workplace:

> Like in my job, I had to have the mathematics spurs, breathalyzer operated, and we had to figure out a formula of how . . . what the . . . and I thought I'd never had to use that years ago, when my math teacher was telling me, "you might need this one day." And sure enough, I needed it on the police department—what a man weighs, how much he drinks, then you can tell about what he's going to blow, from his weight and all that. So mathematics is . . . it just covers a lot of things. It takes mathematics to build a home, it takes mathematics to operate a vehicle, I mean not to operate… well in a way it takes it to operate it, but to build a vehicle. Mathematics is involved in the engine and the drive train. Mathematics just covers everything. That's my opinion.

Beliefs about the Importance of Mathematics

The second theme that emerged when examining the meanings of teaching and learning mathematics in a Lumbee Indian community is the beliefs about the importance of mathematics. The participants were asked to explain how taking Algebra in the eighth

grade would help the students. In general, the students, parents, and teachers mention one of the subsequent responses:

- Algebra helps students achieve goals.
- Algebra helps students get ahead of the other students in the same grade level.
- Algebra helps ensure that students have more time to master content in preparation for high school.

Based on the students and parents' previous responses about the projected careers that the students plan to enter, some of the participants seem to have a clear understanding of the level of mathematics necessary to be prepared to enter college. For example, Student David offers the following explanation about this anticipated math sequence and career choice:

> I'd like to make it through . . . all the way through Calculus, AP, in high school and to become an architect or an engineer when I grow up and to own my own business. . . . It can allow me to build on principles that I know have another step that can get me closer to my goals.

Parent Ms. Molly, Student David's mother, also offered a similar response as noted below:

> Uh, well, he . . . he won't have to take it in Ninth, so he can go onto Geometry and Algebra 2, so he can actually get more of the higher level courses in high school . . . Well I think it will help him since he's thinking about going into architecture or engineering, and I think that's a great start and he'll need as much math as he can get.

The participants also understand the importance of having a solid foundation of algebra knowledge and the part algebra plays in the future success in advanced

mathematic courses. For example, Parent Ms. Leah discusses the role that algebra plays in Student Gabriel achieving his goals:

> Well first of all, it's required for graduation—that's number one. Um, it is a requirement, it also is a building block for other mathematical courses that he needs to take to achieve his goals in life and in order to take Geometry, Algebra 2, you know, it's important for him to have a solid basis, solid foundation.

Student Deanna also expresses her desire to achieve her goal of taking as many math courses as possible at the high school level: "I want to take as many math classes as I can in high school and so I feel that if I take . . . took Algebra in the eighth grade that it allows me to take more in high school."

Additionally, the participants talk about taking Algebra in the terms of getting ahead of other students in the same grade level. There exists a distinction between the participants' responses of reaching goals compared to getting ahead of other students in the same grade level. This is due to the fact students are measuring their mathematics achievement against the standard of other students in the same grade level not taking Algebra until the ninth grade or beyond. The students and parents express a strong desire for the students to excel in comparison to other students. For example, Student Rachel expresses this view: "I will be able to go up higher in my math, I will . . . I can be ahead of everybody; and if somebody else needs my help, I can help them." Student Jacob also expresses a similar view: "It's helped me because instead of having to take it in ninth grade, I'm a take ahead, taking it in eighth grade, so I'm ahead of most of the ninth graders that are at Purnell Swett."

When the teachers discuss taking Algebra in the eighth grade they talk about how the students have a longer period of time to cover the concepts and objectives. The teachers feel that the yearlong course versus the semester course in high school will enable students to build a stronger foundational knowledge in preparation for the high school mathematics curriculum. The teachers are well informed about the perquisite skills that are necessary for students to be successful in mathematics when they reach high school because they demonstrate a clear understanding of the requirements and standards for taking mathematics at the high school level. For example, Teacher Ms. Melissa offers the explanation below:

> Well sometimes I feel like a child is not mature enough to take it in the eighth grade, but I feel like with them being able to take it over that long period of time, versus when they get to the high school, it's more in a semester-type, and I just feel like students would do better if they had that long length of time, because I feel like if they're having to cover a lot of objectives within a 90-minute period, versus not covering as many objectives, they would have more time to absorb the standard or objective that you were covering.

Teacher Mr. Matthew discusses how Algebra in the eighth grade also enables the students to expand their mathematics abilities at the high school level:

> Plus the fact that if they master Algebra in the eighth grade, then the opportunity to advance farther in the math field in the high school arena is greater, you don't have to spend the semester taking Algebra in high school because you've already gotten it taken care of in the middle school, so that expands your high school abilities.

Meanings of Working in Groups

The third theme that emerged when examining the meanings of teaching and learning mathematics in a Lumbee Indian community is the meanings of working in groups. The students discuss working in groups in terms of cooperation between members, because the students help other members and in return the other members help them. Student Gabriel explains the cooperation using the following explanation: "I'd help them, because if I help them, they help me. Scratch your back, you scratch my back." Student Nicole discusses cooperation in terms of the support that she provides to other students to help them understand the mathematics concepts that they encounter in the classroom:

> If another student needed help and they would ask me, I would look at the problem and see if I was able to solve it and if I was, I would . . . I wouldn't do it for them, I would just . . . break it down and show them what needed to be done and stuff, if they needed help.

The students participated in focus groups utilizing the *Proportional Reasoning Assessment Instrument* to examine the level of cooperation that the students exhibit between each other. The eighth grade students display a more competitive way of engaging in the problem solving process. Therefore, the description of the focus groups interactions will focus on the cooperative nature of the ninth grade students during the problem solving process. To examine the cooperation between the students, a description is provided of how many of the students contributed to solving the problems. The students' participation is evaluated by determining how many of the students asked and answered questions. The students asked questions when they needed further clarification

on how to solve the problems or why other participants completed the problems a particular way. Table 4.2 shows, by question, the participants that asked questions and answered questions.

The students begin the focus group by first reading the question aloud. When the students begin solving Question 1, the students offer solution strategies to the problems. However, it becomes apparent that the students do not just accept answers offered by other students. Students Erin and Nicole ask about the method that will be used to solve the problems. Student Jacob says proportions, but Student Erin wonders about the absence of an unknown in the question. Student Erin solves the problem quickly and says, “Aren’t they equal, because one-fourth equals one-fourth.” The students have a desire to ensure that they understand the concepts because Student Erin questions Student Jacob about his method for solving the problem. During the course of solving the problems students who ask questions initially also answer questions once they develop an understanding of the problem and the process is utilized to solve the problems.

The students transition into solving Question 2. They decide as a group to use proportions to solve the problem and quickly find the solution to the question, but Student Gabriel has questions about the problem. Students Jacob and Erin in unison explain the proportion used to solve the problem so Student Gabriel understands.

The group moves on to Question 3. During the process of solving the problem, there is a lot of discussion about the solution strategies used to solve the problem. Student Jacob offers a solution to the problem and explains how he obtains his answer.

Table 4.2. ***Summary of the Students that Asked and Answered Questions***

		Students				
Questions		**Erin**	**Nicole**	**Gabriel**	**Jacob**	**Kevin**
Question 1	Asked Questions	X	X			
	Answered Questions	X	X	X	X	
Question 2	Asked Questions	X	X	X		X
	Answered Questions	X	X		X	
Question 3	Asked Questions	X	X	X	X	X
	Answered Questions		X		X	X
Question 4	Asked Questions			X	X	
	Answered Questions	X	X	X	X	X
Question 5	Asked Questions	X			X	
	Answered Questions		X		X	X
Question 6	Asked Questions					
	Answered Questions	X	X		X	
Question 7	Asked Questions			X		
	Answered Questions		X		X	
Question 8	Asked Questions	X	X	X	X	
	Answered Questions	X	X	X	X	X
Question 9	Asked Questions			X	X	
	Answered Questions	X	X		X	
Question 10	Asked Questions	X	X			X
	Answered Questions	X	X	X	X	X

However, all of the students engage in dialogue about the process used to solve the problem, which results in the students struggling back and forth about whether the girls or boys receive more pizza in the problem. Student Kevin asked Student Jacob to clearly explain how he solved the problem. Even after he explains, Student Erin says that she still does not understand how he obtains his answer. He explains his solution strategy again, but Student Nicole still needs more clarification. Therefore, Student Erin offers an alternative method to solve the problem and the students appear satisfied with her explanation and decide to move on to the next question. During the transition, Student Jacob wants to make sure that Student Gabriel understands how to solve the problem because he checks on his progress through the problem solving process. Student Gabriel states, “I’m just going to take a little time to do it.” He wants to make sure the group is taking their time to solve the problems. The students also offer explanations to each other that may not include the entire group at various points during the process.

The students begin solving Question 4 by reading the problem on an individual basis. Student Nicole explains her answer to Student Erin. Student Erin explains her answer to the whole group, but the Student Jacobs wants to know how the other students set up their ratios. They discuss whether to set up the ratios in terms of white eggs to brown egg, brown eggs to white eggs, or brown eggs to the whole carton. The majority of the students decide on an answer, but Student Gabriel would like to come back to the question later because he does not agree with the answer.

Student Nicole begins reading Question 5 and Student Kevin tells her to read louder so that the group can clearly hear her. Student Kevin quickly decides on Tray A

for the answer. The students understand the solution strategy for Question 5, 6, and 7 because they are similar and relate to the same concept of setting up the ratio of orange juice to water. Student Jacob asks Student Gabriel if he was okay with the problem solving process for the questions. However, the students do not like to explain their thinking; therefore, they had to be encouraged to write their explanations. Student Gabriel asks Student Jacob about the explanation they wrote for the problems and he tells him while the other students move on to the next question.

Student Nicole reads Question 8 for the group. Students Erin and Nicole offer their explanations about Sarah's speed when riding the biking. Student Kevin makes sure that the group understands that Sarah accelerates from a stopping point. The students begin writing out their explanation for the graph. They are writing their explanations as a group. When they start writing their explanation for interval B, the majority of the group suggests that Sarah is maintaining a constant speed; but Student Gabriel does not agree. All of the group members discuss whether interval B is displaying Sarah going at a constant speed or stopping. Student Gabriel explains that Sarah is stopped because "the distance does not change but time does so they are not moving". Student Nicole asks him to give his explanation again. Student Jacob relates the question to the types of problems they solve in Physical Science. Once the students understand the concept they are able to explain the solution to the other group members. Student Kevin even explains to Student Erin that they would obtain a constant speed if time and distance where on different axes. Therefore, the group decides that Sarah was at rest on Interval B and accelerates at a faster rate on Interval C.

The students continue on to Question 9 and decide to use ratios to set up the heights of the two trees. Student Nicole explains to Student Jacob about using tree A as a ratio and tree B as a ratio. During the time that the other group members are solving the problem, Student Gabriel is moving at his own pace. They make their decision about which tree grew higher by evaluating the ratios in terms of percentages. The students verbalize the explanations they wrote for solving the problem. After the students decide that tree B has increased the most relative to its initial height, Student Gabriel makes them aware that tree A and tree B both grew 6 feet during the five year period. The students work together to try to gain an understanding of what it means for the trees to go the same amount. The students decided to move on to the next question.

The students decide to use proportions to solve Question 10.Student Erin and Student Jacob discuss how to set up their proportions. Student Jacob decide to set his proportion with the length of Flag 1 over the length of Flag 2 being set equal to height of Flag 2 over the quantity the problem is looking for. However, Students Erin and Nicole want to set up their proportion with the length of Flag 1 over the height of Flag 1 being set equal to length of Flag 2 over the unknown quantity for the height of Flag 2. Student Jacob helps them to understand that using either method will result in the same answer of 4 for the height of Flag 2. Student Kevin asks what the area will be. Student Gabriel uses a visual representation of the flag to help the other students understand that the length is the only dimension that increased by three. After being provided with the drawing, Student Kevin is able to explain to others that you multiply to length and the width together to obtain 24 square feet. Student Erin express the need for further clarification;

therefore, all of the others students worked together to make sure she understood the problem.

The students returned to the questions that they expressed concerns about the solutions, so they went back other Question 4. Student Jacob told Student Gabriel that they had the blue carton for the answer and he showed concerns about the answer choice. Student Jacob wanted to know the proportions that Student Gabriel used to solve the problem. He helped the group to understand that they need to set up the ratio with brown eggs to white eggs, which result in the red carton actually being the correct answer.

The students demonstrate cooperation by their willingness to work together to ensure that all of the group members develop an understanding of the various concepts involved in solving the problems. All of the students assumed different roles throughout the process. The different roles included the following:

- Explaining their reasoning to other group members.
- The willingness to listen to the ideas of other group members if it differed from their own.
- The asking of questions of the group if they did not have the appropriate understanding of the concepts.
- The questioning of other members of the group to make sure they understood the problems.
- A willingness to revisit the problems so they could address differences in various group members' interpretations of the problems.

Upon completion of the focus groups, during which students solved mathematics problems, a reflection of the problem-solving process was completed. The students were asked to respond to the following:

- Describe how your group worked together to solve these problems. Give some examples that support your views of your group.
- Would you rather work in a group when asked to solve difficult problems or would you rather work alone? Explain why you have this opinion.

The eighth-grade students took the approach of working the problems individually, while discussing the solution strategies of each individual. The students also selected a solution to the problems based on what the majority of the group members decided to be correct. The process used to discuss and select the correct solution strategies resulted in some of the students feeling like their voices were not heard. For example, Student Jasmine expressed concerns about not being able to discuss solution strategies effectively as demonstrated below:

> I guess you could say the group worked well, but I just felt like a tag-along, because I tried to discuss but I was stopped. Besides that, everything went fine. There was a question that 3 others had something different than me and one other, but we came to an agreement.

Student Deanna states the process used to solve the problems:

> Together we read each question, thought about the question as reading, and then discussed our strategies. We had a problem that we come in contact with that we had to review a couple of times. We realized that we were all wrong but it was a simple mistake. We then came to the conclusion that the one person was right.

During the process of solving problems within the classroom, the students often employ a strategy called “the challenger’s method” to determine if solutions are correct. The students are engaging in a process that could be described as cooperative competition. Student David describes the process: “Well, we end up kind of in competition mode and we try to see who’s right or wrong, go over each other’s work to see if it’s right, if it’s a big problem.”

The ninth-grade students worked together throughout the problem solving process by offering different solution strategies, a discussion of those strategies, and an overall collaboration often resulting in a consensus about solutions. In addition, every student had the opportunity to contribute their ideas to the large and small groups. If particular group members needed clarification about what the questions were asking, the other members would try to ensure that the student understood. Student Nicole offers the following explanation about how the group worked together: “We exchanged each other’s thoughts about different ways to solve the problems. If one person had a different way of explaining it, then we would talk about the best solution.” Student Jacob describes the process the members utilized if an agreement was not reached: “We explained the answer first, then we all agreed it if it was right, but if we didn’t all agree we talked the answer over.”

The students also responded to whether they prefer working in a group or working alone to solve difficult problems. Nine of the ten students said that they would rather work in a group to solve problems, but one of the nine students said it depends on who is in the group and another said that it depends on what types of questions are asked. The

reasons that the students favor working in a group are because they help one another understand the problem, they offer different solution strategies, and they check to ensure that the strategies each other use are correct. However one of the students would rather work alone and the student offered the following explanation: “I would rather work alone so I can concentrate and go about finding the solution my own way.”

Summary: Research Question One

During the examination of the meanings of teaching and learning mathematics in a Lumbee Indian community that promote mathematics achievement, three major themes were identified: beliefs about the purpose of math, beliefs about the importance of math, and meanings of working in groups. The individuals’ responses about the usefulness of math typically fell into three categories: everyday uses, application to career, or a combination of everyday uses and career. The participants describe a variety of projected career pathways, such as pharmacy, engineering, and forensic science to name a few. Some of the participants identified more specific applications of mathematics such as using mathematics in law enforcement during the administration of a breathalyzer. The participants were asked to explain how taking Algebra in the eighth grade would help students. Their responses were identified as helping in the following ways: the achievement of goals, the higher achievements over other students in the same grade level, and the mastering of content in preparation for high school. Nine out of ten students prefer solving problems in a group setting, because the group can help the student understand the problem, offer different solution strategies, and check to ensure that the strategies the student uses are correct.

Research Question Two

How does mathematics teaching and learning emerge during an examination of the community? The social perspective of Cobb and Yackel's framework is utilized in classroom social norms and sociomathematical norms to study the emergence of mathematics teaching and learning in a high-achieving Lumbee Indian community. Classroom social norms materialize as a result of the teacher and students working in cooperation with each other to determine the responsibilities and expectations for classroom participation. Instances of classroom social norms include providing reasoning and the rationale for solutions, understanding the explanations of others, whether there is agreement about the explanations, and the resolution of differences in interpretations when they arise (Bowers et al., 1999; Cobb et al., 2001; McClain & Cobb, 2001a). Social norms are seen as evolving during group participation in a variety of subject areas in the local classroom community. Therefore, social norms do not adequately address the patterns that emerge during activities that are specific to mathematics. The second aspect of the interpretive framework was developed to address the norms that are explicitly mathematical, referred to as sociomathematical norms. Examples of sociomathematical norms involve what is regarded as a different mathematical solution, a sophisticated mathematical solution, and an acceptable mathematical explanation (Cobb & Yackel, 1995; McClain & Cobb, 2001a; Yackel & Cobb, 1995).

Classroom Social Norms

The classroom social norms are not developed in terms of individuals but from the collective and individual's beliefs about what constitutes being a student within the

classroom community. They appear as patterns that emerge during group participation in the classroom activities. The classroom social norms are revealed through the examination of the students', parents', and teachers' responses to the various activities and patterns of behaviors that materialize during the classroom interactions. Table 4.3 shows the classroom social norms that were identified by analyzing and categorizing the participants' responses.

The first classroom social norm identified through an examination of the agreed upon responsibilities and expectations for participation in the classroom is questioning and trying to resolve differences in interpretations when they arise. The research participants' responses are related to their interpretations about why it is important to explain how the participant obtained an answer, and the interaction, which takes place when obtaining an answer different from another answer offered in class. Student Nicole offers the following explanations for difference in interpretations:

> Everybody has different . . . I don't want to say different opinions . . . but think different, and some people might have a different way of solving the problem but get the same answer and so he just wanted to hear everybody's different opinions of how they solved their problems.

Student Rachel says that the questioning may often occur in the form of a debate:

> Um, it's like a reasoning . . . you have other people's opinions going against yours; it's a debate, you have a debate about it. You give your answers and you work out the problems and then like . . . he'll show you what the person that got the wrong answer did wrong and show you how you can get it right, by switching maybe one little step around.

Table 4.3. ***Participants' Classroom Social Norms***

Classroom Social Norms	Participants		
	Students	**Parents**	**Teachers**
Questioning and trying to resolve differences in interpretations when they arise	Erin Nicole Rachel Deanna Jada		Mr. Caleb Mr. Matthew Ms. Melissa
Trying to understand the explanations of others and whether they agree or disagree with the explanations	Gabriel Erin Deanna Nicole Jada	Ms. Leah	
Agreement that students are expected to explain and provide the reasoning and the rationale for solutions	Gabriel Erin David Rachel Deanna Jasmine Jada	Ms. Marissa Ms. Andrea Ms. Molly	Mr. Caleb Mr. Matthew Ms. Melissa
Technology as a tool	Gabriel Deanna Jasmine Jacob	Ms. Leah Ms. Amber Ms. Lauren Ms. Marissa Ms. Jessica Ms. Evelyn	Mr. Caleb Mr. Matthew Ms. Melissa
Partners in learning	Erin David Rachel Deanna Jasmine Jacob Jada	Ms. Leah Ms. Amanda Ms. Amber Mr. Luke Ms. Lauren Ms. Jessica Ms. Andrea Ms. Molly Ms. Evelyn Mr. Steven	Mr. Caleb Mr. Matthew Ms. Melissa

The teachers also discuss the process involved in questioning and trying to resolve differences in interpretations. Teacher Mr. Caleb talks about the social norms in terms of the process involved when students give incorrect answers during class discussion, as shown in the following:

> And if someone gives a negative . . . or not the right response . . . it's to sit there and let them explain why they felt it was that answer and to try to probe as to, you know, what went wrong, because I'm sure the whole thought process was not wrong. And to just go back and undo one little way that they went wrong, try to undo that and show them the way it should have been thinking.

Trying to understand the explanations of others and whether they agree or disagree with the explanations is another classroom social norm that emerged during the analysis process. Several students and one parent give examples of the classroom activities that are in place when trying to understand the explanations of others or when others would try to understand the explanations of the participants. For example, Student Jada says: "I explain it clearly, raise my hand, and if somebody don't understand it, I try to explain it more better. Because some people just don't think the same and maybe they have another way of figuring out a problem." Parent Ms. Leah demonstrates a clear understanding of the importance of understanding the explanations of others:

> Math is a thing you have to understand before you move to the next level and I think his teacher was very aware of that and tried to enforce or make sure students understand. Giving them time for group work, sometimes you learn by explaining it to someone else, it helps your retention.

The next classroom social norms is the agreement that students are expected to explain and provide the reasoning and rationale for solutions. The research participants were asked the following questions to gain an understanding of this social norm:

- When you were in class, what did you do when you gave an answer?
- Why do you think it is important to be able to explain how you obtained your answer?

Seven of the ten students gave an explanation of process for giving answers in class and why it is important to be able to explain how they obtained an answer. Student Gabriel discusses the importance of offering a clear understanding of the mathematics problems that students solve: “Because if you don’t know how to find it, imagine when you get to the bigger numbers, harder stuff. You still have to use that process from previous subjects to apply it to the current subject.” Student David offers a similar view about the importance of offering a clear understanding of the problems: “First so you can understand it and others can understand it, and second so you make sure you did it right—make sure you didn’t skip anything or leave out anything.”

Several parents also discuss the importance of students explaining and providing reasoning and the rationale for solutions. Parent Ms. Marissa states: “I mean, I expect him to participate; if he’s got a problem, he needs to ask questions. If he’s got a solution, then he needs to you know, share with the other class, how he derived at that solution.” Parent Ms. Molly, Student David’s mother, discuss the role that he plays in the classroom:

> Well, from what I’ve been told, he does participate a lot in class, he has an answer, you know, the teacher asks who wants to give an answer, volunteer, whatever, that he is willing to do that. And he’s also willing to help others if there’s a period of time when some other student may need some help with something that he understands, you know, and they don’t, then he’s available to do that.

The teachers also talk about the importance of giving an explanation to problems. Teacher Mr. Matthew says:

> A concept that I fully believe in is that if a child is able to teach how to do a math problem, then the understanding of that math concept is greater than if they can just sit down and do it themselves. They may have that part of it where they understand it, but if they're able to teach it, then they fully understand it. So, explaining it to me is their way of teaching me how to do the problem.

Teacher Ms. Melissa states the importance of all students engaging in the process of answering questions in the classroom setting:

> Well, like in my class, I . . . when I ask questions, I let every child respond. Some teachers don't do that, they want them to raise their hand and just that one, but I mean I like to hear from everybody, so I mean, it's like, if you come into my class and we're working on an example, you're going to see a lot of responses, it's not just going to be a child raising their hand, they're going to all respond.

The next classroom social norm the research participants talk about are the various ways that technology is used as a tool to aid in the delivery of mathematical concepts during the instructional process, and the tool helps students to master the various mathematical concepts they encounter in the classroom. For example, Student Jasmine talks about how she utilizes the website that accompanies the textbook as a frequent resource to gain additional practice: "There's this website on the computer, NC.Algebra1.com, I use it a lot. It has quizzes that you can take, it has study guides, it has extra examples, it has everything under it." Student Jasmine's mother, Ms. Evelyn talks about the time that her student devotes to mastering the concepts that she will encounter in the classroom setting:

> And in the book, it's got websites you can go to, and she uses that. It's got practice tests in there to help her, and she'll sit up, I've seen her, if she's having a test the next day, I've seen her take a LOT of tests until she gets it in her head that she's got it, before she goes to bed. But she uses them websites in the books.

While Student Gabriel discusses how the teacher utilizes technology to deliver instruction:

> Oh yeah, Mr. Clyde would break it down, explain it to you, all that stuff, put it on the Starboard and put it in front of the class and show the process by which he found the answer and if . . . he'd ask you if you needed any additional assistance.

Parent Ms. Leah, Student Gabriel's mother, offers a similar explanation:

> I think one of the things for me was the explanations, using overhead, or… what is the information called? Using a computer . . . yeah, Starboard. And going through step-by-step and trying to make sure the students understand before you move to the next concept.

Teacher Mr. Caleb says the following about technology use within the classroom:

> I think technology is a big key, being able to present information in a different way, instead of just going to the chalkboard or the dry erase board; I used Starboard and data projectors, and being able to use those different colors to stimulate the mind. Allowing kids to come up and solve problems on that Starboard, you know, that motivated them because they wanted to do that.
>
> Um, one that I found that was always good—I hate to even say it like this—Kuta Software—it's an online program and it's basically for teachers, but it is so close, it covers . . . it's got the same concepts that are taught in the classroom, they have it online, so I use that a lot. Also that United Streaming, I think there's a Discovery Education I think is the new word for it—they have a lot of like video clips that you can use. And it basically has clips on everything that you teach. So being able to show the relevance—it shows relevance to how what you're doing in the classroom can be used in the real world.

Partners in Learning is the final classroom social norm that the research participants discuss. Seven out ten students, 10 out of 14 parents, and the three teachers discuss tutoring. The research participants talk about partners in learning in terms of the

teacher always being available to provide assistance to the students, and several of the research participants discuss how the students are utilized as partners to help their peers learn.For example, Student Erin states how teachers are constantly offering assistance to students:

> Teachers—they were . . . they go out of their way to help you. They wouldn't just ignore you, or just say, "if you can't do it, then oh well." They would go out of their way, stay after school, help you, take you aside in class and help you. It's a lot, really helpful . . . Tutoring, they keep you after class sometimes if you really need help and you can't stay after school. Some teachers would actually call you and ask if you needed help or something like that, or e-mail you.

Student Jasmine gives a similar explanation of the devotion that the teachers show towards their students:

> I have like . . . he volunteers for tutoring . . . ok . . . he's paid for tutoring on Mondays and Tuesdays, but he's staying on Wednesdays, Thursdays, and Fridays without pay to help to tutor me. They're making teachers go to meetings on Thursdays and Fridays, but he still tutors for me on Wednesdays without pay, voluntarily.

Several of the parents also discuss how their students' are utilized as a partner to help peers learn. For example, Parent Ms. Molly states how Student David helps other students:

> And he's also willing to help others if there's a period of time when some other student may need some help with something that he understands, you know, and they don't, then he's available to do that. Last year, he actually did some tutoring during . . . I'm not sure what session it was, during school, but at . . . during a certain session, and he would help some of the students along with the teacher, to help them get up to speed.

Parent Ms. Andrea also talks about how her daughter, Student Jada offers assistance to other students at the school:

> I think the school, in some ways, helps more. If children are having problems, like Chloe, she does tutoring on the side. If teachers see that their children are having problems, they take their best students and have them to tutor the ones that are having problems.

Teacher Mr. Caleb gives a similar explanation of how the teacher utilized the students that are strong in mathematics as a partner to help their peers learn:

> And the other resources that we use, we have after school tutoring; we stay after school and I would try to work with a smaller group, and I tried to keep that to the students that were struggling. And sometimes those kids that were proficient, or that were good, I would try to encourage those to stay so in those study groups or after school tutoring, I could pair them up.

Socialmathematical Norms

The interactions that develop when students offer a variety of justifications to different mathematical solutions enable the teacher and students to navigate through the development of sociomathematical norms in the classroom. The norms involve making judgments about what is an acceptable mathematical explanation, what characterizes a mathematical difference, and the requirements for sophisticated, efficient, or easy mathematical solutions, etc. The negotiation of sociomathematical norms presents opportunities for the teacher and the students to learn. The teacher gives a variety of solutions, explanations, and judgments creditability; therefore, increasing the teacher's and students' knowledge of what constitutes sociomathematical norms. Table 4.4 shows

the sociomathematical norms that were identified by analyzing and categorizing the participants' responses:

Table 4.4. ***Participants' Sociomathematical Norms***

Sociomathematical Norms	Participants		
	Students	**Parents**	**Teachers**
Importance of developing the right interpretations of the material	Gabriel Kevin Jacob David Erin Nicole Rachel Deanna Jasmine Jada	Ms. Leah Mr. Darryl Ms. Amanda Ms. Molly Ms. Amber Mr. Timothy Ms. Lauren Ms. Julia Ms. Evelyn Ms. Andrea	Mr. Caleb Mr. Matthew Ms. Melissa
Using Appropriate/Correct Strategy	Gabriel Kevin Jacob David Erin Nicole Rachel Deanna Jasmine Jada		Mr. Caleb Mr. Matthew Ms. Melissa
Teacher will accepts multiple solution strategies	Gabriel Kevin Jacob David Erin Nicole Rachel Deanna Jasmine Jada		Mr. Caleb Mr. Matthew Ms. Melissa

As shown in Table 4.4, all ten of the students, ten of the fourteen parents, and all of the three teachers discuss the first sociomathematical norm, the importance of developing the right interpretations of the material. The teachers implement sociomathematical norms through various interactions that they engage in with the

students during the instructional process. Teachers provide support to students by guiding them through the problem solving process and monitoring the steps and strategies that students employ to solve the problems. The research participants responded to the following questions to enable an examination of ideas related to the importance of developing accurate interpretations:

- How does your teacher help you become a better student?
- What do you do when you have a problem understanding an idea in Algebra?
- What does your algebra teacher do to help you understand Algebra?

For example, Student Gabriel talks about the assistance that Teacher Mr. Caleb provides:

> Mr. Caleb, he was just a great teacher all in all and he knew how to motivate you and he knew the subject. He could explain it down to a level of where anybody could understand it. . . . He'd just say . . . he'd tell me why I was wrong and probably tell me what I probably did wrong and I'd go back and look over it and I'd find my mistake and correct it.

Student Erin also offers the following explanation concerning the assistance provided by teachers to ensure that students are successful:

> He . . . if you did it one way, and you still didn't understand it, he would get a different problem and see if you could understand that problem and he'd keep on working it out and if you still didn't understand it, he'd pull you aside and try to explain it.

Student Nicole provides a similar view of the role that the teacher assumes to enable students to develop a clear understanding of mathematical concepts:

> He really broke everything down for me, if I . . . there was just one little step out of the problem I didn't understand, he would take that one step out and break it down for me and just explaining everything right to where it needs to be.

The parents also provide another perspective of support that teachers gave in order to ensure that students were successful in developing accurate interpretations of mathematical concepts. For instance, Parent Ms. Amanda says the following:

> You know, like when he's in the eighth grade and he had Mr. Caleb and if he had a question, he would always ask or try to find out before he got there, because of being what? Outspoken.
>
> Teachers, always; I hate to keep saying Mr. Caleb, but that's who he had in Pre-Algebra and Algebra and any time he ever needed him, you know, he could contact him or after . . . and like I said, after school, you know, if he needed him, I mean, you know, from what he says, he was just always available, there for him.

Parent Mr. Timothy makes the following statement about the role that teachers play in students' success:

> I think, from what I've heard and been told, he's a very thorough teacher and he covers the material, and to me, that's what helps the child to learn, if you're able to explain it in a way that they understand and you take the time, as a teacher, to properly explain it, not just put a problem up there and put an example and say, "there it is, work it out." The teacher has to go a step further and explain it in a way that child can understand.

Parent Ms. Lauren, Mr. Timothy's wife expresses a similar point of view:

> The teacher, he would stay over, that was one thing I admired about Mr. Caleb, he would stay over if he had to, to help his students, you know, the ones that was a little weaker or didn't understand something, he would stay over after school and help them.

The second sociomathematical norm that emerged during an examination of the mathematics teaching and learning in the community is the students using an appropriate/correct strategy. All of the students and teachers discuss ensuring that students use an appropriate/correct strategy because teachers want to ensure that students are employing a solution method that is applicable in various mathematical situations. Students talk about how the teacher does not wish for them to use strategies that only work in special situations. For example, Student Jacob states the following when discussing what occurs when he obtains the correct solution but utilized a different strategy to solve the problem:

> When I did that, most of the time I'd ask them, is that a way or a different way that you could work it out? Most of the time he'd say no, it only works for some of the questions, not all of them, so he'd make us do it his way.

Student David offers a similar view, but talks about it in terms of the basic principles of mathematics: "It's alright—or he's alright, as long as we're able to get the right answer and it works every time and it doesn't really mess with anything—any basic principles." The teachers emphasize how students can arrive at the correct answer, but use an incorrect solution strategy. Teacher Mr. Caleb discusses it in the following statement:

> But I had to see it and look at the way they solved it to make sure that that was a good way. Because I tell kids in math . . . math you can work in different ways, you can work a problem out the wrong way and get the right answer, but you are not going to be able to work out another problem that's just like that and come up with the right answer. So that strategy that they're using is **not** correct. So I need to make sure that they way they're doing it is effective; and as long as it is, then I have no problem with it.

The final mathematical norm is the teachers accept multiple solution strategies in order to solve problems; however, it is conditional because the students have to use an appropriate/correct strategy and develop the right interpretation of the material. Whether or not a teacher accepts multiple solution strategies enables the examination of how flexible the teacher is when students offer a variety of solution strategies. All of the students and teachers say that they allow students to use a variety of solution strategies, as long as the strategies use the appropriate mathematical ideas. Student Jada explains how students are able to use various methods, and how they can select a method based on the ease of use:

> When I worked out my problems different, because my way's sometimes easier and I understand mine better, because I do it myself and it comes out right sometimes . . . most of the time. Because it's . . . if we do it like that, we can just go on the way we do it, unless it's a special kind of problem, where you can't use your way, only the book's way.

Student Rachel also talks about how other student solution strategies are demonstrated to the class and students are allowed to choose which methods work best for each individual:

> Um, take one of my classmates for example, he can work out any problem that you give him, but he . . . he can do it in a different way than you do. So he'll show us his way, and the teacher will show us his way, and whichever way is easier is the one you go with, or the one that's . . . that you're more known to, that you can do it better at.

Student Erin offers a similar view:

> They would ask you how you did it first and if it was a good way that would work every time with that problem, then they would tell the students maybe they could use it that way, instead of just the other way if it was easier for them.

The teachers explain that there are multiple ways in which to solve problems and describe how they afford students the opportunities to see how problems can be solved in such ways. For example, Teacher Ms. Melissa discusses how students will comment on how they solved a problem using a different strategy:

> Even when I go over an example, I try to show them different methods and a student might say, "Well Ms. Leslie, I didn't work it out that way," and my response is always, "Well, there are several ways you can come up with an answer, there's more than one way to work the problem out."

Teacher Mr. Caleb discusses the importance of students voicing their opinions about the different solutions that are employed during the solution process:

> I like to give different strategies as a way that lesson can be, you know, well that problem can be solved, and not just say, "It's my way or the highway," and allow the children to be able to voice their opinion as they see it, then try to build it upon their idea, because it's just not . . . math can be solved in many ways, and for me, I don't really care how you solve it, as long as it's successful.

Summary: Research Question Two

During the examination of how mathematics teaching and learning emerges during an examination of the community, the themes are classified into classroom social norms and sociomathematical norms. During analysis of the classroom social norms, the teachers maintain the integrity of the concepts while addressing the needs of students. The teachers and students work together to ensure that students are participating in the

classroom interactions by working together to support each other in developing and understanding concepts they encounter within the classroom. Teachers and students recognize that the students' contributions must be validated. The sociomathematical norms revolve around the importance of allowing students to use multiple approaches to solve problems; however, the teachers ensure that the interpretations and strategies utilized are mathematically sound and accurate.

Research Question Three

How does the social networking system within the community promote the mathematics achievement? Coleman's social capital framework is utilized to study the social networking system within the community to understand how mathematics achievement is promoted in a high-achieving Lumbee Indian community. The three forms of social capital discussed by Coleman (1988) are utilized to examine the social networking system: trustworthiness in the form of obligations and expectations, the social network used to communicate information, and the norms and constraints put in place to address the concerns of the group.

Expectations and Obligations

In the form of expectations and obligations, social capital ensures that students are successful in mathematics. The expectations that are placed on the students through the social networking system fall into three categories: expectation to do their best, expectation to succeed, and expectation to seek help. To aid in the mathematical achievement of students, parents and teachers feel an obligation to help children and schools to ensure that students are successful in mathematics. Table 4.5 displays the

expectations and obligations identified by examining and classifying the research participants' responses:

Table 4.5. ***Expectations and Obligations Related to Mathematical Achievement***

	Participants		
Expectations and Obligations	**Students**	**Parents**	**Teachers**
Expectation to do their best	Erin Deanna Jasmine Nicole Kevin	Ms.Amber Ms. Molly Ms. Evelyn Mr. Steven Ms. Leah Ms. Julia Mr. Timothy Ms. Lauren Mr. Joseph Ms. Marissa Ms. Jessica Ms. Amanda Mr. Luke	
Expectation to succeed	David Rachel Deanna Jacob Kevin Jada	Ms. Amber Ms. Julia Mr. Timothy Ms. Lauren Mr. Luke	Ms. Melissa
Expectation to seek help	Erin Rachel Deanna Jacob Jada	Ms. Amber Ms. Andrea Ms. Evelyn Ms. Leah Ms. Julia Mr. Timothy Ms. Lauren Ms. Marissa Ms. Jessica Ms. Amanda	
Obligation to help child/school	Nicole	Ms. Amber Ms. Molly Ms. Evelyn Mr. Steven Ms. Julia Mr. Timothy Ms. Jessica Mr. Luke	Mr. Caleb Mr. Matthew

The first expectation identified through an examination of social networking was the expectation to do their best. The research participants were asked what would happen if the students brought home a poor grade in math and what the students were expected to do when they participated in group activities. Five of the ten students and thirteen of the fourteen parents express a view that the students are expected to do their best when they are participating in their mathematics classes and engaging in group activities.

Student Jasmine discusses how her mother would respond if she brought home a poor grade in mathematics:

> First, the first question she'd ask if I really tried my best, and of course I'd tell her yeah. But if she's like . . . she knows when I have a test, she always knows when I have a test. If the night before, she don't see me studying or anything then I bring home that grade, she knows that it wasn't the best I could do, she gets really upset. But if she knows that I tried, she don't get upset.

Student Erin offers a similar explanation, because the parents want to ensure that students are performing at the highest level possible to ensure their success in mathematics:

> They would ask me why and if I was doing my best, or if I was just like . . . I got a bad grade in my Geometry class last semester, mama and daddy told me to bring it up, they asked me why did I get it, I told them I didn't understand, it's not that I wasn't doing my homework or just flunking the tests for no reason, it's just that I didn't understand it. They told me to bring it up and they'd help me.

The parents were asked the following questions in regards to expectations concerning their children's participation in math:

- What are your expectations concerning his participation in math class?
- Are they different from what your expectations are for his other classes?

Parent Ms. Molly expresses the following view concerning her expectations for her child's participation in math class:

> Well, I . . . I expect him to do his best in all of his classes. Math is one of his better subjects . . . well actually, math, science, and geography . . . social studies. But I . . . I just expect him to do his best.

Parent Mr. Timothy says the following: "In math class? Learn all she can learn (laughs) and apply it and understand why and how that she might need to apply math in the future."

The research participants also discuss the expectation for the students to succeed in their mathematics class. The research participants were asked the same questions stated above in regards to the grades that students will earn in math class. Student Deanna says the following: "I don't even . . . I can't imagine . . . I've never did that. When I picked with them one time and said I did, she just took it the wrong way." Student Jacob gives the following explanation about his parents' response to his grades in his mathematics classroom:

> They would ask me about what was the problem, they usually tell me that I should bring it up, because they expect me to have mostly A's in my classes, so they tell me, "you better bring it up next time."

Parent Ms. Julia, Student Deanna's mother, expresses how her daughter would respond if she received a poor grade:

> I would comfort her, because I know she'd be crying. She's harder on herself than I am. I know she always does her best, so. But I would review it with her, because I would know it's obviously something she didn't get.

Teacher Ms. Melissa discusses the parents' responses if their student did not perform as well as they expected:

> Well, I know they would . . . a lot of my thing with that Algebra group would be the ones that haven't gotten . . . it wasn't that they got a bad grade, I mean they expect their child—the ones in the Algebra group—they expect their kids to have A's. And so if they get a B, a lot of times they'll come out and want to know what the problem was, and with the group that I have this year, for a couple of them, it was the Accelerated Math, not doing their Accelerated Math, so what they'll do is just make them do what's expected of them.

The last expectation that the research participants discuss in terms of how the social networking system within the community promotes mathematics achievement is the expectation to seek help. The students are expected to seek help typically from their teacher before they leave school because of two reasons: the parents experience difficulty in helping their children with the material and the children do not like the method their parents use to explain the material. The reasons stated by parents for having difficulty in explaining the material was attributed to their lack of exposure to the content and/or the amount of time that had passed since they had seen such content. Five of the ten students and ten of the fourteen parents expect the students to seek help. For example, Student Jacob discusses how the amount of help he receives from his parents has changed over time and how his parents would help him to improve his grade if he obtained a poor grade:

> Since I'm getting older, I pay more attention in class, because I know I can't be slacking in class, so I pay more attention so when I get home I don't have to ask them, because I like to be self-independent on my work, instead of having to ask them for help.

> Sometimes they ask me about getting a tutor or something, but I really don't need that. "Do you need extra time to go talk to the teacher?" seeing if I could get extra time or something if I had a bad grade most of the time.

Parent Ms. Lauren talks about how the parent can support their child in mathematics:

> Offer any kind of help that they can, any extra tutoring, like going to school now, like tell her, any time she has any problems in any of her classes, especially math . . . I know math can pretty well be the, you know, the most difficult one, I tell her to make sure if she's got any questions to ask her teacher, to go over it with her, not to leave out of class until she understands what she's . . . what is expected of her and to stay for learning centers. Any time she can get any extra tutoring, take advantage of it.

Parent Ms. Jessica also discusses that parents are supporting their child in mathematics by ensuring that the student attends tutoring and seeks the help of the teacher:

> In math? Ok . . . well, like Rebecca, she's not . . . she knows I'm not strong in math. My thing is, if by me knowing that, I'm gonna try to get her all the help I can, see what I'm saying? Rebecca's been involved in tutoring, 3 days a week since school started, because she knows I'm not strong in math. She goes to tutoring with Mr. John in the morning time, you know, for about 20 minutes, she's in there with him. My thing is if you know your child's not strong in an area, you should be willing to do all you can do to help that child achieve, you know, that goal.

Several of the parents and teachers express an obligation to help the children and/or the school. Parent Ms. Molly offers the following view of how parents can support their children in mathematics:

> Well, there's a lot of ways that parents can support kids in mathematics. Um, as we talked about a while ago, you know, just in everyday things, in whatever a parent is doing, if you're at the grocery store and somebody tells you how much something costs and you say, I'm gonna give them a $20 bill, how much change am I gonna get back? or if you're cooking and you're doing measuring, you

> know, look at this, how much is this? And if we make 2 of these, how much are we gonna need extra to put in? Just if it's . . . I feel like if you start out doing that as a natural . . . a natural flow of things in whatever you're doing, then it will help a student not to be intimidated by math. And then of course, as they're doing homework and learning new things, looking over what they're required to do, you know, see if you can understand what it's asking and see if the student's understanding what they're asked to do.

Parent Ms. Evelyn discusses the importance of parents making sure that students complete homework assignments and seek help when necessary:

> I think parents need to stay behind their child and make sure they do their work, because subbing, I have seen some children, I know they're not doing their work at home, you can tell, just by subbing in class one day, you can tell who's trying to do their work at home and who's not. And some of the parents aren't ensuring that their children are doing it.

Teacher Mr. Caleb explains how parents would ensure that students received the help necessary to be successful in the mathematics classroom:

> I would say the parent support was uh . . . and they would even go out and get tutors; if I felt like, they'd say, Mr. Caleb does my child need a tutor? and you know I felt like they did or they would benefit, you know, I'd say, well sure, it's not gonna hurt. But what you need to do is be able to let me talk to that tutor as well, so that I can keep that tutor abreast of what's going on in the classroom, not just rely on what the student says. So you know, I think that they do a real . . . were real supportive with the children.

Teacher Mr. Matthew also discusses how the parents are willing to volunteer their time at the school:

> Volunteers. The volunteer rate at this school is greater than I have seen at any other school. You see parents there all the time with little stickers that say they're volunteering for the day. They'll come in and, like for example, if we had an activity going on and the teachers were not enough to handle it, they'll step in and

> help out. You know, serve drinks, and candy for prom, and stuff like that. My parents at prom, for my kids, Spring Fling, for my kids, didn't just drop the kids off, they came in and spent an hour or two to make sure everything was going smoothly and then they left. We had a Halloween night, parents volunteered for that. We've got parents that come in and read to kids; I've got parents that come in and just sit with their kid and make sure that behavior is what it's supposed to be.

Social Network

The next form of social capital that emerged during an examination of the social networking system in the community that promotes mathematics achievement is the information channels that are utilized to communicate the mathematics courses necessary for students to achieve goals. The social networking system is also utilized to find students help. Table 4.6 shows the different members of the system that are utilized to communicate the necessary information.

Parent Ms. Amber utilizes many different people through her social networking system to determine the courses necessary for her child to meet the specified requirements for her chosen career:

> Talk to the guidance counselor, and then see too what they've told her, as far as her path and she has a cousin who's in the Eleventh Grade that's pretty much on the same path that she's on, and talk to her too, because I'm not a high school person, I'm a middle school person. I've been in high school now 2 years, and so I'm not sure exactly what kind of courses that they should take and what kind of paths she should be on. . . . But you know, if I had a question, I'd go to the guidance counselor to find out and if I couldn't get an answer there, or if she was busy, then I've got people at the University that I could contact, or other teachers, such as yourself that I could ask, as far as what track she should be on, or what she should be taking. Because beyond math courses, as far as her sciences courses and stuff like that, I really would actually not be knowledgeable about what she should be taking, so I would definitely have to go to somebody about that.

Table 4.6. ***Social Networks within the Community***

Social Network	Participants		
	Students	**Parents**	**Teachers**
Social network with teacher/parents	Nicole	Ms. Amber Ms. Molly Mr. Steven Ms. Leah Mr. Timothy Ms. Lauren Mr. Joseph Ms. Marissa Ms. Jessica Mr. Luke	Mr. Caleb Mr. Matthew Ms. Melissa
Social network with guidance counselor		Ms. Amber Ms. Andrea Ms. Molly Ms. Evelyn Ms. Julia Ms. Lauren Ms. Marissa Ms. Jessica	
Social network with family members/community members		Ms. Amber Ms. Leah Mr. Timothy Mr. David Ms. Marissa	
Social network in place to help others	Gabriel Erin Rachel Jasmine	Ms. Andrea Ms. Evelyn Ms. Amanda	

Parent Ms. Leah uses the social networking system for a variety of reasons as noted in the following:

> If they need tutoring, provide tutoring your child. If the school does not provide it, ask if there's someone in the community who can do that, and make sure they receive it. Sometimes it's even necessary to network with the other parents. In case you have a problem with a particular teacher, sometimes you need to network to make sure that your child's giving you the correct information. Sometimes even network with parents to make sure you get homework assignments if your child's out sick, because that's important with achievement. Things happen that we can't control, so we need to know what we need to do. But

> as a parent, I always try to talk with the principal, especially if I had a problem and . . . not only if I have a problem . . . I like to let the principal know when the teacher's doing well, because that's important, to let him know when success is being carried out.

The teachers discuss the importance of the social networking system by ensuring that the students are successful in mathematics and how the social networking system is utilized to communicate the students' progress in the mathematics classroom. For example, Teacher Mr. Caleb talks about how the parents and the teacher are in constant contact with each other to ensure that the students are successful in the Algebra classroom:

> A lot of the parents within . . . the students were . . . that took Algebra, you know, those parents were very supportive. They were . . . always wanted to know what was going on in the classroom and if there was a problem, they expected me to be able to be able to contact them, you know, with those problems. Um, so, I mean, it wasn't uncommon for them to either come out to the school, to make that phone call, PTA, they were the parents . . . a lot of those were the parents that were there for those kids that you know, that took Algebra.

Teacher Mr. Matthew also discusses the opportunities that he has to associate with parents outside the school setting:

> Well you see them everywhere—not just as school—you see them in shopping centers, you see them in grocery stores. Hill Community's lines or districts or boundaries extend almost to Maxton, so some of the parents go to Maxton to shop, and even while I'm in that Food Lion, I may run across a couple of parents and they'll say, "how's my child doing?" or "we need to talk about this, we need to talk about that."

The social networking system is utilized to help the students in the social network. For example, Student Erin says the following about the effort that teachers make to ensure that the student is successful in the mathematics classroom:

> They keep you after class sometimes if you really need help and you can't stay after school. Some teachers would actually call you and ask if you needed help or something like that, or e-mail you.

Norms and Constraints

The last form of social capital that emerged during an examination of the social networking system in the community that promotes mathematics achievement is norms and constraints. Table 4.7 shows the norms and constraints that are established within the social networking system to aid in student's success in mathematics.

The first norm that emerged during an examination of the social networking system is the norm to help children to be successful. Nine of the ten students, thirteen of the fourteen parents, and one teacher discuss how parents or teachers help the students to be successful. The research participants' responses fall into two categories: parents that can currently help students in mathematics and the parents that are unable to help students because of the amount of time that it has been since they have had to solve problems related to algebra.

For example, Student Nicole explains how her parents were able to help her with mathematics in the elementary grades; however, the more difficult the mathematics became the less they have been able to help her:

> I can ask them, but I don't know if they'll be much help, since things have changed since when they were in school.
>
> When they did know what they were doing, they could try to . . . try to do like my teachers do, break it down, but it wouldn't be broke down as much and my brother would try to help me when they didn't understand it, but when they didn't know what to do, they'd just give it back to me, tell me to try to do it on my own.

Table 4.7. ***Norms and Constraints that Promote Mathematical Achievement***

Norms and Constraints	Participants		
	Students	**Parents**	**Teachers**
Norm to help child	Gabriel David Rachel Deanna Jasmine Nicole Jacob Kevin Jada	Ms. Amber Ms. Andrea Ms. Molly Ms. Evelyn Mr. Steven Ms. Leah Ms. Julia Mr. Timothy Ms. Lauren Mr. Joseph Ms. Jessica Ms. Amanda Mr. Luke	Mr. Matthew
Norms for students to decide to accept help from parents in math	Gabriel Erin David Rachel Nicole Jacob Kevin	Ms. Amber Ms. Andrea Ms. Leah Ms. Lauren Ms. Marissa Ms. Amanda	
Constraints of parent using different teaching method from teachers		Ms. Amber Ms. Andrea Ms. Marissa	
Constraints of consequences for not succeeding	David Deanna Nicole Kevin Jada	Ms. Andrea Ms. Evelyn Mr. Joseph Ms. Marissa Ms. Jessica	

Parent Mr. Timothy, Student Nicole's father, answer reflects the response offered by his daughter. For example, he discusses how he helped his daughter in the lower grades:

> Well I didn't give much help—like I said, just, she'd come to me look but I'd give her examples and I'd go to the examples and I'd tell her, "we'll have to call somebody" to be honest, I wasn't a math major.
>
> . . . Before it got so complicated, yeah, I've helped her over the years, yes. Time tables and stuff like that.

Student Jacob offers a similar explanation:

> My mother, she helps me mostly with my homework if I were struggling in that class, she'd help me when I needed help during that time.
>
> . . . Since it gets harder and stuff, they really usually expect me to know how to do it when I get home, so they really don't ask me if I need help, because they know I usually know how to do it when I get home.

From the responses offered by the research participants, the parents also fall into the other category of being able to help students with their mathematics because of the parents' mathematical ability. For example, Student Jasmine discusses the amount of time her mother is willing to put into help her understand the math that she is doing:

> Like, ok, mama will have to look at it and figure it out herself, then she'll sit there and work through every step and figure it out with me.
>
> Um, a lot of times in math, in rules, doing slope intersection, and mama would tell me, "You know I haven't been in school in over 20 years, I don't know how to do this." But she'd sit down and she'd figure out in probably 5 minutes . . . probably about 5-10 minutes, she'd figure it out. Then she'd sat down and explained every single step to me and I eventually got it.

Parent Ms. Evelyn says the following:

> Well, the further along she's got, the less I've been able to help, I'll be honest. But I have, in the past, I've sat down with her and if I knew it, we'd go over it until she figured it out. If I didn't, I have sit in that chair—well not that one, but

> the one before it—I have sit over there and worked on a problem and worked on it until I found the answer and figured out how I got it and then tried to help her explain it to her and help her with it.

The second norm that emerged during the examination of the social networking system within the community is the norm of students deciding to accept help from parents in mathematics. Seven of the ten students and six of the 14 parents discuss the norms of the students making the decision about accepting help from parents. The students made the decision about whether to accept help from parents based on whether they felt their parents could help them and what type of interaction they would have with their parents if they did accept help from them. For example, Student Gabriel was asked whether he had an opportunity to receive help from his parents in math and offered the following explanation:

> I do have the opportunity, but I make the decision whether I do or not. I make the decision of whether I ask them or not.
>
> . . . Um, if it looks kind of easy, I might ask them, but not if it's some of that complicated stuff, I don't even waste my time.

Student Erin expresses views about receiving help from her mother:

> Well me and mama, we kind of butt heads because we're alike a lot, but sometimes she will ask me if I need help, it will be me who won't want the help sometimes, but if I really need it, she's there to help me.

Parent Ms. Amber offers an explanation similar to her daughter, Student Erin:

> Well I mean, me being a math teacher, I . . . I ask her how she's doing and "Well, I'm actually having problems on such and such . . . Well how come you haven't asked me?" "Well mama, you know you get on my nerves when you help me."

Student David explains how his mother helps him to develop a clearer understanding in mathematics:

> They help me understand or look over steps to help me . . . they go over it thoroughly with me, especially my mom.
>
> It helped me out a lot by her showing me how to do things and how to comprehend and understand. And now an early age, my grandmother, about when I was two, started playing games, like what's 1+1, or there's two cows on the side of the road when we're driving by and here comes another one, how many is that? Simple things, but it helped start me out early.

Parent Ms. Marissa also mentions that her children would make the decision to receive help from their mother:

> They always knew that if they didn't understand something in class, they always knew they had mama to kind of fall back into. But still again, I would say that my kids always pretty much got a lot of theirs out of the classroom. I haven't had to do—even though I do have a math degree and taught school—I've not had to do a lot of one-on-one. Now if they came and asked me questions, I would help them.

One of the constraints that emerged during the process of helping students understand math is the parent using a different teaching method from their teachers. For example, Parent Ms. Amber says the following:

> what I always assumed was, gosh, she'll never struggle in math because if she's having a problem at school, then I'm going to be able to help her at home, but that doesn't always work, because it's like, "you don't explain it like she does," of course you know, everybody says that. But I have to make sure I ask her because she's always been good in math, but that doesn't always mean she won't struggle

> on some things, so I have to be really careful sometimes to make sure and remind myself, you need to be careful, you need to ask her if she having any trouble with anything, you know, her being good in math. But usually she is, but now occasionally, I've kind of helped her along on stuff and tried to not show her my method, to try to show her a generic method of doing things, and it's worked pretty good.

Parent Ms. Marissa, also a mathematics teacher, offers a similar view:

> You know, sometimes by me helping them, I'd be showing them a different way than the teacher showed them in the classrooms, and "mama, now you're confusing me." Then I'd say, "well you better go back and get a better understanding from your teacher." Not saying that I couldn't . . . or I'd end up trying to show them two different ways. Sometimes that can be confusing, because they've seen it one way and I've presented it another way, but I mean, I've always helped them when I could.

Parent Ms. Andrea discusses the issues involved in explaining mathematics problems to her child if the explanation is different from the method offered by the teacher:

> Me and her butt heads too, so she's screaming at me, "not that way!"
>
> That's not the way to work it out . . . well I say, "Well this is the way I know." I'll get my book out, or I'll look in her book, you know, it's got similar problems and whatever, 'cause I have my college Algebra book and you know, we just go from there. And if I . . . we can't work it out, then I find somebody that can.
>
> . . . Because she's looking at the way that Mr. Matthew showed her or whatever and I'm trying to show her my way, and I can understand that.

The last constraint that is identified during the examination of the social networking system within the community is the constraints put in place as a result of not succeeding. Five of the students and five of the parents discuss the consequences for not

succeeding. For example, Student David was asked what would happen if he brought home a poor grade and he offered the following explanation about the consequences:

> David: If I brought it home twice, I'd probably get whipped, but if I brought it home once, they'd say I better get it up.
>
> Chavis: What would they do to make sure you brought it up?
>
> David: They'd make sure I understood it, if I didn't, I would get whipped, better bring it up, right, I know that's right. Especially dad.
>
> Chavis: What would your dad do?
>
> David: He's the one that would whip me if I brought it home twice.
>
> Chavis: Why do you think they would do that?
>
> David: Because they care about my grades and how I do in school and they understand why it's important to make good grades.
>
> Chavis: And why do you think they have their expectations for you?
>
> David: One, I'm their son and two, they know what I'm capable of.

Student Kevin offers a similar view of the consequences of bringing home a poor grade: "First beat me . . . tell me I needed to do better, and start doing some extra stuff so I could do better in school." Parent Mr. Joseph says the following, if his son Student Kevin received a poor grade in mathematics: "He would be disciplined." Parent Ms. Marissa, Student Kevin's mother, also discusses the consequence: "He'd be grounded. He wouldn't do nothing and he wouldn't have no . . . (laughs). He'd be grounded." Student Jada talks about the following consequences:

> They would tell me that I needed to bring it up and that I needed to do better and make sure I brought it up the next reporting period.

> . . . Well, they give me . . . they made . . . my time to do other activities outside, watch any TV, they'd make me more time studying and make their cutouts and games and stuff, and they help me study.

Parent Ms. Jessica, Student Jada's mother, offers similar consequences to those offered by her daughter:

> Hmmm . . . I haven't whipped her in a long time—I used to whip them when they were younger. But um, she usually gets grounded and she's not to bring another one . . . if she brings home next report, the same thing, she . . . it's more worse.

Summary: Research Question Three

The themes that materialize after analyzing the social networking system within the community revolves around how the three forms of social capital are utilized to ensure the mathematical success of the students. The expectations and obligations focus on the students exhibiting the work ethic to succeed, seeking help to ensure success, and the parents and teachers provide the support to aid in student success. The social network assists the members of the network by providing the parents and students within the necessary information to make certain the students continue the pathway to success. The norms and constraints continue the promotion of success by helping students if the need arise, and enables the students to receive the assistance of parents and/or teachers if required. If students are not meeting the expectations for success the parents have certain consequences in place to ensure that their children (students) get back on the pathway to success.

Research Question Four

How does the community support teaching and learning? Coleman's (1988) three forms of social capital are also utilized to examine how the community supports teaching and learning. The three forms of social capital are listed below:

- Level of trust, which can emerge as the obligations and expectations
- Social network utilized to communicate information
- Norms and constraints that put the concerns of group over individual interest.

Closure is also examined to determine how its presence aids in the creation of trust between the members of the community, allows behavior to be monitored and steered in an appropriate direction, enables the development of effective social norms, and increases the sense of obligations and expectations within the system (Coleman, 1988).

Historical Sense of Community and Closure

Coleman (1988) also discusses the importance of closure to the social capital structure system because it works as a means of checks and balances that enables each component of the system to work effective for the common good. In order to examine the three forms of social capital, it is necessary to see the historical sense of community, the presence of closure and the valuing of the rural nature of the community. Table 4.8 shows the participants that discuss the historical sense of community, the closure within the community and the valuing of the rural nature of the community.

During the examination of the community, the research participants discussed the historical sense of community to gain an understanding of how the various forms of

social capital have emerged over the course of time. The participants were asked what the strengths of the community are and why they thought the community has these strengths.

Table 4.8. ***Participants Who Discuss Historical Sense of Community and Closure***

Historical sense of community	Gabriel Rachel Deanna	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. Timothy Ms. Marissa Ms. Andrea Ms. Molly	Mr. Caleb Mr. Matthew
Closure (everybody knows everybody)	Erin David Rachel Deanna Jasmine Jacob	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. Timothy Mr. David Ms. Marissa Ms. Amber Ms. Jessica Ms. Molly Ms. Evelyn	Mr. Caleb Mr. Matthew Ms. Melissa
Value the rural nature of community			

The research participants' responses are related to their views of how the community has upheld different dynamics that function to ensure that the community's norms are preserved. Student Gabriel offers the following perspective of why the community possesses these strengths:

> Because it is founded on great moral values and morals theirselves. A hardworking group of farmers helped form this community, such as my great-grandfather, Doug Bielmore himself. He was one of the . . . he was the first

> teacher over at the college, at UNC-P, University of Pembroke, so all of these people put together to naturally have a great community that would be able to support most of itself.

Student Rachel talks about the development of the strengths over time: “I think they build upon it from past generations, people that they grew up with. It’s very old, so I guess it grew . . . like grew up on wise bones.” Several of the parents give explanations similar to the ones offered by the students. Parent Mr. Timothy gives the viewpoint of the community:

> A lot of it’s come from one family and one generation to the next was raised in this community, so it’s been like a . . . something passed on from one generation to the next, because my neighbor here, then my father was friends with their father and mothers. And it goes back probably . . . 150 years I guess, from the talk that I hear. . . . My grandfather was the . . . he came here in the 1800s and he passed in 1922. He was . . . at the time served on the Board of Trustees at the University; he was involved in that. Find out not from a high school standpoint, it started out as a high school, then turned into a University.

The teachers also give explanations of the historical sense of community. Teacher Mr. Caleb says the following:

> Because they’ve always been in place. I mean it’s like tradition, it’s . . . it started way back and it just keeps on building and it keeps on growing stronger and stronger. This is . . . some of the characteristics that our ancestors pretty much, so to speak, had and they just haven’t let them go, they’re still alive and well within the community.

Teacher Mr. Matthew also discusses the difficulties in obtaining land in the community:

> It’s been around for quite a while; it’s not something that’s just started. My grandmother lived in this community, her gra . . . her mother lived in this community, even though it was more widespread than what it is. Even back then,

> neighbors knew neighbors and they were still willing to help and it's grown since then. As a matter of fact, the running joke around Hill Community is it's hard to get land in Hill Community—no one wants to sell their land. So you know, you can tell people know this is a good community and want to stay here.

Another component to understanding the community is the closure that exists. The research participants constantly mention how "everybody knows everybody." As a result of closure, the three types of social capital function to ensure that the group's interests are upheld within the community structure. Student David discusses the closure of the community in the following:

> Well it's very, very . . . what's an easy way to put it? It's pretty much a family—everybody knows each other and really, you know who to be with, you know who to stay away from, and you know where to go and people are looking out for you.

Student Deanna also talks about the community being like a family, with everybody knowing everybody as she explains below:

> I like the Hill Community because there, everybody is together and they know each other and it's like we're all one big family and anybody needs help, somebody's there at some point in time.

Parent Ms. Leah talks about how the stability of the community as a result of the community members remaining in the community:

> The Hill Community is a unique area. Most of the people own their own land, they have lived there all their life, generations. It's not just people who are moving in, most people are . . . their parents were born there, their grandparents, and they're very close-knit, so they know everybody in the community and in the area. So there's a lot of stability there, a lot of community ties, a lot of reinforcement from other people, as well, because everybody knows who your child is.

Parent Ms. Amber discusses how the aspects of the community can be difficult to tolerate sometimes. However, the closure contributes more positively than negatively because of the benefit that results from honest concern that the community members have for each other.

> Very close-knit, very supportive, pretty much I almost feel like the phrase that, "it takes a village to raise a child" almost might have originated from the Hill Community, because everybody . . . sometimes it's kind of a situation to where they get involved a little bit too much, in some cases, but for the most part, they are so much involved, everyone is so much involved in everybody else's lives that it actually becomes very beneficial and it turns out to be very positive, so that's how I feel about the community.

All of the teachers mention the closure that exists in the community. Teacher Ms. Melissa gives the following explanation when asked about the glue that holds the community together:

> like you have a lot of . . . I think within that school, you have a lot of, like family-type relationships. I mean, I think as far as a lot of them being . . . as far as being relatives, I think that has a lot to do with it too.

Teacher Mr. Caleb mentions how the community members that are not originally from the community typically have married someone within the community:

> Close-knit, we're a close-knit community. The majority of people within the community are from the community originally. You know, there's people from other communities that have married into the Hill Community, but for the majority I feel like most of them are born and raised in this community.

Trustworthiness, Expectations, and Obligations

The first type of social capital that emerged during the examination of the community is trustworthiness, expectations, and obligations. Coleman (1988) says trust, expectations, and obligations allow social capital to develop through the interactions that the community members engage in that result in the individuals being dependent upon each other. The first component of the social capital is trust. The research participants' were asked to describe the community and who in the community the parents trusted with their children. Table 4.9 shows the research participants that discuss trust in relation to the community.

Table 4.9. ***Participants Who Discuss Trust***

	Participants		
Trust	**Students**	**Parents**	**Teachers**
Trust	Gabriel Erin Nicole	Mr. Luke Ms. Leah Mr. David Ms. Marissa Ms. Amber Ms. Andrea Ms. Evelyn	Mr. Matthew

Student Erin says the following about who her mother trusted her with:

> mama knows a lot of people in the Hill Community since she lived there when she was younger, like people that still live there from when she lived there. Yeah, she'd trust me to go there, because she knows them well.

Student Gabriel discusses trust in terms of the lack of negative influences that exist within the center of the community:

> The community is a good, wholesome community. Very little crime happens in the Hill Community itself. We have a church, school, all the makings that would make a community good and there's very little crime factors that bring into it; you can't buy alcohol anywhere in the Hill Community, you can't buy . . . well you can probably buy drugs in certain places in the Hill Community, but not in the main parts, that would be in like the backwoods part, stuff you wouldn't be able to get to easily.

The parents also discuss the trust that develops through the interactions with the community members. Parent Mr. Luke gives the following explanation about the development of trust:

> Well there's families in the community that we . . . that you get to know, most of them's husbands and wives in the community that you meet as your children grow up—husband and wife and you learn to trust them in the community.
>
> . . . Over a span of time, over a span of time, because you're involved with the children in school, in different activities, like sports, you meet these parents, husbands, wives, and because of sports and different things like meetings you go to, you get to know them, you meet them. And the children, as your children come home, they meet these children as they go to school with these children, then the children, then you meet the parents too, through your children.

Parent Ms. Leah talks about the trust that develops as a result of knowing everybody in the community:

> Um, there's a lot of people in my community that I trust with my child, as far as taking care of him, because I know everyone there, unless they've come from… and there's very few people who have come from somewhere else, only those who have married somebody and moved in. The teachers—most of those teachers at school I do know personally, on a first-name basis. I've got a lot of cousins and aunts and uncles who live in the community.

However, Parent Mr. Joseph is more reluctant to openly trust the members of community with his child and limits the individuals to just include family members: “Probably just my parents . . . my parents, or . . . her parents are outside the community, but I trust them too . . . my sister.” Parent Ms. Marissa, Mr. Joseph’s wife, has a more expanded circle of individuals with whom she trusts her child: “School, I mean teachers at school, obviously, you know, church, church families, and then it would be immediate family.” Teacher Mr. Matthew also discusses trust in terms of the interactions that he has with individuals when he goes to the convenient store in the community:

> I like the fact that I’m able to go to a convenient store and actually write a check without being required to show 10 or 15 forms of ID, or get those suspicious looks, that say, “should I take this check or shouldn’t I take this check?” They just understand that most of the people in this community are trust-worthy people. And I like that, I really do.

Social Networking System

The second type of social capital that emerged during the examination of the community is the information channel, which I refer to as the social networking system. Coleman (1988) says the information that the individuals gain access to involves using the social relationships that they have in place. Figure 4.1 shows the members that are involved in the social networking system.

The research participants were asked about opportunities the students had to interact with individuals from their school outside of the school setting, what people would see if they came and observed the community, what aspects of the community support the success of children, and what happens if various events are taking place at the

school. Table 4.10 shows the research participants who talk about the social networking that takes place between the various components of the community structure.

Figure 4.1. ***Trust among Community, Church, and School***

Table 4.10. ***Participants Who Discuss Social Networking System***

	Participants		
Social Network	**Students**	**Parents**	**Teachers**
Social networking system	Erin David Rachel Deanna Jasmine Nicole Jacob Jada	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. Timothy Mr. David Ms. Marissa Ms. Amber Ms. Jessica Ms. Andrea Ms. Molly Mr. Steven	Mr. Caleb Mr. Matthew Ms. Melissa

Student Jacob discusses how the community is interactive and how the school is part of the glue that holds the community together:

> It's more of a smaller community, so that means they're more close together and they're more interactive with each other.
>
> . . . The school, because it's a big part of the community and it mostly when the sports are involved, mostly everybody from around the community goes to it and interacts.

Student Erin also mentions how the members of the community interact during various activities in the community:

> There is a park the people get to go to, they get to hang out and play and play basketball and baseball games and soccer and volleyball and the Hill Community's so big, everybody pretty much knows everybody, so they go to each other's houses and hang out sometimes and play sports.

Student Jada discusses the social networking that the school has with the church:

> The church services help us right out of our school sometimes. They . . . sometimes they sell donuts and stuff and we go out there for ministry once a week sometimes.
>
> . . . Well, we get more advantages than other schools, some schools don't get to go to church like we do, because we live right across the street from it.

Parent Ms. Amanda discusses the relationship that the school has with the church and the relationship that the church has with the community:

> I think the church—even the church across the street is a big part of that school still, even now.
>
> . . . If they need different things, I mean, they use the school at least once a week to do community-based things. I do know that that church across the street does… they let them use it for Boy Scouts—not that that's part of the school, but when my boys were younger, they used the school for Boy Scouts. They even paid for stuff for the trips—Boy Scout trips that the kids went on. They even used monies of the church to help pay for the trips that the kids went on. I know that for a fact,

> because my boys were a part of it. So . . . and they've helped not even just the school, even in the community, that church has helped probably some of their parents or grandparents pay utility bills that you know a lot of people don't even know about.

Parent Mr. Timothy also discusses the relationship that the church and school have with each other:

> Mmm . . . a close-knit community as far as family and ties and neighbors are helping one another. Community that's well-involved with the school and the church, church and school together, working together in this community.
>
> . . . From what I understand and know, no I don't. Like we have… got revival that the children, those that want to come, can come over to the church, during that week. And as a matter of fact, I was told that we were the only church that was able to do that right now.

Parent Ms. Lauren discusses how the social networking system is in place to help members of the community stay aware of the behavior and actions of their children:

> If a teacher sees your child doing something they're not supposed to be doing, participating in any way, fashion or whatever they're not supposed to be doing, they'll contact you and let you know what's going on, where you'll be able to talk to your child. And you know, like I said, they'll tell you in a way where you won't be upset, mad, in any way.

Parent Ms. Amanda gives a similar explanation:

> I've had parents at the school, other people working there that tell my child if he was doing something wrong, they would tell his daddy, or tell his parents, so therefore, he would stop, because they don't just let your child go and be on his own, by himself, that they will come and acknowledge what he's doing and let him know that the parents will find out. So it's not that, you know, everybody just gets involved in one child, not just one person. They don't just let a child go on their own.

Norms and Constraints

The third type of social capital that emerged during the examination of the community is norms and constraints. Effective norms are a tool that allows schools to foster academic success among students by managing their behavior (Kao, 2004). The norms and constraints that emerge during the analysis process are the following:

- Norm to value education
- Norm of upholding morals and values
- Norm to support/help
- Constraints of behavior

The research participants were asked to describe the community and who in the community the parents trusted their children with. Table 4.11 shows the norms and constraints that were identified by analyzing and categorizing the participants' responses.

The first norm identified through an examination of how the community supports teaching and learning is the norm to value education. The research participants' responses are related to their views of the aspects of the community that are special and how the school has aided in the success of the children. Student Gabriel says the following about the role the community has in the success of various individuals:

> We're good people, as far as I can tell. Most of the lawyers and stuff that are in Robeson County come from the Hill Community itself and go from the Hill Community to Pembroke, to the University in Pembroke, or they go somewhere that's even better, it would seem of a higher stature. But all in all, it's . . . the Hill Community is like the . . . they're like the factory of Robeson County. They produced anything that's got to do with culture of people, people high in society and people that make money from the Indian Race anyway.

Table 4.11. ***Norms and Constraints Identified by Participants***

Norms and Constraints	Participants		
	Students	**Parents**	**Teachers**
Norm to value education	Gabriel Rachel Deanna Jasmine Jacob Kevin Jada	Ms. Leah Mr. Timothy Ms. Marissa Mr. Steven	Mr. Caleb
Norm upholding morals and values	Gabriel Rachel Deanna Jacob Jada	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. Timothy Mr. David Ms. Marissa Ms. Amber Ms. Jessica Ms. Andrea Ms. Molly Ms. Evelyn	Mr. Caleb Mr. Matthew Ms. Melissa
Norm to support/help	Gabriel Erin David Rachel Deanna Jasmine Nicole Jacob Kevin Jada	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. David Mr. Timothy Ms. Marissa Ms. Amber Ms. Jessica Ms. Andrea Ms. Molly Mr. Steven	Mr. Caleb Mr. Matthew Ms. Melissa
Constraints of behavior	Gabriel Jacob Kevin	Ms. Julia Ms. Amanda Mr. Luke Ms. Leah Mr. Timothy Mr. David Ms. Marissa Ms. Amber Ms. Andrea Ms. Evelyn	Mr. Caleb Mr. Matthew Ms. Melissa

Parent Ms. Leah, Student Gabriel's mother, also talks about the role that community plays in promoting the value of education:

> For me, it would probably be my church, because I do attend the Hill Community Church and a lot of the people there that know him would often ask, "Gabriel, how are you doing in school, how's everything going?" I think that would be a big plus for him, just for him to know other people are concerned about his success. We just don't assume your child's going to learn and just from the parent asking. Other people need to be involved as well—we need that reinforcement for others.

Student Rachel explains the effect that the school has on her success in school:

> I think it's learned . . . it's learned me that you gotta take the road . . . the path to education to get what you need. It has also taught me that I can achieve anything by reading a book, picking up a pencil, paper, anything.

Student Jasmine offers a similar view about the effect the school has on her success in school:

> The education process, like I said, without the Hill Community standards and stuff, I wouldn't be . . . what's the word . . . achieving so good, succeeding like I am now, without the teachers and stuff. Their dedication.

Parent Mr. Steven's, Student Jasmine's father, response mirrors the explanation provided by his daughter:

> They're really, really, really attentive to all the students. I mean, they really try to achieve education and they try to make students believe that everything is about education. Achieve everything you can, and get all the knowledge you can, that way you can prosper.

The second norm is the norm of upholding morals and values. The research participants were following questions to gain an understanding of this norm:

- What are the strengths that you see in the community that are special?
- What is the glue that holds the community together?

Student Deanna explains that the strengths of the community and the glue that holds the community together are the following:

> Support, education, religion, that's the basic things.
>
> . . . I say the elders, because they're the one that started practicing that and they've taught their children and their children and it's all been raised up.

Her mother, Parent Ms. Julia explains why the community has these strengths:

> I personally believe it's because of the religious integration in the school, that's my personal opinion. Because there's something that makes parents from all around want their kids to go to that school, because they have a large number of kids going there out of district. And I mean, the kids seem to have . . . I mean, they have . . . they really seem to like to get involved in the religious activities there. It doesn't seem to be looked down on there, or something that's kept real hush-hush, because a lot of schools don't seem to want to deal with that or to integrate any type of religious activities in anything. And then it seems like people are comfortable with discussing it there, in the classroom or wherever.

Student Jacob describes the community in the following: "Mostly it's a Christian-based community, go to church and everything . . ." He also feels that the school has helped in the following ways: "They help me by encouraging me to do the right thing so I won't grow up and get to high school to be a bad student and not . . . and fail all of my classes." Parent Ms. Amanda, Student Jacob's mother, discusses the strengths of the community:

> Family involvement, I would say church involvement, keeping the kids raised in church. I know a lot of people don't see it that way these days, not when you look around, but you know, that's what I would think it would be, the scripture says . . . and I'm not saying everybody in this community are Christian families, but even if they're not, they're raised with good moral values, and that, you know, goes a long way.

The teachers discuss how the norms of upholding morals and values transition to when the students enter the high school setting. Teacher Mr. Caleb discusses how other teachers can see differences in the academic performance and behavior of the students:

> Being a former teacher at in the Hill Community and then being able to talk with other teachers from the high school, you know, they say they can tell a difference between students from the Hill Community as opposed to you know, other students. Basically not just in academics, but in the way that they carry themselves—they don't misbehave and cut up as opposed to their other counterparts. I would think it would be the discipline that they have at the school that makes a world of difference.

Teacher Mr. Matthew says the following:

> Most of the times, some of the students that I see or some of the students that my fellow teachers in high school teach, tell me is that the student has no respect. You ask them to sit down and they want to have words with you, they don't want to comply to your wishes. And you even talk to the major school, Purnell, and they can tell you that they notice a difference in the students that come from the Hill Community than the students that come from other schools.

Teacher Ms. Melissa explains the process that is involved when the school and church partner together for the religious week:

> Well our kids, they go over to the church from 1:00 until maybe 2:30, and there are, you know, pastors from different churches that come in and they have a revival. And the kids . . . they let the kids do different things with them that week, like children might sing, some of them do drama, you know, that they . . . some of

> them are on drama teams, so they perform their drama. And we have parents that, you know, come out during that time also and participate. And then they also have a . . . later on, after the religious week, the kids go back, like the kids during that time, children who get . . . confess to be saved or whatever during that week, they go back for one day and they have like an incentive-type program, where they have pizza, or pizza and drink or whatever.

The last norm that the research participants talk about is the norm to support/help. The research participants mention a wide variety of ways that they help or offer support to various programs or organizations within the community. The forms of support could involve helping people from the community, participating in various programs, helping others in the school and/or church, etc. For example, Student Erin discusses how the members of the community learn to help themselves and also help others from the community:

> They have learned how to help themselves, they've been educated, been able to help themselves out, been able to do stuff on their own.
>
> . . . They help each other out, they wouldn't just leave you alone, they'd help you out, go to other people, ask for help. Because this is a big church community, they go to church all the time, they pray for you and all that. It's pretty cool.

Student Jasmine talks about the ways that the teachers help the students to develop an understanding of the material they are exposed to in the classroom:

> Like the . . . like if you say you don't understand something, they will go out of their way to tell it . . . tell you in some way that you will understand; they won't leave you hanging or anything, so you will understand it by the end of the day.

Student Rachel offers various examples of the ways that the school helps with different causes:

> They help you, they give you what you need, and they'll explain things to you. This is a very good community I like it a lot.
>
> . . . They have clean-ups, clean up days, we come out here with that, they have field days with younger children, stuff for . . . Pennies for Patients and stuff like that.
>
> For Leukemia awareness, Lymphomia, the Beta Club did something for them, and we raised about . . . $1,700.

When Parent Mr. Joseph was asked why he provided financial support to Camp Grace, an organization that allows groups of children to participate in various outdoor and group activities and gain exposure to Christian-based values and principles, he responded in the following way: "It's the right thing to do and God's gonna bless you for it." The parents also discuss the ways in which the members of the community support the school during different school-related functions. For example, Parent Ms. Leah mentions the amount of the participation from the community:

> The school that he attended, when you have PTA; usually the cafeteria is full and that's very good. So that gives you an idea that the parents are concerned about their children and what's taking place. And I don't think a lot of schools have that, so parents are very involved, very concerned about their children.
>
> . . . In most things, it's wall-to-wall people. They had May Day this past Friday, and the place was full. And it's normally that way—if you have graduation, if you have a Christmas concert, you have other activities, especially PTA, there is a lot of parental support. Not only just parents, but grandparents, great-grandparents, who attend these programs to see their children.

Parent Ms. Julia also provides examples of the support the community provides to different school sponsored activities:

> Ms. Julia: They really involve the community in everything going on with the school, whether it's clean-up day, the discount night that they have or percentage night that they have at McDonalds. All of their staff, their community, they're really, really involved in everything that they do there. And the parents—it appears—play a major role in the students' lives at the school.
>
> Chavis: I know you're the first person that I've heard mention the discount program at McDonalds, what was that like when they had it?
>
> Ms. Julia: The street . . . road was really backed up because you couldn't even pull in because there were so many people there. The inside and the outside of the school . . . of the McDonalds was packed with people and they really push in the school, the importance of it. They're always encouraging the different activities that they do to bring funds into the school to be able to get other resources for the students there.

Parent Ms. Molly also discusses the support that the community provides to the school by volunteering their time:

> I think it has a lot of support; there are a lot of volunteers from the community that work in the school. I used to do that some when Byron first started and I had some time to do that and I got to know a lot of teachers and other volunteers and students and all. I think that really makes a big difference.
>
> . . . I used to volunteer some, I've been too busy lately to do that. I enjoy being able to go out and help with the . . . help other students, since some of those students are struggling with math or reading, we're able to help them a little bit.

Teacher Mr. Matthew discusses how the school responds when participating in various fundraising activities:

> Um, there are some activities that help the children be successful outside of the school, we are a learning a couple of new programs online, which they can do at home. There's baseball, the sports is still school-related . . . you want something outside of school . . . what they use outside . . . oh. Fundraisers. Fundraisers—our school is large amount of fundraisers. We have candy sales, we have can drives, we have penny drives, just today we collected within 20 minutes . . . well you know the kids have the little boxes to take home—within 20 minutes of going

> around the school, we had collected a four foot by two food by six foot cylinder full of pennies, nickels, dimes, quarters, and two twenty dollar bills. I don't know the amount of money, but I'm pretty sure counting it was an excessive job, and that wasn't even the entire school. Can drives—we collected over 11,000 canned goods in the month of October, November, somewhere around in there. We're currently doing another can drive, coats for the winter, we're still successful with that. Candy sales—we had a large amount of funds raised from candy sales, so those kinds of activities, the kids get into to help support them being better kids, and it gets them out in the community. I mean, they don't always get their own change, they might go and say, "Hey, you got some spare change, some pennies?" they get to talk to their neighbors and they get to talk to other people around their community that they might not have the opportunity to had it not been for that fundraising activity.

The constraint that was identified during the analysis of the research participants' responses is how the community constrains the behavior of the students to ensure that they are behaving appropriately. Three of the ten students, ten of the fourteen parents and the three teachers discuss the constraints of behavior. Student Jacob explains the behavior that his parents expect him to exhibit when participating in group activities:

> They expect me to be respectful and not back talk or be uncooperative and they allow me to work hard and don't be . . . they just don't want me to be unsuccessful in what I do.

Student Gabriel gives a similar response: "They expect me not to be fighting, fussing with whoever's in charge, and causing problems." Parent Ms. Amber discusses how the community is set up to ensure that the children's behavior is constantly monitored to ensure that they are behaving appropriately:

> If my child's out in the community, at school, and doing something they're not supposed to be doing, I'm probably going to hear about it—not in a tattle-tale kind of way; in a way that, you know, "I just wanted you to know because I know you'd want to know . . . if it was my child, I'd want to know," that kind of thing.

> So it's always like you have someone looking out for your children and for their well-being.

Parent Ms. Andrea says that the parents are made aware of any issues that may arise with the child:

> the parents, they're more in . . . to me, they're more involved in the children at school and whatever, and the teachers always call if they have a problem with a child, or if the child's not doing good in a class or whatever. Communication.

Parent Ms. Jessica also discusses how the school still enforces corporal punishment:

> Well like I said, corporal punishment, we still do corporal punishment, but the thing about our school is . . . I hadn't seen anybody use it that didn't feel like they needed to, you know what I'm saying? Our parents here are . . . they're involved, you know, if you need our parents, I know they'll come, you know.

Teacher Mr. Matthew explains how parents will also come to the school to monitor the student's behavior: "I've got parents that come in and just sit with their kid and make sure that behavior is what it's supposed to be." Teacher Ms. Melissa gives a similar explanation:

> We still—like at the Hill Community, they still do corporal punishment and I think that makes a difference. Then a lot of times, if you call a parent and you're having problems with the child, several parents would come out to the school house right then.

Summary: Research Question Four

Themes that emerge during the examination of the community show how the community supports teaching and learning through the utilization of three forms of social capital:

- Level of trust, which can emerge as obligations and expectations.
- Social network utilized to communicate information.
- Norms and constraints that put concerns of group over individual interest.

However, it was necessary to examine the historical sense of community and closure because of the important role they have in the three forms of social capital functioning properly. The Hill Community provides an example of how social capital can become a tool to aid in the success of individuals in the community because of the role that knowing your neighbor plays in the relationships that are developed between the school, the church, and the community.

CHAPTER V

DISCUSSION AND IMPLICATIONS

Overview

From the results of this study it appears that Lumbee Indian parents, teachers and students within a Lumbee Indian community experience a shared vision of academic success. The purpose of this study is to gain an understanding of the aspects of the community that may influence the academic success of the students, particularly in Algebra One. Therefore, I utilized Cobb and Yackel's (1996) social and sociomathematical norms framework in conjunction with Coleman's (1988) social capital framework to examine the meanings of teaching and learning within a Lumbee Indian community. An instrumental case study was utilized in conjunction with qualitative research methods that involved interviewing students, parents and teachers. Focus groups were also used to collect data to answer the four research questions of this study.

In the Hill Community, the research participants' beliefs about mathematics centered on the linkage that math has to academic success and the successful transition into college and the workplace. Even though some of the parents say they do not possess a high level of mathematical understanding, they have expectations for their students to be successful in mathematics. The social networking system within the community utilizes the three forms of social capital to ensure the academic success of the students. This system involves the establishment of trust between the parents, teachers, and

students; therefore, the parents and teachers share power with the students to promote academic achievement. In order to maintain the balance of power with the parents and teachers, the students have a responsibility to fulfill the high expectations and obligations put in place by the parents and teachers.

Summary of Findings

This study employs four research questions to gain an understanding of the aspects of the community that influences the academic success of Lumbee Indian algebra one students. The following is a summary of the findings related to the aspects of the community.

Research Question One

What are the meanings of teaching and learning mathematics in a high-achieving Lumbee Indian community that promotes mathematics achievement in the middle grades? This research question used the psychological component of Cobb and Yackel's framework as the tool to analyze meanings of the participants' beliefs about the roles and nature of mathematical activity and the individuals' mathematical beliefs and values. Two major themes were identified: beliefs about the usefulness of math, and meanings of working in groups.

Beliefs about usefulness of mathematics. Students, parents, and teachers in the Hill Community agree that the purpose of learning mathematics is that it is useful. Beliefs expressed by the participants about the usefulness included everyday uses of mathematics and the future study of mathematics in relationship to college and careers. Previous research studies report beliefs about the usefulness of learning mathematics (Howley,

Pendarvis & Gholson, 2005; Kloosterman & Cougan, 1994; Kloosterman, Raymond & Emenaker, 1996; Reyes, 1984; Schommer-Aikins, Duell, & Hutter, 2005; Wilkins & Ma, 2003).

Several researchers report that their research participants recognize the usefulness of mathematics to everyday activities (Howley et al., 2005; Kloosterman et al., 1996). Kloosterman et al. (1996) report how the students discuss the everyday uses of mathematics, such as, shopping, taxes, cooking, sports, and the use of mathematics in technical jobs. Two of the students from their study provide more specific examples of the usefulness of mathematics in terms of farming and the winery business. The subjects in Howley et al. (2005) study discussed the everyday uses of mathematics in relationship to money.

Various researchers also report that their research participants understand the usefulness of mathematics in the future study of mathematics (Kloosterman & Cougan, 1994; Reyes, 1984; Schommer-Aikins, Duell & Hutter, 2005; Wilkins & Ma, 2003). A clearer understanding of the importance of mathematics to future academic goals after high school is important for students as they make decisions about how much mathematics to take in high school (Kloosterman & Cougan, 1994; Reyes, 1984). Reyes (1984) states that even when students do not like taking mathematics courses, they make the decision to take three to four years of mathematics because of the importance that it has on their future academic or career goals. Students who lack an understanding of the relevance of mathematics to these future goals often drop out of mathematics in high school and often limit the options they have for the future. Wilkins and Ma (2003) also

indicate that student beliefs about the usefulness of mathematics influences whether students take more mathematics courses in high school. Schommer-Aikins et al. (2005) expand the concept of the usefulness of mathematics and found if middle school students do not feel that mathematics is relevant to their lives, they are reluctant to spend the time or energy necessary to be successful at it.

Furthermore, several researchers report that their research participants value the usefulness of mathematics to their projected careers (Howley et al., 2005; Schommer-Aikins et al., 2005; Wilkins & Ma, 2003). Wilkins and Ma (2003) determined that the students who had a strong awareness of the importance of mathematics to their career goals could have an impact on the number of mathematics courses taken in high school. Results from their studies also indicate that parents who view mathematics as important to academic and career success often transfer this belief onto their students. Howley et al.'s (2005) findings revealed that students believe that mathematics is necessary in order to obtain success in a career. Several of the students equate success within the acquisition of mathematical knowledge; therefore, they pursue mathematics because of the impact that it has on their ability to obtain good jobs.

Students, parents and teachers in the Hill Community also express beliefs about the usefulness of mathematics to everyday activities, and the future study in mathematics including college, and careers. One of the strengths of the community in this study is that the members share the same meanings of the usefulness of mathematics (Cobb & Yackel, 1996). Prior studies support the research findings of this study about the research participants' beliefs about the usefulness of mathematics because of the students' ability

to articulate the everyday uses of mathematics and they are able to identify examples of the usefulness of mathematics to specific careers. Previous research also supports the findings of this study because the students' understanding of the importance of mathematics on academic and career choices influence the amount of mathematics that the students took at the high school level and parents transfer beliefs about the importance of mathematics onto their students.

Beliefs about working in groups. Students in the Hill Community agree that they should work together to learn mathematics. Beliefs expressed by the participants about working cooperatively to learn mathematics included: the group can help the student understand the problem, offer different solution strategies, and check to ensure that the strategies the student uses are correct. Previous research studies report beliefs about the working together to learn mathematics (Kysh, 1998; Mevarech & Kramarski, 1997; Nattiv, 1994; Webb & Mastergeorge, 2003; Webb, Troper & Fall, 1995; Wood, Cobb & Yackel, 1991).

Several researchers report that their research participants help other students understand how to solve the problems when working cooperatively in a group (Nattiv, 1994; Webb & Mastergeorge, 2003; Webb, Troper, & Fall, 1995). Webb and Mastergeorge's (2003) findings indicate that students who received a high-level of help and also sought explanations to ensure an understanding of the problems were highly successful when completing posttests. The same students also provided a high-level of help to others by offering explanations to their peers when necessary and acquired the ability to solve problems independently. Webb et al. (1995) determined that students who

use the explanations of others to create their own mathematical understandings are better able to resolve inconsistencies about the solution process. They are also able to develop an understanding of how to solve the problems. Giving and receiving explanations that aid in students' mathematical understanding has a positive influence on their success in mathematics (Nattiv, 1994).

Prior studies also discuss how the research participants help others by offering different solution strategies when working together to learn mathematics (Mevarech & Kramarski, 1997; Wood, Cobb, & Yackel, 1991). Wood et al. (1991) results indicate that when students work collaboratively, they are able to utilize the process to openly communicate about how the solve mathematics problems. During the collaborative process students offer various solution strategies, explain and justify their ideas, and resolve the differences in the various explanations offered. Mevarech and Kramarski's (1997) findings indicate when group members work cooperatively to solve mathematics problems and focus on developing a better understanding of concepts; students are given opportunities to realize that there are various ways to solve mathematics problems.

Various researchers also report the belief that working in groups while learning mathematics enables students to check to ensure that the strategies other students use are correct (Kysh, 1998; Mevarech & Kramarski, 1997). Kysh's (1998) study of students working in groups in an Algebra classroom determined that students who work cooperatively take longer in solving problems due to member checking. The members of the cooperative group also seem to value the input of the various students within the group. Mevarech and Kramarski (1997) findings also indicate that cooperative groups

work at resolving differences in solutions while encouraging each other to look at problems in new ways.

Students in the Hill Community share the same meanings about working together to learn mathematics. Previous research findings mirror the findings of this study because the group members exhibit the following behaviors: explaining their reasoning to other group members, being willing to listen to other group members ideas if it differed from their own, asking questions of the group if they did not have the appropriate understanding of the concepts, and a willingness to take a longer amount of time on the problems so they could address differences in various group members' interpretations of the problems.

The students, parents, and teachers in the Hill Community share beliefs about the usefulness of mathematics and beliefs about working together to learn mathematics. Previous findings (Howley et al., 2005; Kloosterman & Cougan, 1994; Kloosterman et al., 1996; Reyes, 1984; Schommer-Aikins et al., 2005; Wilkins & Ma, 2003) support the research findings of this study about the beliefs of the usefulness of mathematics. Additionally, previous studies including the work of Kysh (1998), Mevarech and Kramarski (1997), Nattiv (1994), Webb and Mastergeorge (2003), Webb et al. (1995), and Wood et al. (1991) mirror the findings of this study concerning the importance and benefits of working together to learn mathematics.

Research Question Two

How do the meanings of mathematical teaching and learning emerge during an examination of the community? This research question used the social component of

Cobb and Yackel's (1996) framework as the tool to analyze patterns that emerge during participation in the classroom activities. Two major themes were identified: classroom social norms and sociomathematical norms.

Classroom social norms. Students, parents, and teachers in the Hill Community discuss classroom social norms that are the various activities and patterns of behaviors that materialize during the classroom interactions. Classroom social norms identified by the participants about mathematics teaching and learning included: questioning and trying to understand explanations of others and resolve differences in interpretations, agreement that students are expected to explain and provide the reasoning and the rationale for solutions, technology as a tool, and partners in learning. The current study is unique because of the insight that is provided by discussing the parents' perspectives of the interactions that take place within the mathematics classroom. Previous research studies report the classroom social norms about mathematics teaching and learning; however, they do not address the parents' perspectives of the interactions within the classroom (Cobb & Yackel, 1996; Depaepe, De Corte & Verschaffel, 2007; Goos, 2004; Hershkowitz & Schwarz, 1999; Lehrer & Shumow, 1997; Pierce & Ball, 2009; Wood, Cobb, Yackel, & Dillion, 1993).

Several researchers report that their research participants establish questioning and trying to understand explanations of others and resolve differences in interpretations (Cobb & Yackel, 1996; Depaepe et al., 2007; Goos, 2004; Wood et al., 1993). The subjects in the Depaepe et al. (2007) study were able to understand differences in interpretations by recognizing that problems can be solved using different methods and

the importance of trying to understand the explanation of others. Wood et al. (1993) examined the interactions between students in small groups during the problem solving process in a mathematics classroom. When the students try to understand the explanations of their group members, they may question others' explanations, ask for clearer understanding of their explanations and determine whether they agree or disagree. All of these findings support the beliefs of the Hill Community research participants of the social norms of the mathematics classroom.

Various researchers report technology as a classroom social norm (Hershkowitz & Schwartz, 1999; Pierce & Ball, 2009). According to Hershkowitz and Schwartz (1999) computerized tools, such as, graphing calculators and computer software allow students to represent particular concepts and perform particular task to develop a better understanding of material. Hershkowitz and Schwartz say, "Whatever the tools, they allow the establishment of practices and the taken-as-shared basis for mathematical communication in explanations and justifications" (p. 151). Pierce and Ball's (2009) study examined mathematics teachers' views on technology use. The majority of the subjects in the study reveal the technology can be used as a tool to help students expand their understanding of mathematics, a view held by the Hill community research participants.

Students, parents and teachers in the Hill Community identified specific classroom social norms that support mathematics teaching and learning. One of the strengths of the community in this study is that teachers and students work together to ensure that students are participating in the classroom interactions. This in turn supports

students in the development and understanding of the concepts encounter within the classroom. Prior studies about classroom social norms support the research findings of this study.

Sociomathematical norms. Students, parents, and teachers in the Hill Community discuss sociomathematical norms that are the interactions that develop when students offer a variety of justifications to different mathematical solutions. The sociomathematical norms identified by the participants in my study about mathematics teaching and learning included: (a) the importance of developing the right interpretations of the material, (b) the use of appropriate/correct strategies, and (c) the acceptance of multiple solution strategies. Previous research studies that relate to my findings report on the sociomathematical norms about mathematics teaching and learning (Hershkowitz & Schwarz, 1999; Kazemi, 1998; Kazemi & Stipek, 2001; McClain & Cobb, 2001a, 2001b; Yackel, 2001; Yackel & Cobb, 1996).

Several researchers identify the importance of developing the right interpretation of the material and using appropriate/correct strategy as a sociomathematical norm (Kazemi, 1998; Kazemi & Stipek, 2001; McClain & Cobb, 2001a; Yackel, 2001; Yackel & Cobb, 1996). Numerous researchers report the acceptance of multiple solution strategies, which the researchers identified as different mathematical solutions (Kazemi, 1998; McClain & Cobb, 2001a, 2001b; Yackel & Cobb, 1996).

Students, parents and teachers in the Hill Community identified specific sociomathematical norms that support mathematics teaching and learning. One of the strengths of the community in this study is that teachers seem to provide support to

students by guiding them through the problem solving process and monitoring the steps and strategies that students employ to solve the problems. In this community the sociomathematical norms emphasize the value of allowing students to use multiple approaches to solve problems; however, the teachers' makes certain the interpretations and strategies employed are mathematical appropriate and correct. Previous studies about sociomathematical norms support the research findings of this study because the researchers identified the following norms: importance of developing the right interpretations of the material, using an acceptable strategy and allowing different solution strategies.

The students, parents, and teachers in the Hill Community share the beliefs about what constitutes being a student within the classroom community. Prior studies support this study's findings concerning the role effective social norms and sociomathematical norms serve in terms of student learning. Algebra is a critical area of focus in the middle grades, because of the significant role that the development of algebraic reasoning has on the future success of students (Ball, 2003). The mathematics curriculum in the Hill community school should equip them with the ability to effectively use algebraic reasoning and meet a specified set of expectations for middle school. Through the establishment of classroom social norms and sociomathematical norms, Hill teachers are able to effectively implement changes in classroom practices that provide continuous improvement in the quality of instruction and practices that keep students achieving and to move closer to the desired level of mathematical proficiency (NCTM, 2000).

Research Question Three

How does the social networking system within the community promote the mathematics achievement? This research question used the Coleman's (1988) framework as the tool to examine how the social networking system within the community promotes mathematics achievement within a high-achieving Lumbee Indian community. The following major themes were identified in my study: expectations to accept help to ensure success, social networking system, and constraints that aid in students' success.

Accepting help. Students, parents, and teachers in the Hill Community agree that the expectations and obligations functions as a means for the students to meet the expectations set in place by parents and teachers to ensure students are successful in mathematics. Expectations and obligations expressed by the participants through social networking included: expectations to seek help to ensure success and the obligation to help aid in students' mathematical success. Previous research studies report expectations and obligations to ensure the success of students in mathematics (Birenbaum & Nasser, 2006; Buxton, 2005; Fan, 2001; Furstenberg & Hughes, 1995; Lee & Bowen, 2006; Newman & Goldin, 1990; Walker, 2006).

Several researchers report that expectations are placed on students to seek help from teachers to ensure success in mathematics (Birenbaum & Nasser, 2006; Buxton, 2005; Newman & Goldin, 1990). Newman and Goldin (1990) discuss students' views of seeking help in mathematics. The willingness of students to ask for help in mathematics is influenced by the students' perceived ideas of how parents and teachers view them academically when soliciting help. They also determined those students' views on help

from teachers in mathematics as critical because of the influences that the help has on the academic success of the students. Buxton's (2005) study focuses on how the concept of an educated person evolves within the school setting. Learning, achievement, resistance, and success were the factors identified as impacting the views of what characteristics an educated person possessed that enabled the creation of a culture of academic success within the school setting. The social networking system with the school community enabled the various members of the network to work together to ensure the expectations are place to aid in the academic success of the students within the school. This supports the findings of the Hill Community's research participants' views on seeking out help in understanding the algebra from teachers.

Various researchers discuss students making the decision to accept help from parents and parents' obligation to help aid in students' mathematical success (Fan, 2001; Furstenberg & Hughes, 1995; Lee & Bowen, 2006; Lehrer & Shumow, 1997; Walker, 2006; Yan & Lin, 2005). Walker (2006) reported that parent were involved in students' academic success by setting high expectations, and offering support to ensure that students completed academic coursework and utilizing all of the opportunities that were available to them to ensure success.

Students, parents and teachers in the Hill Community utilize the social networking system to help ensure that students understand the expectations and take measures to achieve their success in mathematics. Parents and teachers fulfill obligation to help aid in students' mathematical success. One of the strengths of this study's community is that students have a clear understanding of the expectations to achieve success and the

teachers and parents work together to aid in the students' mathematical success. Previous studies about expectations and obligations support the research findings of this study because the researchers identified expectations for academic success and the influences that parental involvement has on the academic success of students. This study adds to the research by reporting the teachers' perspectives concerning the obligation to help the students achieve mathematical success.

Social network. Students, parents, and teachers in the Hill Community agree that the social networking system is important to help ensure student success. The presence of various members of the community and their connectedness is an important factor that seems to ensure that students are successful in mathematics. Also, the social networking system is utilized to communicate the students' progress in the mathematics classroom and enables students to receive necessary help. Previous research studies report the social network as an important component to ensure the successful of students in mathematics (Crosnoe, 2004; Sheldon, 2002; Yan & Lin, 2005; Zhao & Akiba, 2009).

Sheldon's (2002) findings indicated that the social network that parents developed influences their involvement in school. The parents in the study who communicated with other parents in the school were more likely to have higher level of parental involvement in schools. Parents networking with schools resulted in students having less behavioral problems and higher levels of mathematical success (Powell, Son, File, & San Juan, 2010). Yan and Lin (2005) determined the importance of schools networking with parents to allow them to gain an understanding of the role that they play in students' academic success by communicating the importance of success and high expectations in

academics. Zhao and Akiba (2009) say, “Parental involvement becomes effective for promoting student learning only when this trusting and respectful relationship between schools and families is established” (p. 426).

Students, parents and teachers in the Hill Community utilized the social networking system to ensure the mathematics achievement of the students. One of the strengths of the community revealed in this study is the extensive social networking systems that exist. The community members utilized the system to communicate information between and among the students, parents and teachers to: (a) inform what mathematics courses are necessary for students to achieve goals, (b) communicate the students’ progress in the mathematics classroom, and (c) obtain information necessary to ensure success of students. Prior studies about social networking system support the findings of this study, revealing how parental involvement with school impacts students’ mathematical achievement and the influences that parent have on the academic success of students.

Constraints. Students, parents, and teachers in the Hill Community also agree that the social networking system is important to help ensure student success by enacting constraints. The constraints identified by the research participants that influence students’ mathematical achievement include: (a) parents’ use different method from teacher, and (b) consequences for students not succeeding. Previous research studies report that constraints impact the success of students in mathematics (Coleman, 1987, 1988; Croll, 2004; Crosnoe, 2004; Goddard, 2003; Lehrer & Shumow, 1997; Sheldon, 2002; Yan & Lin, 2005; Zhao & Akiba, 2009).

Several researchers report the constraint of parents using a different method from teacher when helping with mathematics work (Lehrer & Shumow, 1997; Powell et al., 2010; Walker, 2006). Lehrer and Shumow (1997) reported that teachers and parents use different instructional strategies when helping students in mathematics. Parents typically used traditional method that involved using a procedural approach and would just tell the students what steps to take next when solve the problems, but the procedural approach did not enable the students to develop a clear understanding of the problem situations. However, the methods that the teacher used enabled the students to make sense of the problem and develop a mathematical understanding of the problems.

Numerous researchers also report on the consequences for not succeeding (Coleman, 1987, 1988; Croll, 2004; Goddard, 2003). Coleman's (1987) findings show that the social networks and social norms that exist within the community provided guidelines for students to follow and aided in the education of students. Goddard (2003) reports when children value the norms that promote academic success they have a greater opportunity to succeed. However, when a child's actions do not match the values and beliefs of the group, the child will have sanctions placed on them. Coleman (1990) concludes that if the people within a child's social network feel that schoolwork and learning are critical to success, the expectation to succeed will result in sanctions for those who do not.

Students, parents, and teachers in the Hill Community also agree that the social networking system is important to help ensure student success. The Hill Community members report enacting constraints to ensure the success of the students. These include

helping students if the need arises, and enabling the students to receive the assistance of parents and/or teachers if required. If students are not meeting the expectations for success, the parents implement certain consequences to ensure that the students get back on the pathway to success. Prior constraint studies support the findings of this study.

The students, parents, and teachers in the Hill Community utilize expectations and obligations to ensure student success, utilizing the social network to gain access to information to aid in success, and help ensure student success by enacting norms and constraints to promote mathematics achievement. Previous findings support the findings of this study concerning assistance, social networking system, norms and constraints that all aid in students' success. In examining the aspects of the community that support students' academic success community social capital allows for an understanding of how obligations and expectations enable the members of the community to work together to ensure that the students receive every opportunity available to them. Effective norms are also a valuable tool that enables schools to foster academic success among students by managing their behavior (Kao, 2004). If social norms promote academic tasks, such as studying, completing homework and staying on task in the classroom, the students' opportunities to obtain academic success are enhanced. Additionally, within the social networking system information that people acquire involves them not only in paying attention, but also utilizing the social relations that they have in place (Coleman, 1988). Information channels can be a valuable means for individuals to gain knowledge about particular subject matter; however, it requires the individuals to seek out people within the social network who possess the particular knowledge they are looking to acquire.

Research Question Four

How does the community support teaching and learning? This research question used the Coleman's (1988) framework as the tool to examine how the community to supports teaching and learning within in a high-achieving Lumbee Indian community. The following major themes were identified: historical sense of community, closure, trust, and norms.

Historical sense of community and closure. Students, parents, and teachers in the Hill Community agree that the historical sense of community, and closure (everybody knows everybody) are utilized to support teaching and learning within the community. These components serve an important role among the other forms of social capital and contribute to the social capital of the community. Previous research studies report that the historical sense of community and closure (everybody knows everybody) are utilized to support teaching and learning within the community (Bauch, 2000; Blanchard & Navajo Tribe, 1971; Carbonaro, 1998; Coffman & BeLue, 2009; Coleman, 1988; Dika & Singh, 2002; Howley, Harmon, & Leopold, 1996; Israel et al., 2001; Morgan & Sørensen, 1999; Symeou, 2008).

Various researchers discuss the historical sense of community (Bauch, 2000; Blanchard & Navajo Tribe, 1971; Coffman & BeLue, 2009; Israel et al., 2001). Bauch (2000) examines the aspects of a rural community that foster the educational outcomes of the students within the community. Sense of place is one of the aspects that emerged within the community, which manifests itself in the form of community social capital. Sense of place involves a deep commitment to the community and an appreciation and

desire to nurture the local community (Howley, Harmon, & Leopold, 1996). Israel et al. (2001) say that community social capital "develops from resident's action to improve the local economy, provide human and social services, and express local cohesion and solidarity" (p. 46).

Several researchers report that closure within the community supports teaching and learning (Carbonaro, 1998; Coleman, 1988; Dika & Singh, 2002; Morgan & Sørensen, 1999; Symeou, 2008). Symeou (2008) analyzes the differences between urban and rural parents' development of relationship with teachers. Symeou concludes that the constant communication between the school and families within the community enabled a stronger relationship to develop and fostered the formation of closure. The closure resulted in the rural parents having greater trust in the teachers, which then resulted in a greater partnership between the school, the families linked to the school and the community.

Students, parents, and teachers in the Hill Community communicated a strong historical sense of community where everyone knows everyone. These factors exist within the community and support the teaching and learning of algebra in the middle school. Prior studies about historical sense of community and closure support the findings of my study because the researchers discuss how these components enables a deep commitment to the community to develop and fosters the trust that exist between community members.

Trustworthiness. Students, parents, and teachers in the Hill Community agree that trust is utilized to support teaching and learning within the community. Trust is

critical in the community because it plays a role in the relationships that are developed between the school, the church, and the community. Previous research studies report that trust is utilized to support teaching and learning within the community (Bauch, 2000; Coleman, 1988; Goddard, 2003). Various researchers discuss the supportive role that trustworthiness has on teaching and learning within the community (Bauch, 2000; Coleman, 1988; Goddard, 2003). Coleman (1988) describes trust within the community as community members being available to provide assistance to other members of the community and knowing that community members will fulfill their commitments to each other. Goddard (2003) explains that social trust enables group members to have the assurance that others will act appropriately, and allows the members to freely exchange beneficial information between each other. High levels of trust allow the members to have the assurance that members treat each other kindly and respectfully.

Students, parents and teachers in the Hill Community agree that trust supports teaching and learning within the community. One of the strengths of the Hill Community is that the members exhibit high level of trust between each other, which is demonstrated by the interactions of these members. The trust within the community is supported by the closure and historical sense of community that exists in the community. Prior studies support the research findings of my study about the research participants' trust because the community members have numerous opportunities to interact with each other and they trust that the members of the community will take care of each other.

Norm to value education and norm to uphold morals and values. Students, parents, and teachers in the Hill Community share norms that support teaching and

learning within the community. Norms expressed by the participants about how the community supports teaching and learning included: norm to value education and norm of upholding morals and values. Previous research studies report norms support teaching and learning (Bauch, 2000; Francis & Archer, 2005; Lane & Dorfman, 1997; Okagaki, Helling & Bingham, 2009; Park, 2004).

Several researchers report that their research participants recognize value of education (Francis & Archer, 2005; Hoover-Dempsey et al., 2005; Okagaki, Helling, & Bingham, 2009). Okagaki et al. (2009) report that American Indian students view education based on educational beliefs and their perceptions of their parents' value of education. The students' belief about the value of education was dependent upon how importance it was in helping them obtain their goals. Students felt that being successful in school was critical to their views about themselves as individuals. The students' views of their parents' value of education influenced the students' beliefs about the value of education because the parents emphasized the importance of education and promote academic achievement.

Various researchers also report that their research participants acknowledge the importance of upholding morals and values (Bauch, 2000; Lane & Dorfman, 1997; Park, 2004). Bauch's (2000) study of rural communities examined the connections between school and local church community. The teachers appeared to have a direct impact on the moral development of the students because of the interactions they shared in the church setting.

Students, parents and teachers in the Hill Community agree norms support teaching and learning within the community. One of the strengths of the community in my study is that the members exhibit the norm to value education and uphold morals and values. Prior studies support the research findings of my study about the research participants' norms because of the numerous role models of success that exists within the community, the concerns that community members display about the success of the students, the close relationship that exists between the church and school, and the value placed on the maintaining a close relationship with the church.

Conclusion

The Hill Community shares numerous meanings about the teaching and learning of mathematics. The meanings that the community shares about teaching and learning of mathematics centers around the common vision of ensuring that students receive the necessary support to aid in their academic success. The extensive social networking system that exists within the community allows the utilization of the three forms of social capital to effectively function together to ensure the academic success of the students. The social networking system is effective within the community because of the historical sense of community and closure that is present in the community enables the development of trust because "everybody knows everybody." Therefore, the social networking system within the community aids in the establishment of trust between the parents, teachers, and students. Trust develops more effectively because they have a long history of observing how the community members respond in various situations as a result of the numerous opportunities to interact with each other. The community members

trust that the members will work together to provide the support necessary for students' to be successful.

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APPENDIX A

INTERVIEW PROTOCOLS

Interview Protocol (Teacher)

The study will use a semi-structured interview process to examine the aspects of school and community that support the algebraic achievement of Lumbee Indian middle school students. The school and community are of interest to study because of the success that has been observed among students and community members. I wish to gain an understanding of the aspects of the community and school that contributes to this success. I also wish to gain an understanding of the practices within your classroom that contribute to the success of students in mathematics. Teachers will be audio and videotaped during the interview process.

First, I want to ask about your experiences here in the community.

1. How would you describe this community to a Lumbee Indian friend from another community? How would you describe this community to another ethnic group outside the community?
    a. What are the strengths you see in this community that are special?
    b. Why do you think this community has these strengths?
    c. What is the glue that holds this community together?

2. I have noticed that most of the people in the community also attend the school here.
    a. What were your experiences in school?
    b. How are the schools the same as when you went to school?
    c. How are the schools different here than other county schools?
    d. What effect do you think the schools have on students' success in school?

3. Tell me about the groups you work with in the community.
    a. What community groups do your family members participate in? Tell me about them?
    b. What are some of the things that help the group accomplish its goals?
    c. What is your family members expected to do when he/she participate in this group activity?

Now, I am going to ask you more specific questions about math.

4. How do you see your role in the algebra class?
    a. How do you see your students' roles?

5. In your opinion, why is it important to learn algebra in the eighth grade?
    a. Why is it important for children to learn?

6. What are your expectations concerning your students' participation in math class?
    a. Can you explain [expectation] as to what behavior I would see if I was in [child's name] class?

7. How do you know if your students' understand the math they are working on?

8. When your students have problems understanding the mathematics, what do you do to help?
    a. What resources are available to your students if he/she is having trouble in math?
    b. How do your students go about getting help in math?

9. What types of instructional strategies do you use most often in teaching mathematical concepts to your students? Can you talk some more about them?
    a. Which do you find to be most effective with your students?

10. What do your students do when they give an answer in class?
    a. Do your students' have to explain how he/she obtained an answer? If so, why?
    b. What happens in class if students obtain an answer different from the other answers offered in class?
    c. What happens in class if students work problems out different from others in class?

11. What are the daily routines in your classroom?

Now I want to talk with you about the parents in your school.

12. What types of support do you receive from parents in helping students learn mathematics? Can you talk some more about that?

13. What do parents do if their child receives a poor grade in mathematics?

14. How do parents become involved in the activities that take place at the school?
    a. What do you feel the parental involvement would be like if this was other schools in the county? Can you tell me some more about that?
    b. What opportunities do you have to talk with parents outside of the school setting?

Interview Protocol (Mother/Father)

The study will use a semi-structured interview process to examine the aspects of school and community that support the algebraic achievement of Lumbee Indian middle school students. The school and community are of interest to study because of the success that has been observed among students and community members. I wish to gain an understanding of the aspects of the community and school that contributes to this success. Parents will be audio and videotaped during the interview process.

First, I want to ask about your experiences here in the community.

1. How would you describe this community to a friend from another county?
    a. What are the strengths you see in this community that are special?
    b. Why do you think this community has these strengths?
    c. What is the glue that holds this community together?

2. Who in the community do you trust with your child?

3. I have noticed that most of the people in the community also attend the school here.
    a. What were your experiences in school?
    b. How are the schools the same as when you went to school?
    c. How are the schools different here than other county schools?
    d. What effect do you think the schools have on your child's success in school?
    e. What if [child's name] went to another school? How would that be different for them?

4. What other aspects in your community support the success of your child?

5. Tell me about the groups you work with in the community.
    a. What community groups do both you and [child's name] participate in? Tell me about them?
    b. What are some of the things that help the group accomplish its goals?
    c. What do you expect your child to do when he/she participate in this group activity?

6. What ideas do you have about the support parents can give their child that supports the child's math achievement?

7. Where do you get your information about the courses your child should take?

Now, I am going to ask you more specific questions about math and your child as a student of math.

8. In your opinion, what do you think mathematics is?
    a. Why is it important for your child to learn algebra?

9. How do you expect your child to participate in school?

10. What are your expectations concerning your child's participation in math class?
    a. Can you explain [expectation] as to what behavior I would see if I was in [child's name] class?
    b. Repeat "a" for each expectation

11. When your child has a problem understanding the algebra, what do you do to help?
    a. What resources are available to your child if he/she is having trouble in math?
    b. How does your child go about getting help in math?

12. Do you have the opportunity to help your child with their algebra?Can you talk with me some more about that?
    a. Have you ever helped your child with math homework? Can you tell me more about that?

13. How do you know if your child understands the math they are doing?

14. What would you do if your child brought a poor grade home in math?

Now I want to talk with you about the teachers in your child's school.

15. To what extent does having a math teacher from the community help your child learn math? Can you explain this to me some more?

16. What do you see teachers' doing that helps to promote your child's understanding of math?

Thank you for this time. Your information will help me tell the story of this community.

Interview Protocol (Student)

The study will use a semi-structured interview process to examine the aspects of school and community that support the algebraic achievement of Lumbee Indian middle school students. Students will be audio and videotaped during the interview process. Students will also be asked to solve mathematical problems to determine algebraic reasoning. Students will be asked to explain their thought process while solving problems.

First I want to ask about your experiences here in the community.

1. How would you describe this community to a friend from another community?
    a. What are the strengths you see in this community that are special?
    b. Why do you think this community has these strengths?
    c. What is the glue that holds this community together?

2. What is school like for you?
    a. What effect do you think the school has on your success in school?
    b. What if you went to another school? How would that be different for you?

3. Tell me about the activities you participate in within this community.
    a. What community groups do both you and your parents' participate in? Tell me about them?
    b. What are some of the things that help the group accomplish its goals?
    c. What do you your parents expect you to do when you participate in this group activity?

Now I am going to ask you more specific questions about algebra and how you are as a student of math.

4. In your opinion, what do you think algebra is?
    a. Why is it important for you to learn algebra?

5. What things do your parents do that help you become a better student in math?
    a. How does your teacher help you become a better student?

6. What do you when you give an answer in class?
    a. Do you have to explain how you obtained an answer? If so, why?
    b. What happens in class if you obtain an answer different from the other answers offered in class?
    c. What happens in class if you work problems out different from others in class?

7. What do you do if you have a problem understanding an idea in algebra?
    a. What resources are available to you if you are having trouble in math?
    b. How do you go about getting help in math?

8. What do you do if others need additional help to understand what you did to solve a problem?

9. Who would the other kids in your class say were the three best algebra students? Why?

10. Do you have the opportunity to receive help from your parents with yourmath?Can you tell me more about that?
    a. Have your parents ever helped you with your math homework? Can you tell me more about that?

11. What would your parents do if you brought a poor grade home in math?

12. What does your algebra teacher do to help you understand algebra?

Now I am going to ask you to solve some mathematics problems for me.

APPENDIX B

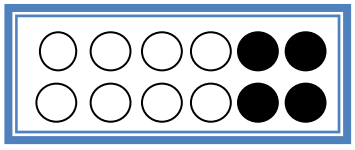
PROPORTIONS TEST

1. Sally bought 3 pieces of gum for 12 cents and Anna bought 5 pieces of gum for 20 cents. Who bought the cheaper gum or were they equal?
   Show all of your work.

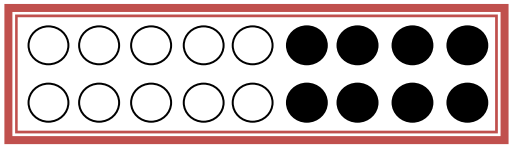
2. To make coffee, David needs exactly 8 cups of water to make 14 small cups of coffee. How many small cups of coffee can he make with 12 cups of water?
   Show all of your work.

3. There are 7 girls with 3 pizzas and 3 boys with 1 pizza. Who gets more pizza, the girls or boys? **Show all of your work.**

4. There are two egg cartons. The shaded circles represent brown eggs and the unshaded circles represent white eggs. The blue carton contains 8 white eggs and 4 brown eggs. The red carton contains 10 white eggs and 8 brown eggs. Which carton contains more brown eggs relative to white eggs? Explain your thinking.



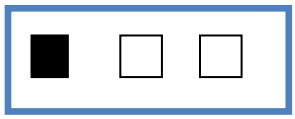
Blue Carton



Red Carton

You and your friend are going to make orange juice for a party. You will be given three different situations. For each situation, you will be present with the contents of two trays. Each tray contains various amounts of orange juice and water. The shaded box represents the orange juice and the unshaded box represents the water. **The goal for each is to determine which drink will have the stronger orange taste or if the two drinks will taste the same.** Each mixture will be expressed as an ordered pair (e.g. (1, 3)) with the first term corresponding to the number of glasses of orange juice and the second term to the number of glasses of water. Show your calculations and explain your thinking.

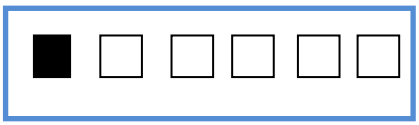
5. Tray A



(1,2)

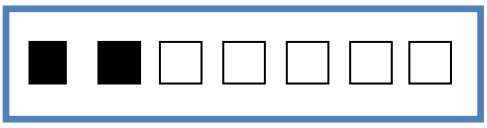
-Vs-

Tray B



(1,5)

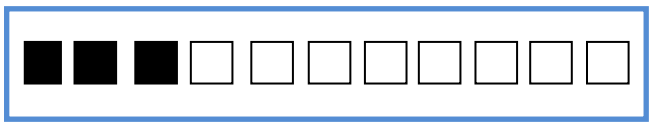
6. Tray A



(2,5)

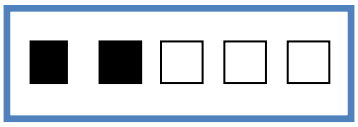
-Vs-

Tray B



(3,8)

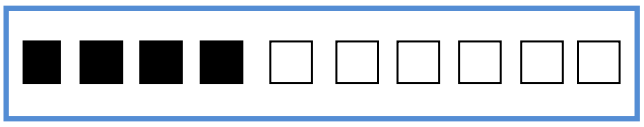
7. Tray A



(2,3)

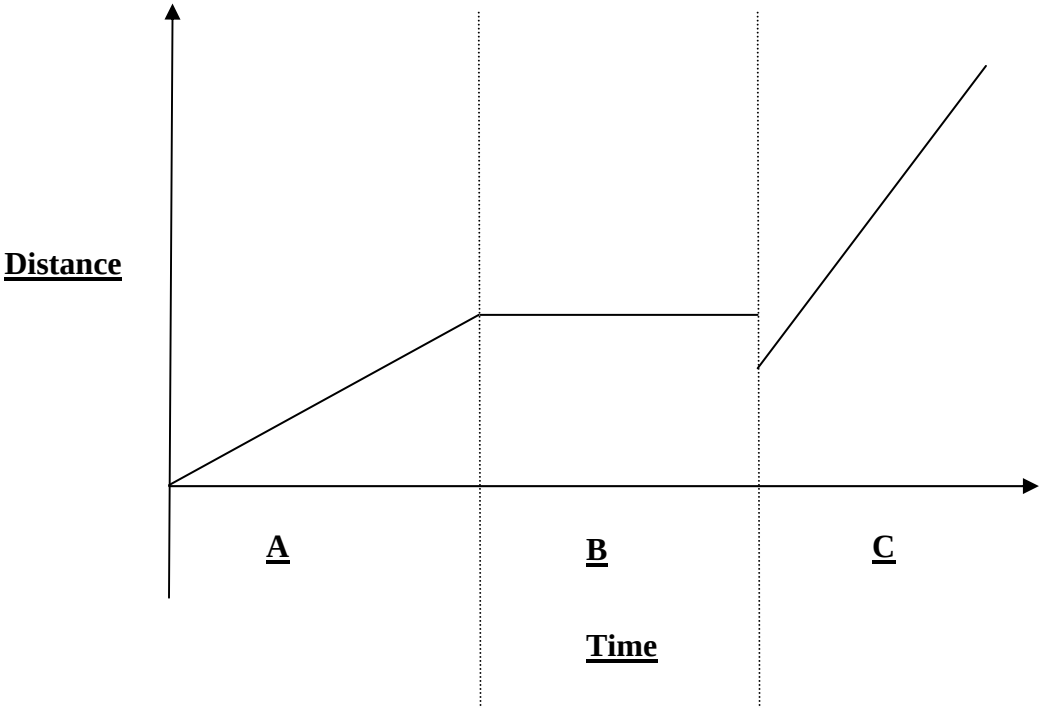
-Vs-

Tray B



(4,6)

8. Sarah took at bike ride this weekend. Below is a graph of her journey. The variable labeled Distance represents the distance Sarah is away from her starting point and the variable Time represents the amount of time that has passed since she began her journey. The graph is divided into three intervals: A, B and C. What information can you deduce from the graph about how fast she was traveling in each interval?



9. Two trees were measured five years ago. Tree A was 8 feet high and tree B was 10 feet high. Today, tree A is 14 feet high and three B is 16 feet high. Over the last five years, which tree's height increased the most relative to its initial height? Show any calculations that lead you to your answer.

10. You are shown a flag that measures 3 feet in length and 2 feet in height. It uses 6 square feet of cloth. If you wanted to make it 3 feet longer while maintaining the same ratio of length to height, how much cloth would you need? Show your work.

	Length	**Height**	**Area**
Flag 1	3 ft	2 ft	6 ft^2
Flag 2	6 ft		