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AFRICAN AMERICAN HIGH SCHOOL STUDENTS' ATTITUDES TOWARD MATHEMATICS AND PERCEPTIONS OF EXTANT CULTURALLY RELEVANT PEDAGOGY AND ETHNOMATHEMATICS

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AFRICAN AMERICAN HIGH SCHOOL STUDENTS' ATTITUDES TOWARD
MATHEMATICS AND PERCEPTIONS OF EXTANT CULTURALLY RELEVANT
PEDAGOGY AND ETHNOMATHEMATICS

A Dissertation
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Education
in
Educational Leadership

by
Brice Le Anthony Scott

June 2018

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ABSTRACT

African American students' severe underachievement in mathematics in comparison to their peers has been framed as an achievement gap that continues to widen despite the efforts of many education scholars and leaders. Throughout history in the United States, mathematics education has been designed, developed, and delivered within a Eurocentric philosophy. Consequently, African American students have been at a systemic disadvantage in terms of perceiving the cultural relevance of mathematics; which has served as a detriment to their academic success. By merging ethnomathematics and culturally relevant pedagogy (CRP) into a theoretical framework, this study investigates these issues and proposes a shift in mathematics education toward a more culturally aware approach. In this study, it is argued that implementing a multicultural education approach such as ethnomathematics into the mathematics curriculum coupled with employing culturally relevant pedagogical practices will increase relevance in the mathematics education for African American students. The purpose of this study was to gain African American high school students' perception of mathematics, as well as their cultural awareness and its relation to mathematics education.

To gain students' perceptions about mathematics education from a cultural respect, 375 students in grades 9-12 completed three online surveys which were (1) a four-item demographic questionnaire (age, gender, grade, ethnicity), (2) the 40-item Attitude Towards Mathematics Inventory (ATMI), and

(3) the 12-item Students Perception about Cultural Awareness (SPCA) survey. This study incorporated a quantitative, correlational research design. To address research questions one and two, Pearson correlations were conducted to examine the associations between the variables of interest which were (1) Value, (2) Enjoyment, (3) Sense of Security, (4) Motivation, and (5) Cultural Awareness. Variables (1), (2), (3), (4) were derived from the ATMI survey through factor analysis while variable (5) was constructed from the SPCA survey. To address research question three, a MANOVA was conducted to assess for differences in attitudes toward mathematics and perceptions of cultural awareness by ethnicity. For research questions one and two, it was found that there was a statistically significant correlation between the variables of interest. For research question three, it was found that there was not a statistically significant difference in the variables of interest by ethnicity.

In further analysis of the data, it was found that many African American students have a substandard attitude of value, enjoyment, sense of security, and motivation toward mathematics. Nonetheless, these students had a high sense of cultural awareness and cultural pride. Generally, the students felt that the incorporation of culture into mathematics would assist in raising their achievement to some degree. This study highlights recommendations to educational leaders to learn about the culture of their students, allow that data to inform policy decisions, and lead a shift to the approach of mathematics education toward the theories of ethnomathematics and CRP.

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DEDICATION

I would like to sincerely dedicate this document to my two beautiful daughters, Myra and Aiyana, who have sacrificed a great deal of time to allow their Dad to complete this degree. I love both of you dearly and I thank you for providing me with the motivation to keep going. I also want to send a great deal of love and gratitude to all of my family members who have exercised patience as I embarked upon this journey. Thank you for the continued support and I hope that I have made you all proud.

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CHAPTER ONE

INTRODUCTION

Throughout history in the United States, mathematics education has lacked cultural relevance for African American high school students which has contributed to alarming underachievement. This study is an exploration into the relevancy and effectiveness of the current mathematics curriculum and pedagogical practices for this specific student population. A main objective of this research is to ultimately examine the potential benefits of a curriculum that is designed upon the theories of ethnomathematics and culturally relevant pedagogy (CRP). In this study, the perspectives of African American high school students on a culturally-based curriculum is gathered, analyzed, and discussed. The overall intent of this study is to obtain authentic information on alternative approaches to mathematics education that is improved in relevancy for African American high school students; which will assist educators in addressing a long-standing issue in academic education.

Background

Within a climate of evolving diversity in our current society, it is critical that high school students are being taught mathematics through an effective, enriching, and relevant curriculum. Moreover, it has become imperative that educators are aware of a changing society and incorporate this ideal into their

approach to teaching and delivering school curriculum. It can be observed that many educators are attempting to academically connect with their students in an effort to increase the efficiency of their teaching and legitimately educate students. In this effort lies the challenge of developing a connection, academic or otherwise, between teacher, students, and curriculum which has become unattainable in many circumstances. The traditional teaching practices, mandated curriculum, and rigid state standards have limited the evolution of education and its correlation with culturally diverse student populations.

A goal of mathematics educators and the purpose to education is for all students to succeed regardless of individual student demographics and characteristics. However, a growing achievement gap in mathematics between African American high school students and their peers has clearly existed for decades (Riegle-Crumb & Grodsky, 2010). It shall be natural for an educator to thoroughly investigate the reasoning for such a gap in academics amongst our youth, and progress toward addressing the glaring issue. The reasoning for this unfortunate phenomenon can be revealed by exploring the history of mathematics education and curriculum. According to Anderson (1990), the dominant mathematics curriculum in use today has been developed upon Eurocentric ideals and does not engage or promote relevance for African American students. Anderson (1990) contends that true mathematical knowledge can only flourish amongst African American students if educators break away

from the Eurocentric perspective and the ineffective pedagogical and curricular traditions that exist today.

Alternative approaches to education have been introduced by D'Ambrosio (1998) and Ladson-Billings (1987) which are ethnomathematics and culturally relevant pedagogy (CRP). Ethnomathematics and CRP advocate for a practice of the ethics of diversity in education. D'Ambrosio and D'Ambrosio (2013) contend that the only hope we have for achieving a just social equilibrium in mathematics is to ground educational practices in the ethics of diversity, if education is to contribute to achieving a new social order. Ladson-Billings (1995) suggests that CRP provides a way for African American students to maintain their cultural integrity while succeeding academically. In essence, these alternative approaches encourage education to allow students to achieve academic success and maintain cultural competence simultaneously.

Problem Statement

The duty of progressive educators is not to try to fix or prop up the current system of education; it is to lay the seeds for a more egalitarian educational system based upon the assumption that any person can learn anything (Anderson, 1990). Nonetheless, existing research and statistics have shown and proved that African American high school students in the United States have historically achieved much lower in mathematics than their peers. Moreover, this achievement gap between African American students and their peers is

increasing each year (Stinson, 2006). Although education professionals are aware of this achievement gap, a lack of understanding of the reasons for this complex issue remains. According to Stinson (2006), “there has [also] been a general lack of examining the specific mathematics schooling experiences of African American students and other minority students” (Stinson, 2006, p. 478). Specifically, the implementation of the traditional mathematics curriculum and instructional strategies has historically been proved as a disadvantage for African American students. The absence of culture and relevancy for African American students is apparent and statistics of achievement clearly portray this unfortunate deficit.

Rouland et. al (2017) contend that “culture shapes students’ learning and problem-solving in several ways—through culture-specific knowledge and skills, values that mold motivation and beliefs, organization of information, and use of contextual cues to guide behavior” (p.186). The students who are unable to feel culturally-connected to their education will eventually fall behind in each of these categories. It has been well-documented that African American students often have the most difficult experience relating to or recognizing the cultural aspects of their education. “Therefore, it is not surprising that a cultural discontinuity exists between home and school that has implications for the school experiences and underperformance of African American [students]” (Rouland et. al, 2017, p. 187).

Studies have shown that African American students perform significantly better in school when they are able to learn in a context that reflects their culture rather than in the context associated with traditional classrooms. Additionally, studies have shown that when students perceive discontinuity between home and school cultures, they have lower motivation, lower confidence, and poorer academic outcomes (Rouland et. al, 2017). This lends itself to the core problem of the current high school mathematics curriculum which is generally Eurocentric and remains as non-relatable and academically ineffective for many African American students.

Purpose Statement

The purpose of this study is to investigate African American high school students' perspectives of their current mathematics education from a cultural respect. This study sheds light on the ineffectiveness of current high school mathematics education which is comprised of instructional strategies and curricular components that are ultimately ineffective due to culture-free approaches and Eurocentric traditions. This current and traditional approach to mathematics education has had adverse effects on the achievement of students who are unable to relate to a culture-free or Eurocentric educational experience. In this study, this matter is specifically addressed by obtaining African American students' perspectives on mathematics and multicultural education. Given the clear underachievement of African American students, this research is pertinent

to better understanding the elements that a mathematics curriculum should contain that will be relative, engaging, and greatly influential in closing the achievement gap between African American high school students and their peers.

Curricular and pedagogical strategies that are currently implemented in mathematics classrooms have traditionally been devised by educational leaders and professionals; however, this study highlights the value of gaining student perspectives and utilizing this knowledge in policy decisions. Moreover, this study investigates how African American high school students feel about culture and cultural awareness as components to their educational experience. In essence, the purpose of this study was to allow students to serve as advocates for their own mathematics education. A main goal of education professionals was to provide the most effective academic environment for students to learn. To assist in obtaining this goal, it was beneficial to gain authentic information about how students feel as they are learning in their current environment. This research delved into the ways mathematics was taught as viewed from the perspective of the students. The findings will help education professionals modify traditions in a way that is more relevant, understandable, and effective for African American high school students.

Research Questions

The research questions for this study were developed to assist in gaining a full understanding of the perspectives that African American high school students have toward mathematics and the correlation to their cultural awareness.

- Research Question 1: Is there a statistically significant association between the subscales of students' attitudes toward mathematics (sense of security, value, motivation, and enjoyment)?
- Research Question 2: Is there a statistically significant association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness?
- Research Question 3: Are there statistically significant differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity?

Significance of the Study

The significance of this research study includes gaining authentic information on African American students' attitudes toward mathematics and current mathematics education as well as understanding student perceptions of culturally-based education. In practice, the data collected in this study could lead to an increase in social and cultural awareness by mathematics teacher and a shift in mathematics education toward relevancy for diverse student populations.

Assumptions

In this study, it is assumed that students will give truthful answers on the surveys. It is also assumed that the demographics data that is provided by the school district and school site are accurate and updated. Additionally, this study is operated under the assumption that the mathematics curriculum and pedagogy that teachers at the school site are implementing are traditional.

Delimitations

This study does not consider any data about the mathematics teachers at the school site. Data in regard to the current or previous mathematics teachers of the students is not collected. Consequently, individual teacher effect on students is not considered in the analysis. Students provided perspectives on their mathematics education in a general sense. This study was focused upon gaining students' perspectives on their mathematics education and it is acknowledged that the experiences of the students will vary.

Limitations

A limitation in this study is the generalizability of the results and findings for all African American students in the United States. It is acknowledged that the research may only be applicable for schools and student populations in a certain region of the country similar to where the study was conducted. It is also

acknowledged that there are limits on the value of the data that is collected due to the limited number of participants.

Definitions of Key Terms

- Achievement Gap: The difference in academic performance between subgroups when one group outperforms another group (Kotok, 2017).
- Culture: The values, traditions, and beliefs that influence the behavior of social groups (Parsons, 2003).
- Eurocentric: The view that mathematics is primarily white, European, and male (Rowlands & Carson, 2002).

Summary

This research study attempted to address solutions to improving the mathematics achievement of African American students. This study sheds light on an alternative approach and mindset to mathematics known as ethnomathematics which focuses on the importance of the implementation of historical, social, and cultural components into the mathematics curriculum. It is proposed that students' culture is reflected in the curriculum which will increase relevancy as students are exposed to mathematics that provides reflection of their culture and individual experiences. Moreover, the theory of culturally relevant pedagogy (CRP) is insisted as an approach to teaching that is effective in improving mathematics achievement, confidence, and motivation for African

American students as well as developing social and cultural consciousness. Weissglass (2002) asserts that “the historical contexts and the sociocultural structures in which mathematics and mathematics teaching and learning are embedded have a significant effect on students' mathematics learning and performance, especially on those students who have been historically marginalized” (p. 38). In the next chapter, a review of the literature provides an elaborate discussion on multicultural education, ethnomathematics, and culturally relevant pedagogy as it relates to education for diverse student populations.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The literature review is divided into three sections that address the historical, cultural, and social approach to teaching mathematics to an African American student population. The first section involves a brief review of the current mathematics education paradigm in a sociocultural context specific to African American culture and student achievement. The second section discusses and analyzes the theory of ethnomathematics and the evolution of its influence in society and education. The third section delves into the development of culturally relevant pedagogy (CRP), analyzes the components of the theory, and investigates instances in which this theoretical practice has been effective in mathematics education for African American students. The literature review concludes with analyzing shared elements of ethnomathematics and culturally relevant pedagogy into theory for improving the effectiveness of mathematics education for African American students.

The articles referenced in the literature review were identified by searching databases such as Google Scholar and the extended databases of EBSCOhost which include Education Full Text, Educational Resources Information Center (ERIC), Primary Search, PsycARTICLES, PsycINFO, Social Science Full Text, and Teacher Reference Center. Moreover, articles that were cited and included

in the references section of selected articles were obtained and included in the literature review.

Separate searches of the EBSCOhost database using the descriptors “ethnomathematics” and “ethnomathematics in the classroom” resulted in 495 and 89 scholarly articles, respectively. Additionally, a search of the EBSCOhost database using the descriptors “culturally relevant pedagogy,” “culturally relevant teaching,” “African American student achievement,” “African American mathematics achievement,” and “high school math curriculum” resulted in 1,904, 4,391, 12,311, 2,475, and 4,262, respectively. Furthermore, searches on Google Scholar using each of the aforementioned descriptors resulted in large numbers of articles that were condensed by reading the article titles to determine relevancy to topics that are covered in the literature review.

Mathematics Education through a Sociocultural Lens

In this section, mathematics education for African American students is explored through a sociocultural lens. The literature reviewed in this section provides a foundation for the theories of ethnomathematics and culturally relevant pedagogy which are discussed later in this literature review. This section serves as an introduction to mathematics education for African American students and sheds light on the sociocultural challenges that exists in their educational journey. Current research has employed sociocultural and historical approaches to help in the understanding of how African American students experience mathematics and how this experience affects their achievement.

According to Clark, Badertscher, and Napp (2013), this work has supported a phenomenon in which mathematics classrooms have become settings where power struggles related to students' identities occur; that is, struggles that often involve students' affiliations with racial, ethnic, and gender categories. An ideal that is guiding current research that seeks to better understand the mathematics schooling experience is the acknowledgment that the learning and teaching of mathematics is not culture-free (Clark et. al, 2013). Stigler and Hiebert (1999) asserted that students who have different racial, ethnic, economic, language, and geographical experiences will experience mathematics differently than students positioned in other communities; furthermore, these differential experiences contribute to differences in mathematics performance, achievement, and competence.

Clark et. al (2013) recognized the experimental differences of students and assert that these differences contribute to the phenomenon of the underperformance and lack of participation by African American students in the mathematics classroom. The concepts of teacher knowledge, mathematics instructional practice, and students' mathematics achievement should be viewed through a sociocultural lens to help teachers gain knowledge of students' lived experiences and histories; moreover, teachers sharing their experiences and identities in the classroom will be valuable to educating African American students (Clark et. al, 2013). To investigate these assertions, Clark et. al (2013) employed a study in which they observed and interviewed two successful and

well-respected African American high school mathematics teachers over the course of one year to explore their practices and perspectives as they supported their African American students' mathematics identity formation and social development. Each teacher was observed in their respective classrooms approximately 25 times and participated in 10 semi-structured interviews that included questions that were based upon the two overall research questions: (1) What perspectives do these teachers hold of their students' mathematics identity and their role in its development? and (2) What practices do these teachers engage in their efforts to socialize their students toward seeing themselves as *doers* of mathematics? (Clark et al., 2013).

A guiding perspective of this study by Clark et. al (2013) is that the classroom actions and practices of participating teachers are not only efforts to impact their students' mathematical understanding and proficiency but also efforts to positively influence African American students' perceptions of themselves as capable, competent doers of mathematics (Cobb et al., 2009). Clark et. al (2013) found that both teachers made use of their capacity to serve as models and motivators for students' current and future success in mathematics. Furthermore, analysis suggests that both teachers held perspectives and engage in practices that tacitly or explicitly aim to cultivate in their students positive, healthy mathematics identities in a sociocultural manner (Clark et. al, 2013). If equitable mathematics instruction is a goal for educators, it is strongly recommended "that teacher identity, including those dimensions

associated with race, class, and gender, serves as an instructional and motivational resource as teachers work to create productive and meaningful learning environments for their students” (Clark et al., 2013, p.33). The findings and recommendations from the study by Clark et al. (2013) support the concepts of ethnomathematics and culturally relevant pedagogy which are discussed further in the next sections.

Ethnomathematics

Background

In recent years, the standards for the mathematics curriculum and mathematics education in general have evolved in various ways; ranging from rigor, sequencing, and the addition of new concepts. In recent years, concerns about equity in mathematics education has been on the rise in many countries across the world (Presmeg, 1998). Mathematics had generally been considered objective, culture-free, and value-free. This view among many educators contributed to the belief that there was no need to take into consideration the growing diversity of student populations (Presmeg, 1998). According to Presmeg (1998), teachers need to become aware of the impact of race and ethnicity on the lives of minority students. This awareness is indispensable if they are to cope with cultural diversity in the classroom.

Ladson-Billings (1995d) asserts that many students are receiving underdeveloped education due to a socially and culturally insensitive

mathematics curriculum. “There is a growing awareness amongst mathematics educators that ‘the American educational system is differentially effective for students depending on their social class, race, ethnicity, language background, gender, and other demographic characteristics” (Secada, 1992, p. 630). The education system is not only incomplete in the aspects of rigor, sequencing, and concepts; it also lacks relevance and fails to reflect the social context or culture of the students which negatively affects achievement (Ladson-Billings, 1995d).

Definition of Ethnomathematics

To address the absence of social class and race in the mathematics curriculum, D’Ambrosio (1994) introduced the concept of ethnomathematics as an approach to teaching mathematics by researching societal history, philosophies, and cultures. “Ethno refers to sociocultural groups and mathematics to activities such as ciphering, measuring, classifying, inferring, ordering, and modeling” (D’Ambrosio, 1985, p. 46). D’Ambrosio (1999) defines ethnomathematics as “a program in history and epistemology with an intrinsic pedagogical action that responds to a broader conception of mathematics, while considering the cultural differences that have determined the cultural evolution of human mankind and the political dimensions of mathematics” (p. 133). In this review of the literature ethnomathematics will be defined in greater detail within a range of different context to assist in understanding and clarity.

Ethnomathematics Development in Society and Education

In this section, the historical development of ethnomathematics in society and the eventual transition into education is discussed. Historical context is critical to understanding ethnomathematics; D'Ambrosio (1999) cites history for his position to critically reject the current, transitioning mathematics curriculum in favor of ethnomathematics because the former is believed to be oppressive in the sense that it maintains the dominant culture and power relations; consequently, it should be seen as separate from ethnomathematics (Rowlands & Carsons, 2002). Rowlands and Carsons (2002) describe the oppressive nature of mathematics as *Eurocentrism* which is the view that mathematics is primarily white, European, and male. Throughout history, many of the *elites* or the social leaders in our society have directly or indirectly subscribed to the view of Eurocentrism and it has perpetuated itself into our schools. Rowlands and Carsons (2002) explain D'Ambrosio's brief historical overview in which he draws upon the experience in which the Greeks made a distinction of the *type* of mathematics that would be taught to citizens of their society. It was maintained that what was deemed as scholarly mathematics would be ideal for non-working class citizens in contrast to practical mathematics for the manual laborer or working-class citizen (Rowlands & Carsons, 2002). D'Ambrosio asserts that mathematics was taught selectively to maintain the economic and social structures and allow the elites or dominant culture to assume management of the productive sector (Rowlands & Carsons, 2002). In the current education system,

a set of common mathematic standards and curriculum have been devised for each state and policies put in place to ensure that this curriculum is implemented at each grade level. Therefore, it may be irresponsible or incomplete to express any deliberate distinction of the level of mathematics that is taught to students in classrooms today; however, it is beneficial to consider the current distinction of two social categories: dominant and non-dominant – and the effects it may have on the delivery and development of the mathematics curriculum.

D'Ambrosio makes a sharp distinction between academic (or elite) mathematics and ethnomathematics and he expresses this distinction in the sense of the elite class versus the working class (Rowlands & Carsons, 2002). In our current society, it is apparent that each student that enters their respective mathematics classroom is not considered of the dominant culture, but these students deserve a fair and appropriate education, yet the distinction and competition is maintained. Despite this divide, we can implement and emphasize the aspect of ethnomathematics that seems to be on the doing of mathematics, out of their everyday lives, rather than the learning or teaching of mathematics as a formal academic discipline (Rowlands & Carsons, 2002). In the educational context ethnomathematics generally favors a critical mathematics education that enables the students to reflect upon the reality they live in and empowers them to develop and use mathematics in an emancipatory way (Gerdes, 1994). It is known that each student lives in a different reality; has different life experiences, life perspectives, and viewpoints of the world they live in. Consequently, investing

in efforts to embrace and incorporate the diversity of students' life experiences in mathematics is beneficial to improving cultural relevance; which assists in effectively educating each student.

The theory of ethnomathematics draws attention to the fact that mathematics with its techniques and truths, is a cultural product. Every culture – and even every subculture develops its own particular mathematics (Gerdes, 1994). A culture shall not take the perspective of rejecting the evolution of mathematics; but rather, align their respective cultures and develop learning. Cimen (2014) explains the phenomenon from a historically-anthropological approach:

Throughout history, all cultures from all over the world shared the same concerns to deal with the same problems they are faced with in their practices. Their ways or interpretations to express and practice these problems can be different. Their levels of depth on exposition of these problems can be relative based on the appearance of these problems in the environment or sociality they were situated. However, this does not mean that these problems or realities themselves were different. In other words, different cultures developed similar solutions to similar problems, just in different representations (p. 526).

Although Cimen (2014) is referring to general societal *problems*, the basis of the explanation directly relates to the experiences of students in a mathematics classroom. Each student analyzes, understands, and experiences

the exact same mathematics *problem* in a vastly different manner than the student sitting beside them due to their unique cultural, social status, and environmental influence.

It is imperative that ethnomathematics is based upon diversity and empowering students to embrace their cultural and historical differences as opposed to creating *divide* or disparaging the heritage of the perceived “dominant” culture or any other culture. The intention of ethnomathematicians (those who subscribe to and teach utilizing an ethnomathematics approach) is to indulge in honest recognition of the uniqueness of cultural systems and understand that this will help educators better negotiate the cultural pluralism necessitated by the current educational and social scene and bringing together disparate beliefs (Rowlands & Carson, 2002). In result, the mathematics curriculum is supplemented with historical, cultural, and social facets that will benefit students in their lives outside of the academic classroom.

Ethnomathematics in Practice

The previous sections of the literature review provide background of the development of ethnomathematics in to modern society and the field of education. In this section, the practical implementation of ethnomathematics into the modern mathematics classroom is discussed. As mentioned earlier, ethnomathematics embraces *diversity* and the ideals of uniqueness of people. This notion remains true for practical implementation in a mathematics classroom.

Rosa and Orey (2016) provide broad insight on the value of cultural interactions in the academic classroom and elaborate upon the benefits of ethnomathematics; this research develops a foundation for the instructional and curricular components of ethnomathematics that are discussed later in this section. Rosa and Orey (2016) asserted that it is necessary to emphasize how one's own culture and society considerably affect the way in which individuals understand mathematical ideas, procedures, and practices. Every cultural group has developed unique and distinct ways of including mathematical knowledge that often comes to be incorporated into the cultural systems as diverse people interact, immigrate, and create new contexts (Rosa & Orey, 2016). As educators, it is important to embrace these interactions; D'Ambrosio (1985) proposes that ethnomathematics is the coalescence of culture and diversity benefits and enlightens the learning environment.

Mathematical thinking is influenced by a diversity of factors such as language, religion, mores, economics, political, and social activities (Rosa & Orey, 2016). As we know, each student is a product of a different environment; therefore, each of these elements will vary by the student. The environment, the experiences, and the reality of individual students influences their way of thinking, processing, and logical reasoning. "These tools allow for the identification and integration of specific mathematical ideas, notions, procedures, and practices by schematizing, formulating, and visualizing a problem in different ways" (Rosa & Orey, 2016, p. 4). Inclusion of a diversity of ideas brought by

people from distinct cultural backgrounds and contexts can give confidence and dignity to students, while allowing them to perceive a variety of perspectives in order to provide them with a base from which they are able to learn academic mathematics (Rosa & Orey, 2016).

In the attempt “to create and integrate materials related to different cultures and draw on students' experiences in an instructional mathematics curriculum, it is possible to apply ethnomathematical strategies in teaching and learning mathematics” (Rosa & Orey, 2016, p. 7). According to Rosa and Orey (2016), these strategies include, but are not limited to enlightening students to the historical development of mathematics in different cultures. For example, the utilization of mathematics by, an African American biologist or an Asian-American athlete.

“The challenge that many communities face today is determining how to shape a new open, modern, international culture, which integrates, and respects new and alternative ideas, and where diverse ideas coexist” (Rosa & Orey, 2016, p. 7). This challenge is perpetuated in the educational system and is harmful to students' ability to learn mathematics. Rosa and Orey (2016) explain efforts by individuals within the education system that have potential to combat the challenge:

The acknowledgment of contributions that individuals from diverse cultural groups make to mathematical understanding, the recognition and identification of diverse mathematical practices in varied contexts, and the

link between academic mathematics and student experiences should all become central ingredients to a complete study of mathematics. This is one of the most important objectives of an ethnomathematics perspective in mathematics curriculum development (p. 7).

This perspective is crucial in giving minority students a sense of cultural ownership of mathematics, rather than a mere gesture toward inclusiveness (Eglash, Bennett, O'Donnell, Jennings, Cintorino, 2006).

Similar to Rosa and Orey (2016), Borba (1990) acknowledges the notion of culture as a valuable asset to mathematics education. As a result of his research, Borba (1990) proposed specific instructional and curricular elements of ethnomathematics that reflect effective multicultural education. Furthermore, Borba (1990) provides additional context for a concrete study on ethnomathematics in the classroom conducted by Moses-Snipes (2005) that is critically analyzed later in the literature review.

If we contend that different people develop different *kinds* of mathematics, then it is not possible to think about education as a uniform process to be developed in the same way for different groups (Borba, 1990). Alternatively, Borba (1990) asserts that mathematics education should establish ethnomathematics of a given group as a starting point and the goal would be for the student to develop a multicultural approach to mathematics. A key component to this process is *development*; students are encouraged to embrace their individuality as well as absorb the essence of other cultures. Students

should actively participate in the design of their pedagogical program. To this end students and teachers should engage in a dialogical relationship that fosters critical and social consciousness (Borba, 1990). Ethnomathematics encourages relationships, open dialogue, and opportunities for students and teacher to learn from one another in a dialectal manner.

A dialogue in which a teacher *teaches*, or speaks through her/his ethnomathematics and students speak with theirs is not neutral; instead, such a dialogue can allow students to strengthen their sociocultural roots since their knowledge is recognized as valuable in the educational process (Borba, 1990). This practice portrays an approach of intercultural collaboration for students to deeply indulge in the mathematics and approach it as their *own* while learning and embracing the ethnomathematics that is presented by the teacher. In the classroom dialogue, the teacher can learn from the ethnomathematics 'spoken' by the students just as the students are learning from the academic ethnomathematics of the teacher (Borba, 1990). This dialogue is not to deviate from the mathematics curriculum or neglect academic content; but rather to enrich the exchange of knowledge through ethnomathematics. Borba (1990) notes that the ethnomathematics of a cultural group is part of the group's life; the mathematics is generated by the culture in an 'umbilical' way.

As discussed, a culture-based curriculum is imperative to effective implementation of ethnomathematics in the classroom (Borba, 1990; Rosa & Orey, 2016). Pamela R. Moses-Snipes (2005) acknowledged the struggles that

African American students face in finding success in the mathematics classroom; consequently, she employed a study that implemented ethnomathematics into classroom activities in an effort to enhance African American students' interest in mathematics and improve their achievement in mathematics. According to Moses-Snipes (2005), culture can be implemented by discussing various groups of peoples as they relate to social studies. Moses-Snipes (2005) proposed that the primary purpose of her study was to investigate to what extent studying topics in a cultural context, which is a key component of ethnomathematics, affected African American students' achievement.

Moses-Snipes (2005) conducted the study at a public elementary school with a student population that was composed of 47% African American, 37% Caucasian, 7% Hispanic, 5% Multiracial, 3% Asian, and 1% American Indian. She chose to include fifth grade students in this study due to the results on the 7th National Assessment of Educational Progress (NAEP) which concluded that by the fourth grade, 63% of African American students believe mathematics is mostly memorizing facts (Strutchens & Silver, 2000). The study included two fifth grade classes of this public elementary school; one class being randomly assigned as the Mathematics With Culture (MWC) group which included eight African American students, and the other being the Mathematics Without Culture (MWOC) group which included ten African American students (Moses-Snipes, 2005).

Moses-Snipes (2005) served as the researcher and the teacher in this study; she taught a mathematics lesson that lasted approximately 120 minutes to each group of students. Both groups of students completed an entire mathematics (geometry) unit; the MWC group completed the unit with some facet of African culture integrated into each activity while the MWOC group completed the same mathematics unit without the African culture component (Moses-Snipes, 2005). Moses-Snipes (2005) devised a pre-assessment (assessment given prior to the mathematics lessons) and a post-assessment (assessment given subsequent to the mathematics lessons) to analyze the effects on the learning and achieving of the African American students of each group. Moses-Snipes (2005) found that the integration of cultural relevant curriculum contributed to the fact that students' achievement scores increased as they learned about African culture in supplement to their mathematics education. Based upon the achievement results of African American students in this study, Moses-Snipes (2005) concluded that:

The implementation of culture in the mathematics classroom should be researched from the first year students enter school in order to obtain a true sense of cultures' effect on mathematics achievement throughout students' schooling (p. 159).

Although the results of this study suggested that achievement improved after the implementation of culture into the curriculum, it would be beneficial to educational leaders to have an idea of the potential influence of culture on

mathematics achievement (Moses-Snipes, 2005). However, this study did not report the detailed curriculum in order for it to be replicated.

In conclusion, ethnomathematics draws upon the social and cultural experiences of students to enlighten, enrich, and enhance the learning of mathematics in the academic classroom. It is proposed that presenting mathematics with a historical, cultural, and social tone will assist students in their efforts to relate to the content; moreover, the intention is for students to feel that their culture is reflected in the content in some fashion. The theory of ethnomathematics encourages relationships and critical dialogue to allow students and teachers opportunities to explore their social and cultural consciousness. This approach to mathematics education is a supplement to the traditional practices to strengthen the environments and the development of the *whole* student.

Culturally Relevant Pedagogy

Background

This section of the literature review focuses on the theory of culturally relevant pedagogy only as it pertains to the instruction of mathematics. In the continuous effort to improve education, educational practices, and student achievement, Culturally Relevant Pedagogy (CRP) has emerged as an effective theoretical approach to classroom teaching. Ladson-Billings (1995d) pushed-back on the notion of the educational research that focused on social reform that

was based upon programmatic changes such as 're-educating' typical teacher candidates for the variety of student populations in U.S. public schools. Instead, she focused on educational theorizing about teaching itself and proposes CRP as a culturally focused pedagogy that could be considered in the reformation of teaching practices (Ladson-Billings, 1995d).

Culturally Relevant Pedagogy in Theory

Culturally Relevant Pedagogy was designed directly from the observation of successful teachers of African American students (Hubert, 2014). Ladson-Billings (1995d) expressed that the long history of African American educational struggle and achievement is well-documented. She cites glib pronouncements and beliefs that 'Black people don't value education' as motivation to her efforts to conduct research in attempt to further understand the challenges that African American students face in the modern classroom (Ladson-Billings, 1995d).

Jacqueline Irvine (1990) set a vital foundation for CRP with the development of the concept "*cultural synchronization* to describe the necessary interpersonal context that must exist between the teacher and African American students to maximize learning" (p. 9). "Irvine's work on African American students and school failure considers both micro- and macro-analyses, including: teacher-student interpersonal contexts, teacher and student expectations, institutional contexts, and the societal contexts" (Ladson-Billings, 1995d, p. 469). Each of these concepts is a factor or influence on the educational experience of all students; however, for African American students, the shared belief that there is a cultural

deficit or cultural disadvantage is a detriment to the academic outlook for these students. Consequently, “a next step for positing effective pedagogical practice is a theoretical model that not only addresses student achievement but also helps students accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools perpetuate; [this model is called] Culturally Relevant Pedagogy” (Ladson-Billings, 1995d, p. 469).

In its development, CRP entailed two key facets in which one deals with the students participating in CRP and the other deals with the teacher implementing CRP (Hubert, 2014). CRP aims to produce students that are *whole* persons; that is, not only learners of mathematics but as socially conscious individuals. CRP help students by ensuring that a rigorous curriculum is maintained along with the culturally relevant instruction (Hubert, 2014). Moreover, Hubert (2014) asserts that CRP helps students maintain their cultural integrity by helping them realize that they can be themselves and still be successful academically which is typically accomplished by using aspects of students’ culture in the learning process. This reflects a goal of CRP which is to maintain student culture and assure that students are comfortable in an academic environment, regardless of ethnicity and stereotypes, to learn mathematics in a rigorous manner. As African American students are fairly aware of the various disadvantages that surround them throughout their educational journey, CRP proposes that students recognize, analyze, and critique social

inequities by involving students in discussions and lessons that relate to social inequities that exist within their environment (Hubert, 2014).

As mentioned, CRP is a practice for both major parties in the classroom, those being the teacher and students. Hubert (2014) explains that there are three main propositions of CRP that relate to the teacher; the first is that teachers hold positive conceptions of self, their occupation, and others. This positive outlook perpetuates interpersonal relationships; this leads into the second proposition of CRP that relates to the teacher, which is to maintain positive social relations with all students, parents, and the community (Hubert, 2014). Thirdly and most importantly in the academic sense, the CRP teacher must be passionate about knowledge and teaching and believe that knowledge is shared, recycled, and constructed (Hubert, 2014).

According to Ladson-Billings (1995d), “the scholarship that has examined academically successful African American students, a disturbing finding has emerged – the student’s academic success came at the expense of their cultural and psychological well-being” (p. 475). African American students often fell into the phenomenon of ‘acting white’ or conforming to what they felt were acceptable characteristics and behaviors of a *successful* student such as speaking only Standard English, listening to ‘white’ music, and being on time (Fordham & Ogbu, 1986). These specific behaviors opposed common stereotypes of African American behaviors; therefore, students who did not ‘act white’ or exhibit the *expected* behaviors were ostracized by their peers (Ladson-Billings, 1995d).

This complex phenomenon of 'acting white' and neglecting a genuine cultural identity portrays the dilemma for African American students which becomes one of negotiating the academic demands of school while demonstrating cultural competence (Ladson-Billings, 1995d). Thus, the implementation of CRP must provide ample opportunities for students to maintain their cultural integrity and overcome social inequities while succeeding academically (Ladson-Billings, 1995d). Moreover, teachers who employ CRP are also responsible for engaging in their own social and cultural consciousness; and prepared for critique of social and cultural inequities to help students throughout the learning process. "Teachers who meet the cultural critique criteria must be engaged in a critical pedagogy which is a deliberate attempt to influence how and what knowledge and identities are produced within and among particular sets of social relations" (Giroux & Simon, 1989, p. 244).

Giroux & Simon (1989) assert that CRP serves as both a political and practical activity, it attempts to influence the occurrence and qualities of experiences. CRP acts upon the *experiences* of the students that are being served; it accounts for the environment, political influences, and social relations that students *experience* as students in their respective committees.

Culturally Relevant Pedagogy in Practice

Ladson-Billings (1995d) conducted a study of eight secondary school teachers that were considered excellent and exemplary CRP teachers by colleagues and school administration. All eight teachers were female – five were

African American and 3 were white – who had between twelve and forty years of teaching experiences and participated in a four-phase study. In the first phase, “each teacher participated in an ethnographic interview to discuss her background, philosophy of teaching, ideas about curriculum, classroom management, and parent and community involvement” (Ladson-Billings, 1995d, p. 473). The second and third phase overlapped and consisted of classroom observations, audiotaping, videotaping, and reflective conversations with teachers following daily lessons (Ladson-Billings, 1995d). Ladson-Billings (1995d) then employed the fourth and final phase which required the teachers to work together as a research collective or collaborative to analyze and interpret their own and one another’s practice.

Ladson-Billings (1995d) found that the students who engaged in CRP of the eight classrooms that she observed achieved higher than their district counterparts on standardized assessments. More importantly, these students demonstrated an ability to read, write, speak, compute, pose, and solve problems at sophisticated levels – that is, pose their own questions about the nature of academic problems and engage in peer review of problem solutions (Ladson-Billings, 1995d). Furthermore, Ladson-Billings (1995d) deduced that teachers unreluctantly taught students utilizing a curriculum that identified political underpinnings of their community and social world; in turn, strengthening social consciousness and confirmed *community circumstances* as *official* knowledge for students.

While recognizing the remarkable achievements and improvements of the students that were taught by the eight teachers employing CRP in this study, she also acknowledged key elements that were exemplified in the teachers and their interaction with students that was vital to effective CRP. As a participant-observer in the classrooms of these particular African American teachers, Ladson-Billings (1995d) concluded that the teachers: “believed that all students were capable of academic success; saw their pedagogy as art – unpredictable, always in the process of becoming; saw themselves as members of the community; and saw teaching as a way to give back to the community” (Ladson-Billings, 1995d, p. 478). Each of these traits are characteristics of mindset, beliefs, and perceptions and it is imperative that a teacher who employs CRP demonstrates commitment to these concepts in a consistent and deliberate manner (Ladson-Billings, 1995d).

Ladson-Billings (1995d) also found the empowerment that *social relations* and social interaction brought to the classroom implementation of CRP by the eight teachers who participated in the study. These culturally relevant teachers consciously created social interactions to help them meet the criteria of academic success, cultural competence, and critical consciousness (Ladson-Billings, 1995d). Ladson-Billings (1995d) found that the teachers maintained fluid student-teacher relationships, demonstrated a connectedness with all students, and encouraged students to learn collaboratively, and be responsible for one another. “The culturally relevant teachers encouraged a community of learners rather than

competitive, individual achievement; fortunately, the demanding of a higher level of academic success for the entire class, individual success did not suffer” (Ladson-Billings, 1995d, p. 480). Ladson-Billings (1995d) exemplifies this phenomenon with descriptions, analysis, and concrete examples:

In these teachers’ classrooms, the teacher-student relationships are equitable and reciprocal. All of the teachers gave students opportunities to act as teachers. In one class, the teacher regularly sat at a student’s desk, while the student stood at the front of the room and explained a concept or some aspect of student culture. Another teacher highlighted the expertise of various students and required other students to consult those students before coming to her for help....Because she acknowledged a wide range of expertise, the individual students were not isolated from their peers as teacher’s pets. Instead, all of the students were made aware that they were expected to excel at something and that the teacher would call on them to share that expertise with classmates (p. 480).

Ladson-Billings (1995d) suggested that “the teachers used an ethos of reciprocity and mutuality to insist that one person’s success was the success of all and one person’s failure was the failure of all” (Ladson-Billings, 1995d, p. 481).

In addition to the propositions of self-conceptions (and conceptions of others), the conceptions of social relations, Ladson-Billings (1995d) deduced a third which is the conceptions of knowledge. This third conception that emerged from this study was one that indicated how the teachers thought about

knowledge – the curriculum or content they taught – and the assessment of that knowledge (Ladson-Billings, 1995d). According to Ladson-Billings (1995d), these eight CRP teachers believed that *knowledge* was not static, it is shared, recycled, and constructed; therefore, must be viewed critically. CRP teachers must be passionate about knowledge and learning which will influence the implementation of teaching strategies such as scaffolding, or building bridges to facilitate learning and utilizing assessment in a multifaceted fashion by incorporating multiply forms of excellence (Ladson-Billings, 1995d).

Knowledge is an individualized construct and CRP teachers embraced this concept and had an intention to instill the same mindset in their students. For the teachers in Ladson-Billings (1995d) study the teachers felt and practiced the ideal that knowledge was about doing; the students listened and learned from one another as well as the teacher. The teachers in this study deliberately valued the individual *knowledge* that each student possessed regardless of the topic. For example, one teacher who participated in Ladson-Billings' (1995d) study required each student in her class to choose a date on which they were to present on any area in which they felt they had expertise. The teacher felt that “while students made their presentations, knowledge and expertise were given; therefore, classmates were expected to be an attentive audience and take seriously the knowledge that was being shared by taking notes and/or asking relevant questions” (Ladson-Billings, 1995d, p. 482).

As mentioned, CRP is composed of beliefs, strategies, knowledge, and practices that oppose the historical, traditional curriculum and academic experience for students. The eight teachers who participated in Ladson-Billings' (1995d) study recognized this difference and demonstrated a critical stance toward the school curriculum that was in place at the time. Although cognizant of the need to teach certain things because of a districtwide testing policy, the teachers ensured to help students engage in a variety of forms of critical analyses (Ladson-Billings, 1995d). Ladson-Billings (1995d) provides concrete examples of the teachers' stance on the conceptions of knowledge and school curriculum:

For one teacher, this meant [for her students to] critique the social studies textbooks that were under consideration by an evaluation panel. For two of the other teachers, critique came in the form of resistance to district-approved reading materials. Both of these teachers showed the students what it was they were supposed to be using along with what they were going to use and why. They both trusted the students with this information and enlisted them as allies against the school district's policies (p. 482).

For these teachers, some of their conceptions of knowledge and curriculum completely opposed district decisions and policies; however, CRP is not to be considered as a movement to rebel against educational reform. Most importantly, the teachers in this study remained socially conscious about the *knowledge* that was presented and meeting the three criteria of CRP which are: an ability to

develop students academically, a willingness to nurture and support cultural competence, and the development of a sociopolitical or critical consciousness (Ladson-Billings, 1995d). In the teachers' actions of including these students as *allies* lies the component of CRP that perpetuates the ideal of building adolescents' social competence and understanding the circumstances that affect their education.

As emphasized in this literature review, CRP is developed for educational purposes in general and many scholarly researchers recommended implementing CRP specifically for enhancing mathematics education for African American students (Allexsaht-Snider & Hart 2001; Cooks, 1998; Gay, 2002; Hubert, 2014; Ladson-Billings, 1995a, b, c, d, 1997, 2009; Leonard et al., 2010; Tate, 1995). In 2014, Hubert employed a study in which she captured the effects and captured students' perspectives of culturally relevant mathematics instruction for students for participating in a culturally relevant mathematics intervention (Hubert, 2014). Hubert (2014) sought to address two research questions: (1) what are the high school students' perspectives of culturally relevant mathematics? And (2) does culturally relevant instruction affect students' attitude and interests toward mathematics?

Not only was Hubert (2014) the researcher in this study on CRP, she also acted as a participant in the study; specifically, she was the teacher who implemented the culturally relevant mathematics curriculum. The study was conducted at Frankfort High School, a high school located in a southern state of

America, and consisted of 37 students actively participating in a CRP curriculum fully implemented by the researcher over a 10-day period (Hubert, 2014). The age range of the participating students was 16-22 years; and of these students the ethnic demographics were: 40% Hispanic, 30% African American, 11% Mixed, 11% White, 5% Native American, and 3% Asian (Hubert, 2014). Hubert's (2014) primary direction for the study was to focus on African American students' perspectives of culturally relevant instruction; however, she also wanted to understand if other students felt the same way or different than African American students.

Hubert (2014) presented lessons on the mathematics concepts of quadratic and exponential functions; however, she implemented *culturally relevant* topics to these lessons such as teen pregnancy, perinatal HIV, teen smoking, sports, and financial responsibility. Hubert (2014) maintained the primary goal to teach mathematics to students while practicing CRP and presenting material within, or in addition to topics that current students can relate to and develop their social consciousness. Given this *whole-world* approach to teaching mathematics, Hubert (2014) observed that the mathematics achievement of students who participated in the modified CRP instruction, on average, increased by one letter grade.

Student Reception

At the end of the CRP instruction, Hubert (2014) chose five students to participate in semi-structured interviews and posed the following questions:

(1) Before beginning the mathematics intervention, how did you feel about mathematics?; (2) How do you feel about mathematics now?; (3) How does the mathematics instruction used during the intervention compare to the type of mathematics instruction you receive in your regular mathematics class?; (4) Which of these two methods of instruction do you prefer, and why?; and (5) Which of these two methods of instruction helped you to understand and learn mathematics better, and why? (p. 329).

Upon interviewing the five students, Hubert (2014) found that six themes developed from the student responses: (1) home-like classrooms, (2) ethic of caring, (3) participation opportunities, (4) technology use, (5) confidence, and (6) motivation.

The participating students made comments that were “consistent with findings from Howard (2001) in which students stated that the ability of teachers to structure the classroom in a manner that resembled home was a strategy that made CRP teachers effective” (Hubert, 2014, p. 330). One student expressed that she “felt smarter because the lessons dealt with issues that related to her life and society which helped her understand the things that were going on in her home environment” (Hubert, 2014, p. 330). Many students express similar thoughts about CRP instruction being relatable to their lives and engaging in a much more *real* manner than simply mathematical concepts that were being taught for academic purposes only. The students became more interested in the

mathematics because their real-life social experiences were reflected in the content; ultimately, the fact that the lessons contained issues that students experienced at home contributed to students' positive perspectives of CRP (Hubert, 2014).

According to Howard (2001), CRP teachers' willingness to care about the students and their ability to bond with the students was noted as one of the most important features of an effective teacher which coincides with the findings in Hubert's (2014) study. Hubert (2014) expressed that the students felt that they were truly and genuinely cared for during the instruction which made them want to learn mathematics and persevere in their learning. As the CRP teacher, Hubert (2014) ensured that she was patient with the students during the lesson and really focused on understanding as opposed to making sure she finished the lessons. Hubert (2014) included quotes from participating students that exemplified the differences of a *traditional* teacher and a CRP teacher in regards to *care*:

They [non-CRP teachers] are trying to hurry up and get things done, which you, you take time and if you don't really understand or get it, you take out time to make sure you got us one-on-one and help us understand.

Another student shared how the teacher being encouraging helped her to enjoy the culturally relevant instruction. She stated: They [traditional teachers] don't like encourage students enough. You know alright they're [students] not going to do it so get out of my class that is basically how it is

[in a traditional teacher's classroom]. So you know you're [the CRP teacher] like come on you can do this, like I'm a do it with you, and show you how to do it and go step-by-step and that's what helped me (p. 332).

Hubert (2014) also found that allowing students to participate, be involved in the curriculum, and express themselves during CRP instruction positively contributed to their mathematical learning and achievement. The comments made by participating students regarding effective CRP strategies were “consistent with the feelings of African American male students that effective classrooms are ones which allow them to actively participate in the learning process, work collaboratively in groups, and participate in student discourse” (Moore, 2002, p. 1). A student that participated in Hubert’s (2014) study expressed that working in collaborative groups contributed to his increase in interest in mathematics because he was able to work with some of his friends, have fun, and learn all at the same time.

In addition to the positive feelings that students expressed about CRP instruction in terms of collaboration, students also felt that there were individual improvements in confidence and motivation. As mentioned, CRP contains elements that intend for students to build as persons in addition to their learning; a student in Hubert’s (2014) study expressed this sentiment:

I feel more encouraged and you know I feel proud of myself that I'm actually learning something or some things that I thought I couldn't truly do when I said I couldn't do, but you [the teacher] helped me to understand

them so it kind of changed me and the way I thought of my way of living (p. 333).

Fortunately, this newly-discovered confidence will permeate throughout this student's life and increase his ability to learn mathematics. Consistent with Hubert's (2014) intention as a CRP teacher, the results from various studies have indicated that there is a positive relation between math confidence and achievement (Eccles & Jacobs, 1986; Ganley & Vasilyeva, 2011; Liu, 2009; Ma & Kishor, 1997; Valentine, DuBois, & Cooper, 2004).

The implementation of CRP in Hubert's (2014) study also had a direct effect on the student's motivation; all students interviewed discussed an increase in motivation in a multitude of fashions. For example, a student expressed that she was motivated to make a difference; specifically, if she had the given time, she would go to middle schools and talk to them about some of the real-life issues that were discussed as part of the CRP lessons (Hubert, 2014).

Furthermore, students expressed that CRP instruction motivated them to make individual life changes, specifically: taking steps to quit smoking, working harder at studying mathematics, taking the necessary steps to attend college after high school, think about other student's feelings when making decisions, and motivating other students to give full effort and do well in school (Hubert, 2014).

As a result of this study, Hubert (2014) found that the students were given a comfortable space and opportunities to express what works and does not work for them in learning mathematics. In an overall sense, Hubert (2014) concluded

that students had very positive perceptions of culturally relevant mathematics instruction. Furthermore, all students interviewed in the study expressed that they preferred CRP over *traditional* academic instruction, felt an increase in self-confidence, and shared that participating in CRP created a desire in them to learn and motivated them to do better (Hubert, 2014). Also, all of the students commonly discussed how participating in CRP positively changed the way they felt about learning mathematics and increased their interest in mathematics as they continue to navigate through their academic education (Hubert, 2014).

In conclusion, culturally relevant pedagogy (CRP) is an approach to teaching that maximizes the potential of positive relationships, opportunities, and social and cultural consciousness amongst teachers and students. It is vital that teachers understand the uniqueness that all students bring into a classroom, and reflect the phenomenon of diversity in the curriculum. This is a critical element in the learning of mathematics due to students having difficulty of perceiving the *relevancy* of the academic content. However, as Ladson-Billings (1989) and Hubert (2014) found, student perception and mathematics achievement can be increased by effectively implementing CRP to African American students.

Summary

The review of the literature attempts to address solutions to improving the mathematics achievement of African American students. The literature review

sheds light on an alternative approach and mindset to mathematics known as ethnomathematics which focuses on the importance of the implementation of historical, social, and cultural components into the mathematics curriculum. The literature proposes that students' culture is reflected in the curriculum which will increase relevancy as students are exposed to mathematics that provides reflection of their culture and individual experiences.

Moreover, the theory of culturally relevant pedagogy (CRP) is insisted as an approach to teaching that is effective in improving mathematics achievement, confidence, and motivation for African American students as well as developing social and cultural consciousness. The literature proposes practical components of teaching such as positive relationships, dialogue, home-like classrooms, and opportunities for expression to increase student interest in mathematics.

Ethnomathematics and Culturally Relevant Pedagogy in Unity

The literature review emphasizes many of the overlapping implications of ethnomathematics and culturally relevant pedagogy (CRP) which provides a potential framework for effectively teaching mathematics to African American students. However, the literature for both theories is separate as exemplified in the review of the literature; thus, an opportunity for research on a collective implementation of ethnomathematics and CRP has emerged. Given the shared elements of ethnomathematics and CRP, a study on a mathematics education for African American students that integrates the two theories could prove to be prevalent in educational research.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

The purpose of this study is to investigate African American high school students' perspectives of their current mathematics education from a cultural respect. The research will be conducted with an approach to gain insight on African American students' attitudes toward mathematics in general as well as student perceptions on a culturally-based mathematics education.

This chapter presents the methodology for the study. The selection of a quantitative, correlational design will be supported. The population, sampling procedures, and data collection plan will be described. A power analysis will be conducted to determine the minimum sample size required for detecting a statistically significant result when one is present. The selection of two survey instruments will be supported and the variables of interest will be operationalized. The chapter will conclude with ethical considerations and threats to validity.

Research Design

This study will incorporate a quantitative, correlational research design. Because the aim of the research involves statistical examination for associations between numerically measurable variables, a quantitative methodology with a correlational design was deemed most appropriate. Correlational research does not assess for cause and effect but examines if a statistical relationship exists

between the variables of interest (Creswell, 2014). The research will use an online survey as the instrument for collecting the data. Online surveys are frequently used in the social sciences and in psychological fields due to their higher reliability over paper-formatted survey instruments (Tuten, 2010).

Other research designs were considered but were ultimately not selected for the purposes of the research. An experimental design would have involved the random assignment of participants into treatment and control groups (Bordens & Abbott, 2008), as well as the application of a pretest and posttest comparison. Quasi-experimental designs involve the manipulation of variables through a treatment, which is also not applicable for answering the research question of the current study. Longitudinal research was not chosen for the current study because the research will not require long-term follow-ups with the study participants. The following research questions guided the focus of the study:

Research Question 1: Is there a statistically significant association between the subscales of students' attitudes toward mathematics (i.e., sense of security, value, motivation, and enjoyment)?

Research Question 2: Is there a statistically significant association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness?

Research Question 3: Are there statistically significant differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity?

Research Setting

The participants in this study were African American students in grades 9 through 12 that attended Brookhouse High School (pseudonym), located in southern California. Of the 1,350 students that attended Brookhouse High School, the ethnicity distribution is 73% Hispanic or Latino, 16.2% Black or African American, 6.1% White, 1.6% Asian, 1.1% mixed with two or more races, 0.5% Native Hawaiian or Pacific Islander, 0.3% American Indian or Alaska Native, and 0.3% Filipino. Of this population, 92.9% of the students were considered socioeconomically disadvantaged while 15.2% were students receiving special education. African American students at Brookhouse High School have low mathematics achievement in comparison to other high schools in the state.

Research Sample

The sampling procedure employed in this study was convenience sampling. Etikan, Musa, and Alkassim (2016) suggest that the main objective of convenience sampling is to collect information from participants who are easily accessible to the researcher. Convenience sampling is a type of nonprobability or nonrandom sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study (Etikan, Musa, & Alkassim, 2016). The researcher identified the target

population of this study and determined the geographical location of the research setting and accessibility of the research participants were most feasible given the circumstances. The main assumption associated with convenience sampling is that the members of the target population are homogeneous. According to Etikan, Musa, and Alkassim (2016), the researcher may assume that there will be no difference in the research results obtained from a random sample, a nearby sample, a co-operative sample, or a sample gathered in an inaccessible part of the population. Moreover, the researcher chose the convenience sampling method because it places primary emphasis on generalizability; that is, ensuring that the knowledge gained is representative of the population from which the sample was drawn (Etikan, Musa, & Alkassim, 2016).

In this study, the researcher identified the target population as African American students who attended a high school located in a low socioeconomic setting. After careful investigation of demographics and school location, the researcher chose African American students who attended Brookhouse High School. The students who were included in the study from Brookhouse High School were not selected randomly for participation. The population available at the school is similar to African American students in the region and considered representative of the larger target population.

When incorporating inferential analyses to address research questions, it is necessary to sample from an adequate number of participants. A power analysis was conducted using the software program G*Power 3.1.7 to determine

the minimum sample size requirements for a Pearson correlation and a MANOVA (Faul, Erdfelder, Buchner, & Lang, 2014). Using a two-way Pearson correlation (RQ1 and RQ2), with a power of .80, and a medium effect size of $\rho = .30$, it was determined that a minimum sample size of 84 participants would be sufficient for the data collection. Using a MANOVA with four groups, five dependent variables, a power of .80, and a medium effect size of $f^2 = .0625$, it was determined that a minimum sample size of 108 participants would be sufficient for the data collection.

Data Collection

Due to low achievement and a high population of socioeconomically disadvantaged students, the researcher chose Brookhouse High School to conduct the research study and provide data to assist in overcoming educational challenges of the students. The researcher emailed the principal of Brookhouse High School to obtain permission to conduct the research study. Subsequent to approval, the researcher distributed consent forms to the mathematics teachers who then distributed the forms to their respective students. A total of 436 students volunteered by returning consent forms that were signed by a parent or guardian and given to the researcher prior to deploying the online surveys for participation.

It was estimated that approximately 150 students would volunteer and be approved to complete the two surveys titled Attitudes Toward Mathematics

Inventory (Appendix D) and Student Perceptions about Cultural Awareness Survey (Appendix E). The two surveys were deployed such that the students were able to complete them in a single sitting. The first part of the online deployed survey requested students to provide information regarding their gender, age, grade level, and ethnicity. Prior to permitting students to begin the survey, the teacher read a student assent form to ensure that students were comfortable and understood the confidentiality of their responses. The student participants then completed the surveys in a quiet classroom setting on Chromebook laptops that the school provided. The students were instructed to go to SurveyMonkey and access the surveys via a code provided by the teacher. The survey process took approximately 20 minutes for each sitting. After the completion of the survey, the students were instructed to return to their respective classrooms and no additional interaction between the researcher and students followed.

Instrumentation

The online survey included the following components: (1) a demographic questionnaire, (2) the Attitudes toward Mathematics Inventory (ATMI), and (3) the Student Perceptions about Cultural Awareness (SPCA) survey. The demographic survey asked participants to provide information about gender, age, ethnicity, and grade level.

The Attitude toward Mathematics Instrument (ATMI) is a 40-item survey that measures students' attitudes toward mathematics. Each item uses a Likert-scale format ranging from 1 (strongly disagree) to 5 (strongly agree). The survey provides a measure of overall attitudes toward mathematics construct, as well as measures for the four subscales corresponding to (1) sense of security (15 items), (2) value (8 items), (3) motivation (9 items), and (4) enjoyment (8 items). The overall scale and subscales are scored by taking an average of the relevant survey items. The scale has demonstrated excellent internal consistency reliability ($\alpha = .97$) (Tapia, 1996). A principal component analysis confirmed the existence of a four-factor structure.

The Student Perceptions about Cultural Awareness survey is a 12-item self-report survey that measures personal attitudes regarding multicultural education. The survey uses a Likert-scale format ranging from 1 (strongly disagree) to 4 (strongly agree). Because there are no published psychometric properties for the instrument, the reliability of the survey data will be assessed with Cronbach's alpha.

Data Analysis

Following data collection that took a total of 14 days, the responses of the students were analyzed using SPSS version 24.0 for Windows. Descriptive statistics, including correlation coefficients, were computed and examined. Frequencies and percentages were used to examine the distribution in the

nominal level variables of interest. Descriptive statistics were used to examine the trends in the continuous level variables. All inferential analyses will be evaluated for statistical significance at the conventional alpha level, $\alpha = .05$.

Prior to running the inferential analyses, the data was examined for partial or incomplete responses. Individuals who did not respond to more than 50% of the questionnaire were removed from further analysis. In addition, outliers were identified with z-scores. Participants with z-scores on the scales falling outside of the range ± 3.29 standard deviations away from the mean were removed from further analysis (Tabachnick & Fidell, 2013).

Research Question 1: Is there a statistically significant association between the subscales of students' attitudes toward mathematics (sense of security, value, motivation, and enjoyment)?

Research Question 2: Is there a statistically significant association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness?

To address research question one and two, a series of Pearson correlations were conducted to examine the associations between the variables of interest. A Pearson correlation is an appropriate test when assessing the strength of association between continuous level variables (Pagano, 2009). The correlation coefficients can range from 0 (no relationship) to +1 (perfect positive linear relationship) or -1 (perfect inverse linear relationship). Cohen's standard was used to interpret the strength of the associations, in which coefficients

between 0 and .10 represent an insignificant association; coefficients between .10 and .29 represent a small association; coefficients between .30 and .49 represent a medium association; and coefficients above .50 represent a large association or relationship (Cohen, 1988). Prior to analysis, the assumptions of linearity and normality were tested for the variables. To test linearity, a scatterplot was examined for each pairwise relationship to assess whether a monotonic relationship exists. Kolmogorov-Smirnov tests were conducted to assess whether each of the variables resembled a normal, bell-shaped distribution.

Research Question 3: Are there statistically significant differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity?

To address this third research question, a multivariate analysis of variance (MANOVA) was conducted to assess for differences in attitudes toward mathematics and perceptions of cultural awareness by ethnicity (White, Black, Hispanic, Other). An MANOVA is an appropriate statistical analysis when assessing for differences in multiple continuous dependent variables between three or more groups (Pagano, 2009). Prior to analysis, the assumptions of normality and homogeneity of variance were tested by examination of the Kolmogorov-Smirnov test and Levene's test, respectively. Statistical significance for either test at $\alpha = .05$ will suggest that the assumption was not met. The *F* test was used to make the overall comparison on whether collective differences exist

between the dependent variables by ethnicity. Individual ANOVAs were used to assess for differences in each dependent variable by ethnicity.

Positionality of the Researcher

As the researcher in this study, I am particularly passionate due to my personal experiences of learning mathematics as an African American high school student. Throughout high school, I had difficulty determining the relevance and purpose of learning mathematics; instead, I gathered that the subject was made up of steps and procedures that I enjoyed and eventually mastered. Unfortunately, many of my African American friends, classmates, and peers did not enjoy or excel in mathematics due to the same perception of lacking relevance and purpose. Many of these students felt that mathematics was not applicable to their lives or the real-world in general, which reduced the subject in their minds to merely another class to attend and gain useless knowledge. However, as a high school student, I could not perceive any knowledge to be useless and rejected the ideal that mathematics is purposeless.

My high school mathematics education experience inspired my professional pursuits to obtain a degree in mathematics and become a high school mathematics teacher. As a high school mathematics teacher for many academic years, I have witnessed many bright and intelligent African American students underachieve in mathematics due to a lack of interest and an inability to relate to the traditional mathematics curriculum. Consequently, I seek to

investigate the connection between culture, background, and mathematics to better understand how to effectively educate African American students.

Validity and Trustworthiness

Researchers that involve human participants in data collection have a responsibility to inform and protect the participants. The researcher closely followed the ethical regulations established by the Institutional Review Board (IRB). Participants were required to provide consent from a parent or guardian before starting the survey process. In addition, due to confidentiality, participants were expected to answer truthfully. The participant sample corresponded to volunteers who may withdraw from the study at any time, with no consequences. The data was stored on a password protected external hard drive within the researcher's residence for the duration of the survey process.

Summary

The purpose of this study was to investigate African American high school students' perspectives of their current mathematics education from a cultural respect. This chapter presented the methodology for the proposed study. The research methodology and design were identified and justified. The population, sampling procedures, data collection procedures, and instrumentation were outlined. The chapter also includes the data analysis plan to address the research questions and the ethical procedures. This chapter provides a section

detailing the validity and trustworthiness standards followed throughout the research process. The chapter concluded with a brief biographical background of the researcher coupled with an explanation of the positionality of the researcher in the context of this study. The next chapter will present the findings of the data collection and analysis.

CHAPTER FOUR

RESULTS

Introduction

The purpose of this study was to investigate African American high school students' perspectives of their current mathematics education from a cultural respect. The analyses of data followed the following steps. First, the demographic characteristics were examined with frequencies and percentages. Next, descriptive statistics were used to summarize the continuous level variables. Finally, to address the three research questions, Pearson correlations were used to explore the relationship between students' attitudes toward mathematics and perceptions of cultural awareness. An MANOVA was used to explore for differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity (White, Black, Hispanic, Other). Statistical significance was evaluated at the conventional alpha level of $\alpha = .05$.

Initial Analysis of Data

Likert scale responses from 436 students who responded to a four-item questionnaire were extracted from Survey Monkey and uploaded into SPSS version 24.0 for Windows. A total of 436 high school students responded to the questionnaire. However, 61 participants were removed for not responding to any portion of the survey questionnaire besides the consent item. Raw scores for each sub-scale were converted to z-scores and then examined for outliers i.e., z-

scores greater than three standard deviations. No outliers were identified in the sample; therefore, the final sample consisted of 375 students.

Descriptive Statistics

Frequencies and Percentages. The sample of 375 students included 227 males (60.5%) and 148 females (39.5%). The ethnicity of the participants was predominantly Hispanic ($n = 268$, 71.5%). There were a total of 54 African Americans, 21 White students, and 32 participants of Other ethnicities. The participants' ages ranged from 14 to 18 years, with an average age of 15.71 years. A majority of participants were in the 10th grade ($n = 194$, 51.7%). Frequencies and percentages are presented in Table 1.

Table 1

Frequency Table for Demographic Variables

Variable	<i>n</i>	%
Gender		
Male	227	60.5
Female	148	39.5
Ethnicity		
White/Caucasian	21	5.6
Black/African American	54	14.4
Hispanic	268	71.5
Other	32	8.5
Age		
14	38	10.1
15	113	30.1
16	154	41.1
17	56	14.9
18	13	3.5
Grade		
9th	66	17.6
10th	194	51.7
11th	94	25.1
12th	21	5.6

Note. Due to rounding errors, percentages may not equal 100%.

Summary Statistics. The Attitude toward Mathematics Instrument (ATMI) (Tapia, 1996) was used to measure students' attitudes toward mathematics. Each survey item utilized a Likert-scale format ranging from 1 (strongly disagree) to 5 (strongly agree). The survey included four subscales (1) sense of security (15 items), (2) value (8 items), (3) motivation (9 items), and (4) enjoyment (8 items). The Student Perceptions about Cultural Awareness (SPCA) survey, a

second questionnaire, was included with the ATMI to measure students' "personal attitudes regarding multicultural education". Items on this survey were also on a Likert-scale format, ranging from 1 (strongly disagree) to 4 (strongly agree). The variables within each scale were computed through an average of the relevant items comprising each factor. All five scales had acceptable levels of internal consistency (has indicated excellent reliability ($\alpha = .97$) (Tapia, 1996).

The average scores and standard deviations for each sub-scale were calculated. For the Attitudes toward Mathematics scale, the scores all round towards 3.00, suggesting that the participants were neutral towards the survey responses for these factors. Cultural awareness scores ranged from 1.00 to 4.00, with $M = 2.51$ and $SD = 0.52$. Cultural awareness scores fell near in the middle, suggesting that participants collectively did not have a preference towards the items comprising the scale. Table 2 presents the findings of the descriptive statistics.

Table 2

Summary Statistics for Variables of Interest

Variable	Min.	Max.	<i>M</i>	<i>SD</i>	Cronbach's α
Value	1.00	5.00	3.40	0.86	.925
Enjoyment	1.00	5.00	2.83	0.90	.892
Sense of security	1.00	5.00	3.02	0.83	.934
Motivation	1.00	5.00	2.84	0.94	.837
Cultural awareness	1.00	4.00	2.51	0.52	.880

Research Question 1: Is there a statistically significant association between the subscales of students' attitudes toward mathematics (sense of security, value, motivation, and enjoyment)?

To address Research Question 1, a Pearson correlation matrix was obtained to examine the associations between the subscales of students' attitudes toward mathematics. A Pearson correlation is an appropriate statistic when assessing the strength of association between constructs measured on a continuous scale (Pallant, 2013). Sense of security, value, motivation, and enjoyment were all continuous variables. The assumption of linearity was first visually examined with scatterplots. Each of the scatterplots depicted a positive trend between the variables of interest, suggesting that there was an approximate linear trend. In addition, the assumption of normality was assessed with Kolmogorov-Smirnov (KS) tests. The findings of the KS tests were statistically significant ($p < .05$), suggesting that the assumption of normality was not met. Therefore, Spearman correlation coefficients were obtained as a non-parametric alternative.

The findings for the Spearman correlations indicated that there was a statistically significant, positive relationship between every pair of variables. Each of the correlations indicated a strong association between the variables ($r \geq .50$). The findings suggested that there was a direct association among the subscales for attitudes towards mathematics. The results of the correlation are presented in Table 3.

Table 3

Spearman Correlations between Value, Enjoyment, Sense of Security, and Motivation

Variable	Value	Enjoyment	Sense of security	Motivation
Value	1.00			
Enjoyment	.71*	1.00		
Sense of security	.53*	.70*	1.00	
Motivation	.70*	.81*	.61*	1.00

Note. *Denotes correlation is significant at $\alpha = .05$.

Research Question 2: Is there a statistically significant association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness?

To address Research Question 2, a series of Pearson correlation coefficients were proposed to examine the association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness. The variable – perceptions of cultural awareness – was added to the series of variables from the first research question. The assumption of linearity was again validated through examination of scatterplots. Each of the scatterplots depicted a positive linear trend between the variables of interest, suggesting that the assumption for linearity would likely be statistically met. The KS test for normality of data was statistically significant for cultural awareness, suggesting that the assumption of normality was not met for the data for this variable. Therefore, Spearman correlations were conducted as a non-parametric alternative.

Table 4 below shows that small to moderate associations existed between each variable on the ATMI and students' perception of cultural awareness ($.10 \leq r \leq .50$) (Cohen, 1988). However, tests of statistical significance indicated that the Spearman correlations were statistically significantly greater than zero suggesting that there existed a direct association between the subscales for attitudes towards mathematics and perceptions of cultural awareness. The results of the Spearman correlations are presented in Table 4.

Table 4
Spearman Correlations between Value, Enjoyment, Sense of Security, Motivation, and Perceptions of Cultural Awareness

Variable	Perceptions of cultural awareness
Value	.31*
Enjoyment	.33*
Sense of security	.16*
Motivation	.35*

Note. *Denotes correlation is significant at $\alpha = .05$.

Research Question 3: Were there statistically significant differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity?

To address Research Question 3, a multivariate analysis of variance (MANOVA) was conducted to assess for differences in attitudes toward mathematics and perceptions of cultural awareness by ethnicity (White, Black, Hispanic, Other). A MANOVA is an appropriate statistical analysis when assessing for differences in multiple continuous dependent variables between

three or more groups (Pagano, 2009). The independent variable in the analysis corresponded to ethnicity. The continuous dependent variables corresponded to attitudes toward mathematics and perceptions of cultural awareness. Prior to conducting the analysis, the assumptions of normality and homogeneity of variance were tested by examination of the KS test and Levene's test, respectively. As evidenced by the KS tests in the previous research questions, the normality assumption was not met. However, the F test is robust to violations of normality, especially when the sample size is greater than 30 (Howell, 2013). The assumption for homogeneity of variance was met as the findings for Levene's tests were all not significant ($p \geq .05$).

Results of the multivariate F test (see Table 5) did not indicate significance for ethnicity, ($F(15, 1013.53) = 1.11, p = .344, \text{partial } \eta^2 = .015$). The partial η^2 value suggested there was a very small effect between ethnicity on attitudes toward mathematics and cultural awareness. Upon further examination of the univariate ANOVAs, none of the post-hoc F tests were statistically significant (Table 6). These findings indicated that there were no statistically significant differences among students' attitudes and cultural awareness according to their ethnicity.

Table 5

MANOVA for Attitudes towards Mathematics and Cultural Awareness by Ethnicity

Term	Wilks' Lambda	$F(15,1013.53)$	p	partial η^2
Ethnicity	0.06	1.11	.344	.015

Table 6

Univariate ANOVAs for Attitudes towards Mathematics and Cultural Awareness by Ethnicity

Term	$F(3, 371)$	p	partial η^2
Value	1.56	.198	.012
Enjoyment	0.60	.617	.005
Sense of security	0.28	.839	.002
Motivation	0.80	.495	.006
Cultural awareness	0.67	.571	.005

The mean scores for attitudes towards mathematics and cultural awareness were examined for each ethnicity, and by visual inspection the findings suggested that there were not large differences in the scores among the groups (see Table 7 and Figures 1-5). Due to non-significance of the MANOVA and ANOVAs, post-hoc tests were not assessed for ethnicity. The findings of the MANOVA and univariate ANOVAs are presented in Table 5 and 6. The descriptive statistics are presented in Table 7.

Table 7

Means and Standard Deviations for Variables by Ethnicity

Variable	Ethnicity	<i>M</i>	<i>SD</i>	<i>n</i>
Value	African-American	3.30	0.95	54
	Hispanic	3.42	0.84	268
	White	3.15	1.09	21
	Other	3.62	0.74	32
	Total	3.40	0.86	375
Enjoyment	African-American	2.73	0.95	54
	Hispanic	2.85	0.87	268
	White	2.68	0.98	21
	Other	2.93	1.01	32
	Total	2.83	0.90	375
Sense of security	African-American	3.02	0.86	54
	Hispanic	3.03	0.82	268
	White	3.11	0.80	21
	Other	2.91	0.89	32
	Total	3.02	0.83	375
Motivation	African-American	2.73	1.01	54
	Hispanic	2.86	0.92	268
	White	2.63	0.93	21
	Other	2.94	0.93	32
	Total	2.84	0.94	375
Cultural awareness	African-American	2.58	0.62	54
	Hispanic	2.50	0.48	268
	White	2.41	0.68	21
	Other	2.53	0.51	32
	Total	2.51	0.52	375

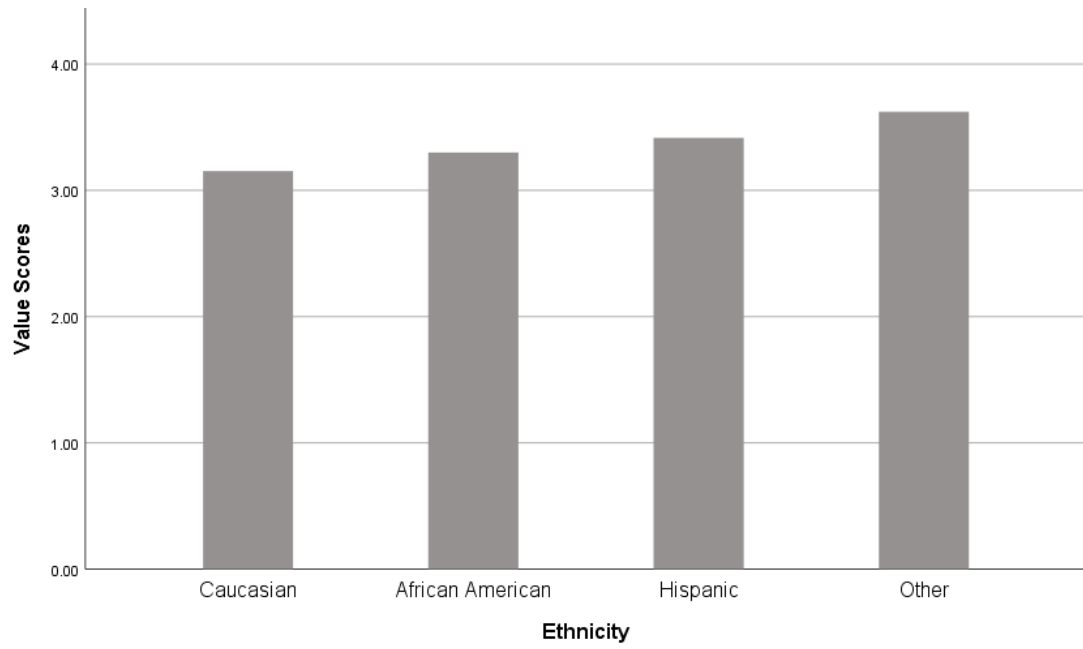


Figure 1. Bar Chart for Value Scores by Ethnicity.

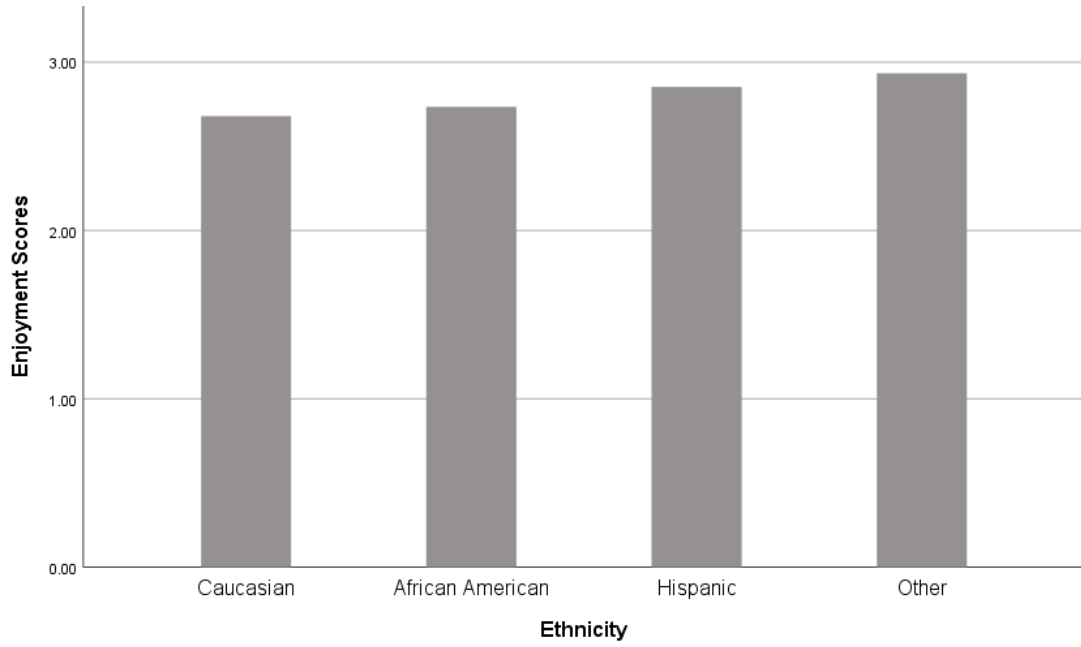


Figure 2. Bar Chart for Enjoyment Scores by Ethnicity.

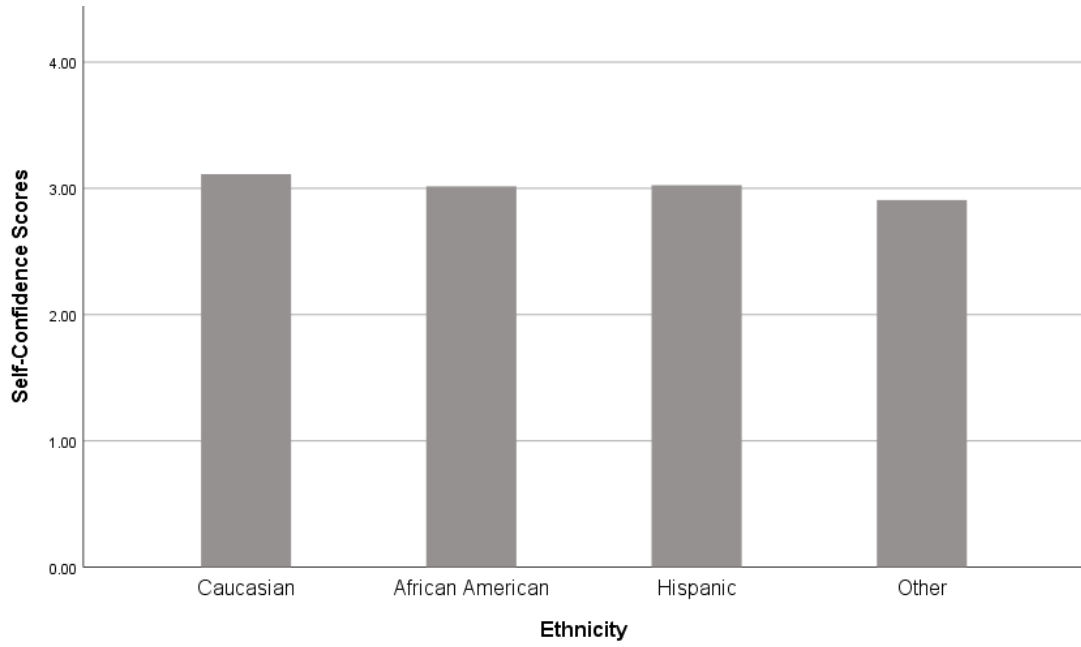


Figure 3. Bar Chart for Self-Confidence Scores by Ethnicity.

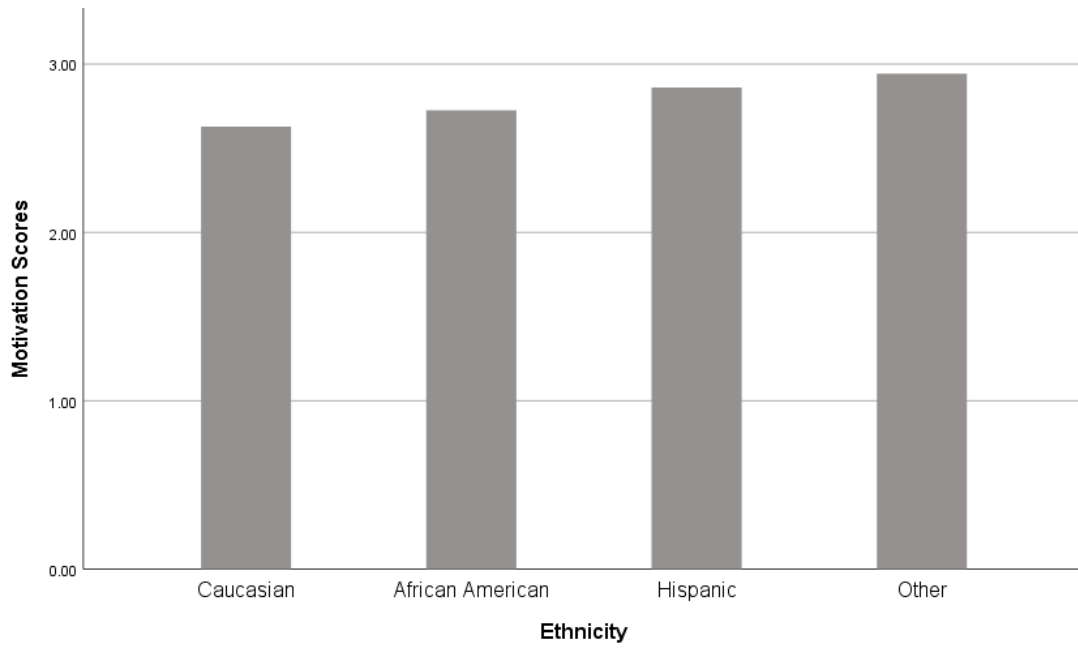


Figure 4. Bar Chart for Motivation Scores by Ethnicity.

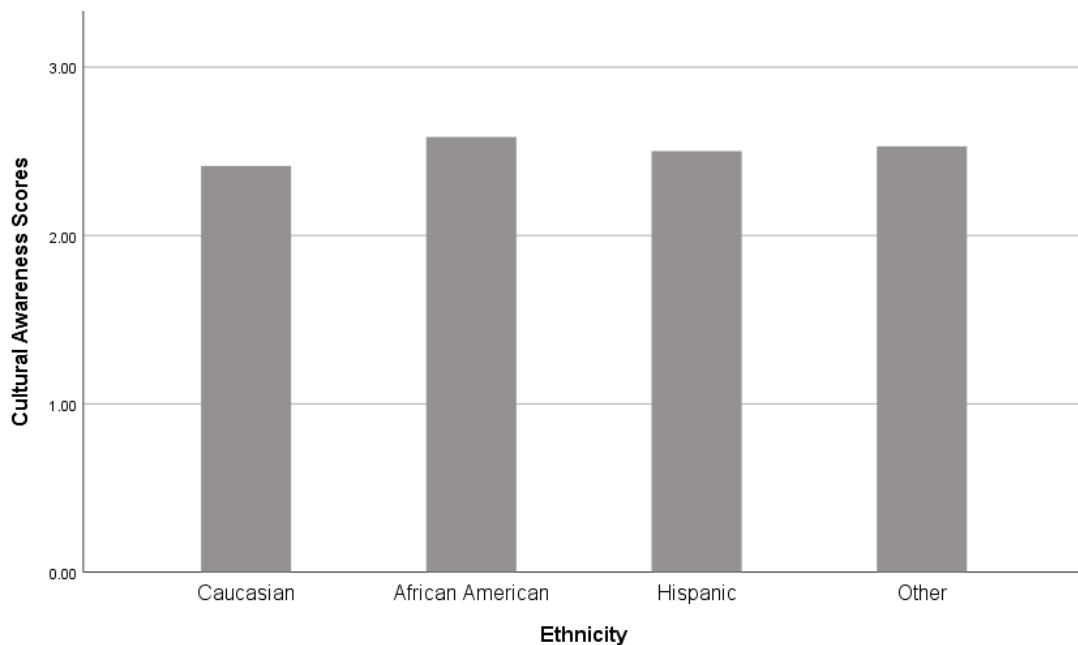


Figure 5. Bar Chart for Cultural Awareness Scores by Ethnicity.

Summary

The purpose of this study was to investigate African American high school students' perspectives of their current mathematics education from a cultural respect. This chapter presented the statistical findings. Descriptive statistics were used to explore the distribution of the demographic factors and to examine the means and standard deviations of the continuous level variables. Internal consistency was acceptable for all five scales. For Research Question 1, the findings of the Spearman correlations indicated that there were statistically significant associations between value, enjoyment, sense of security, and motivation. For Research Question 2, the findings of the Spearman correlations indicated that there were significant associations between attitudes towards

mathematics and perceptions of cultural awareness. For Research Question 3, the findings of the MANOVA suggested that there were no statistically significant differences in attitudes towards mathematics and perceptions of cultural awareness by ethnicity. In the next chapter, further discussions of the statistical findings in connection to the theoretical framework will be provided.

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

Introduction

This chapter is divided into seven sections to present a thorough discussion of the study, provide recommendations for educational leaders and researchers, and to conclude main points and implications of the study. The chapter begins with an overview section that begins by briefly restating the problem, purpose, and theoretical underpinnings of the study. The overview section continues by briefly discussing the rationale for the methodology and the connection to the research questions and hypotheses of the study. The second section of this chapter delves deeper into the results of this study and additional interpretations are discussed. The third section outlines and illustrates recommendations for educational leaders based upon the results and discussion of this study. The fourth section provides next steps for leaders as they embark upon the task of educational reform in areas related to implications of this study. The fifth section proposes recommendations for future research; specifically, emphasizing research components or approaches that may corroborate the results and implications of this study. The sixth section acknowledges limitations to this study after data collection, data analysis, and discussion of results. The seventh section presents a conclusion to all aspects of the purpose, literature, methodology, and results of this study.

Overview

During this current educational crisis of disproportionate achievement amongst ethnicity groups, leaders across the United States are facing the challenge of narrowing the achievement gap in mathematics between African American students and their peers. Historically, mathematics education has been bounded by Eurocentric ideals and approaches that have not been modified to reflect the cultural diversity in the population. Eurocentrism has been engrained in the mathematics curriculum and proposed pedagogical practices, which has served as a detriment to the achievement of the African American student population (Anderson, 1990). As some educational leaders seek to shift the Eurocentric philosophy of mathematics education, it is important to obtain and consider the perspectives of the students who are receiving this education.

This study sought to address the low achievement of ethnically diverse students in mathematics by investigating high school students' perspectives of mathematics education from a cultural respect. The approach to address this outstanding issue in education began by researching and developing a theoretical framework based upon ethnomathematics and culturally relevant pedagogy. The limited purpose of this study was to investigate African American high school students' perspectives of their mathematics education from a cultural point of view. To meet this purpose, a quantitative, correlational research design was employed in which 375 students in grades 9-12 individually completed two

surveys online. Additionally, a 4-item demographic questionnaire was included to gather information of the students' age, gender, grade level and ethnicity.

To investigate the students' perspectives of mathematics, a 40-item Likert-scale survey titled Attitude Towards Mathematics Inventory (ATMI) was administered to the participants. The survey measured the students' attitudes toward mathematics through four subscales corresponding to (1) sense of security, (2) value, (3) motivation, and (4) enjoyment. To explore students' perspective of cultural awareness and mathematics education from a cultural respect a 12-item Likert-scale survey, titled Student Perceptions about Cultural Awareness (SPCA), was administered to the participants. The study was designed to address the following research questions:

- Research Question 1: Is there a statistically significant association between the subscales of students' attitudes toward mathematics (sense of security, value, motivation, and enjoyment)?
- Research Question 2: Is there a statistically significant association between the subscales of students' attitudes toward mathematics and perceptions of cultural awareness?
- Research Question 3: Are there statistically significant differences in students' attitudes toward mathematics and perceptions of cultural awareness by ethnicity?

To address research question one, Spearman correlation coefficients were obtained to examine the associations between the variables of interest which

were the four subscales of the ATMI survey. To address research question two, Spearman correlation coefficients were also obtained to examine the associations between the four subscales of the ATMI survey in addition to the fifth variable of interest constructed from the SPCA survey labeled as cultural awareness. To address research question three, a MANOVA was conducted to assess for differences in attitudes toward mathematics and perceptions of cultural awareness by ethnicity.

Analyses of data for research questions one and two, showed that there were statistically significant correlations between the variables of interest. However, for research question three, the MANOVA procedures did not produce any statistically significant differences among the variables of interest by ethnicity. That is, when students were grouped by ethnicity there were no statistically significant differences among the four variables of (1) sense of security, (2) value, (3) motivation, and (4) enjoyment.

In this chapter, the results of this study will be discussed in the general context and relation to the research questions. The results also will be interpreted in further detail with a specific focus on the survey responses of the African American student participants. Deriving from the discussion and interpretation of results, recommendations for leaders and educational reform will be made within the context of improving mathematics education in a cultural respect for African American high school students.

Interpretation of Results

Commonality of Student Responses

In analyzing the results of this study, it was found that there were no significant differences in the responses of the student participants to the four subscales of the ATMI survey and the SPCA survey (see Table 7 and Figures 1-5). Generally, the students, regardless of age, gender, ethnicity, or grade level, held similar attitudes toward mathematics and their perceptions of cultural awareness. A possible reason for the lack of significant differences could have been that the students in this study attended the same high school and lived in the same communities. The prevailing environment of the neighborhood communities is a powerful component in shaping attitude and perspective. These students have shared a multitude of academic and communal experiences that have influenced their personal viewpoints and mindsets. This finding supports the view point of the impact of school and community on the youth in society. Although this study included a relatively diverse demographically sample, the findings suggested a high degree of likeness and connection amongst student groups as opposed to distinctions or differences.

African American Students' Responses

A purpose of this study was to address the low mathematics achievement by African American students and to explore this phenomenon from a cultural perspective. Relatedly, the results of the responses of African American students to the survey instruments provided insight into their students' attitudes toward

mathematics as well as about their cultural awareness. In an in-depth analysis of the raw score responses from African American students, key findings are presented and interpreted within the context of the results.

Mathematics Education. The Attitude Toward Mathematics Instrument (ATMI) was a 40-item survey that measured students' attitudes toward mathematics. Each item used a Likert-scale format ranging from 1 (strongly disagree) to 5 (strongly agree) while a response of 3 indicated Neutral. Item 24 of the ATMI, which read, "I have usually enjoyed studying mathematics in school" had an average response score of 2.54. This below neutral score to Item 24 shed light on African American students' lack of enjoyment while studying mathematics which should be considered an influence on their underachievement.

It is clear that improving African American students' enjoyment for mathematics should be a focus of school administrators and mathematics teachers. A high degree of enjoyment has a positive correlation with academic achievement (Ladson-Billings, 1997). Educational leaders should use this finding as an impetus for developing curriculum and pedagogy that will actively engage African American students in learning mathematics.

It was also found that for African American students the highest average score on the 40-item ATMI was 3.89 for Item 2, "I want to develop my mathematical skills." This score provides significant evidence to the ideal that the African American students in this sample showed a strong desire to learn and improve in mathematics. These students were aware of their own mathematical

skills or lack thereof and looked to educators and educational leaders to assist in their growth and development. Moreover, this score emphasized African American students' sense of motivation and ambition to learn mathematics.

Cultural Relevance. The Student Perceptions About Cultural Awareness survey (SPCA) was a 12-item survey that measured personal attitudes regarding multicultural education. The survey used a Likert-scale format ranging from 1 (strongly disagree) to 4 (strongly agree). Of the 12 items on the SPCA, the lowest average response score of 2.28 was for Item 8 which read, "Math lessons and activities within the classroom relate to your culture/background experiences." It was found that 64 percent of the African American students disagreed or strongly disagreed with the statement of Item 8. As the item alludes to, the current mathematics curriculum of lessons and activities were not culturally relevant for African American students. Prior research has shown that students have higher academic achievement in settings in which the educational content is reflective of cultural and personal experiences (Hubert, 2014).

Of the 12 items on the SPCA, the highest average response score of 2.93 was for Item 2 which read, "Your culture/background is important to you." It was found that 67 percent of the African American students agreed or strongly agreed with the statement of Item 2. This finding is important in understanding the possible influence of culture on the individual student. The results could be in indication that a majority of the African American students feel a sense of pride in their culture and it is important to their general well-being.

The juxtaposition of the items with the lowest and highest scores lends itself to a premise of ethnomathematics which draws attention to the fact that mathematics, its techniques and truths, is a cultural product (Gerdes, 1994). Additionally, it supports a culturally relevant pedagogy (CRP) ideal that proposes the next steps for positing effective pedagogical practice as a model that not only addresses student achievement but also helps students accept and affirm their cultural identity while developing critical perspectives (Ladson-Billings, 1995d).

Recommendations for Educational Leaders

Value of the Student

The focal point of this study was on students' perspectives of their education from a cultural respect. Of the 12 items on the SPCA, the highest average response score for the overall sample of 3.01 was for Item 2 which read, "Your culture/background is important to you." It was found that 81 percent of the student participants agreed or strongly agreed with the statement of Item 2. This result supports a recommendation for educational leaders to learn about their respective student demographics and communities. This can be accomplished through research of all sorts, conversation, open forums, or surveys implemented with the solid purpose to gain student voice and perspective. For educational leaders, the data collected from students should directly drive the design of school missions and visions, curriculum choices in all subject areas, and the development of applicable pedagogical strategies.

Professional Development

As high school classrooms in the United States increase in diversity, the value of cultural connections in mathematics education may become more pivotal to effective academic instruction. Item 12 of the SPCA survey, which read, “You have a strong sense of cultural identity and understand how this will help you be successful academically” had an average response score of 2.58. It was found that 58 percent of the student participants agreed or strongly agreed with this statement. This average score to Item 12 of the SPCA survey provides evidence to support the ideal that students value their cultural identity and acknowledge a connection between culture and academics. Educational leaders shall continuously seek out instructional and pedagogical strategies that are applicable and appropriate or relevant to the culture of their student populations. These strategies should be implemented into policy and professional development for teachers. Teacher education programs and ongoing professional development should emphasize research-based multicultural education strategies to appropriately equip teachers with the tools to become culturally sensitive and culturally relevant educators.

Next Steps for Educational Reform

Engage in Applicable Research

A next step that educational leaders shall take for educational reform is to engage in research of the implementation and effectiveness of

ethnomathematics and culturally relevant pedagogy at educational institutions. In an effort to design educational reform within the theories of ethnomathematics and culturally relevant pedagogy, research shall be conducted in states and cities across the United States to include various ethnicities and culture. Subsequently, educators and educational leaders shall utilize this research to drive decisions on policy and teacher education.

Value Student Voice

The process to educational reform can begin with an individual in any role of the educational system. This study proposes that reform can begin with the input of the students. Educational leaders should increase their efforts to reach out to students and obtain their thoughts on the current mathematics education. Students should be provided with a platform to express their perspectives; moreover, this information should be valued and considered in policy decisions.

Teacher Self-Efficacy and Preparation

In the effort to appropriately shift the approach of mathematics education for underachieving African American students, rigorous collaboration and support from all stakeholders in education is required. It is most important for leaders and policymakers in education to engage in intentional conversations with current teachers about the issues of mathematics achievement. Teachers should begin to express their willingness and self-efficacy to implement a multicultural education curriculum and engage in culturally relevant pedagogy. For the teachers who may lack the willingness or self-efficacy to adjust their personal

approach to mathematics education, ample professional development opportunities with follow-up support shall be offered continuously.

In addition to supporting current teachers to become culturally relevant educators, a reform in teacher preparation programs shall materialize. As new teachers are being prepared to lead increasingly diverse classrooms, it is critical to equip them with the proper intangible tools to meet the cultural needs of each student. As the results of this study revealed, many students struggle understanding the value or enjoying mathematics and do not feel that their culture is reflected in the mathematics curriculum. Consequently, it will be beneficial to provide the knowledge of culturally relevant education and support new teachers prior to their teaching careers.

Recommendations for Future Research

Theory to Practice

This study was designed and implemented within a theoretical framework that includes the theories of ethnomathematics and culturally relevant pedagogy which were initially proposed by D'Ambrosio (1985) and Ladson-Billings (1987), respectively. The literature over the time since the theories were proposed has on this topic provides extensive theoretical expressions coupled with remarkable insight and perspectives of ethnomathematics, culturally relevant pedagogy, and a broader concept of multicultural education. However, there is a shortage of

research on the high school classroom practice of these theories to corroborate and strengthen the value of the concepts and prior research in general.

It is recommended that future researchers engage in experimental studies that begin with the development of a concrete mathematics curriculum in addition to pedagogical approaches that are specifically based upon the theories of ethnomathematics and culturally relevant pedagogies for African American students. This comprehensive plan should include daily lesson plans, activities, formative assessments, and summative assessments that will be implemented over the majority of an academic school year in a classroom or school site. Data that pertains to students' academic achievement, value, enjoyment, sense of security, motivation, and cultural awareness should be collected frequently over the course of the academic school year. This exact data should also be collected from a classroom or school site where students are receiving the traditional mathematics education. The data from the two distinct settings should be compared utilizing fair and applicable analyses. This research approach will strengthen the theories of ethnomathematics and culturally relevant pedagogy due to concrete data collected from classroom practice.

Qualitative Corroboration

In this study, measures of African American students' perspectives on their mathematics education were solely obtained in a quantitative manner; specifically, via Likert-scale surveys. It is acknowledged that the utilization of Likert-scale surveys unintentionally creates boundaries as students must choose

one phrase (i.e. strongly disagree, disagree, agree, strongly agree) to answer a question that may require further discussion. A basis of this study was to gain authentic student perspectives to assist in improving mathematics education in a cultural manner. Consequently, it is recommended that qualitative research components such as interviews and open-ended questioning could strengthen the authenticity of responses. During interviews, students should be allowed to speak freely and elaborate on their responses to open-ended questions.

Open-ended questions that have potential to corroborate participant responses and strengthen recommendations of this study could be derived from the following items of the SPCA survey: (2) Your culture/background is important to you; (4) Incorporating your cultural/background experiences into the math classroom will help you be academically successful; and (12) You have a strong sense of cultural identity and understand how this will help you be successful academically. To modify the items for elaboration and underlying perspectives of participants, the following open-ended interview questions should be asked:

- 1) Is your culture/background important to you? Why or why not?
- 2) Would incorporating your cultural and background experiences into your mathematics education help you become more academically successful? Explain your reasoning.
- 3) Do you have a strong sense of cultural identity? How so? Do you feel that your cultural identity can have an effect on your academic success? Why or why not? Explain your reasoning.

The qualitative data resulting from these open-ended interview questions should be collected from student participants, coded, and specific themes should be gathered to corroborate Likert-scale responses.

Limitations of Study

It is acknowledged that the sample population is unique and the data collected in this study may not be generalized to student populations across the United States. Student participants were required to respond to survey items about their mathematics education as well as their cultural awareness. In the data analysis, variables such as grade level, age, teacher effect, school effect, and family background have the potential to affect responses but were not considered. It is also acknowledged that the participants in this study attend the same high school and live in the same communities; therefore, their experiences, perceptions, and perspectives have high potential to be similar which may have affected the data analysis.

A limitation to this study was also revealed in the ethnicity distribution of the student participants. Of the 375 participants in this study, 268 were Hispanic/Latino, 54 were Black/African American, 32 were Other, and 21 were White. The focus of this study was to gain the most insight from the Black/African American student population; however, the high Hispanic/Latino population at the school site affected the reach of the study. Also, to address research question three, a MANOVA was conducted to assess for differences in attitudes toward

mathematics and perceptions of cultural awareness by ethnicity but the value of the analysis may have been diminished due to the uneven ethnicity distribution. Due to the quantitative methodology, it is acknowledged that a full examination of the underlying perceptions of students was not attained.

Conclusion

This study explored the phenomenon of mathematics underachievement by African American students in comparison to their peers. Many scholars have examined, analyzed, and produced a litany of literature to investigate the cause, as well as propose strategies to address the mathematics achievement gap. Nonetheless, measurable progress continues to reveal that the achievement gap is widening over time despite new knowledge and educators pushing for reform. The results of this study support the notion that the current approach to mathematics education is ineffective and a proposal to change the cultural aspects is discussed. This study emphasizes the focus on the students and the benefit of obtaining student perspectives to act as advocates for their own education.

As education is currently constructed, students are gathered in a theoretical factory which they call school, and are being taught and presented with a mathematics curriculum that is reproducing Eurocentric ideals. Students shall develop as advocates, express their perspectives, and begin to reject the numerous notions that their culture is inconsequential in school or society.

Students exercising resistance and utilizing their agency to advocate for a more culturally relevant education is what will shift the wave of education from mere reproduction of one culture or ideology to maximizing and valuing the potential of all cultures.

APPENDIX A
INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



February 09, 2018

CSUSB INSTITUTIONAL REVIEW BOARD

Full Board Review

IRB# FY2018-44

Status: Approved

Mr. Brice Scott and Prof. Joseph Jesunathadas

Doctoral Studies Program
California State University, San Bernardino
5500 University Parkway
San Bernardino, California 92407

Dear Mr. Scott and Prof. Jesunathadas:

Your application to use human subjects, titled "Enhancing the Curriculum for African American High School Students: Ethnomathematics and Cultural Relevance in Unity" has been reviewed and approved by the Institutional Review Board (IRB). The informed consent document submitted with your IRB application is the official version for use in your study and cannot be changed without prior IRB approval. A change in your informed consent (no matter how minor the change) requires resubmission of your protocol as amended through the Cayuse IRB system protocol change form. **Your application is approved for one year from February 09, 2018 through February 08, 2019. Please note the Cayuse IRB system will notify you when your protocol is due for renewal. Ensure you file your protocol renewal and continuing review form through the Cayuse IRB system to keep your protocol current and active unless you have completed your study**

Your responsibilities as the researcher/investigator reporting to the IRB Committee include the following 4 requirements as mandated by the Code of Federal Regulations 45 CFR 46 listed below. Please note that the protocol change form and renewal form are located on the IRB website under the forms menu. Failure to notify the IRB of the above may result in disciplinary action. You are required to keep copies of the informed consent forms and data for at least three years. Please notify the IRB Research Compliance Officer for any of the following:

- 1) Submit a protocol change form if any changes (no matter how minor) are proposed in your research protocol for review and approval of the IRB before implemented in your research,**
- 2) If any unanticipated/adverse events are experienced by subjects during your research,**
- 3) To apply for renewal and continuing review of your protocol one month prior to the protocols end date,**
- 4) When your project has ended by emailing the IRB Research Compliance Officer.**

The CSUSB IRB has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval notice does not

replace any departmental or additional approvals which may be required. If you have any questions regarding the IRB decision, please contact Michael Gillespie, the IRB Compliance Officer. Mr. Michael Gillespie can be reached by phone at (909) 537-7588, by fax at (909) 537-7028, or by email at mgillesp@csusb.edu. Please include your application approval identification number (listed at the top) in all correspondence.

Best of luck with your research.

Sincerely,

Caroline Vickers

Caroline Vickers, Ph.D., IRB Chair
CSUSB Institutional Review Board

CV/MG

APPENDIX B

ATTITUDES TOWARD MATHEMATICS INVENTORY PERMISSION LETTER

4/21/2018

CoyoteMail Mail - Attitude Towards Mathematics Inventory



Brice Scott <003233268@coyote.csusb.edu>

Attitude Towards Mathematics Inventory

Tapia, Martha <mtapia@berry.edu>

Tue, Jan 16, 2018 at 7:24 AM

To: "scotb304@coyote.csusb.edu" <scotb304@coyote.csusb.edu>

Dear Brice,

You have permission to use the Attitudes Toward Mathematics Inventory (ATMI) in your dissertation. If you have any question, please do not hesitate to ask me.

Please let me know of the findings in your study.

Sincerely,

Martha Tapia

Martha Tapia, Ph.D.

Associate Professor

Department of Mathematics and Computer Science

Berry College

P.O. Box 495014

Mount. Berry, Georgia 30149-5014

From: Brice Scott [mailto:scotb304@coyote.csusb.edu]

Sent: Friday, January 12, 2018 2:42 PM

To: Tapia, Martha <mtapia@berry.edu>

Subject: Attitude Towards Mathematics Inventory

Hello Dr. Tapia,

[Quoted text hidden]

<https://mail.google.com/mail/u/2/?ui=2&ik=79018b12e8&jsver=OeNArYUPo4g.en.&view=pt&msg=160ff920110a2cd2&q=TAPIA&qs=true&search=query&siml=160ff92>

APPENDIX C
DEMOGRAPHICS QUESTIONNAIRE SURVEY INSTRUMENT

Demographic Information

Please select the appropriate response for each of the items.

* 2. What is your gender?

- Male
- Female

* 3. What is your current age?

* 4. What grade level are you in?

- 9th
- 10th
- 11th
- 12th

* 5. What is your ethnicity?

- African-American/Black
- Hispanic/Latino
- White/Caucasian
- Other

APPENDIX D

ATTITUDES TOWARDS MATHEMATICS INVENTORY SURVEY INSTRUMENT

Copy of page: Attitudes Toward Mathematics Inventory (Part 1)

Directions: This inventory consists of statements about your attitude toward mathematics. Read each item carefully. Please think about how you feel about each item. Select the response that most closely corresponds to how each statement best describes your feelings.

* 6. Please answer each question:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Mathematics is a very worthwhile and necessary subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I want to develop my mathematical skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get a great deal of satisfaction out of solving a mathematics problem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics helps develop the mind and teaches a person to think.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics is important in everyday life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics is one of the most important subjects for people to study.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High school math courses would be very helpful no matter what I decide to study	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can think of many ways that I use math outside of school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics is one of my most dreaded subjects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My mind goes blank and I am unable to think clearly when working with mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Studying mathematics makes me feel nervous.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Mathematics makes me uncomfortable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always under a terrible strain in a math class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I hear the word mathematics, I have a feeling of dislike.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It makes me nervous to even think about having to do a mathematics problem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics does not scare me at all.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a lot of self-confidence when it comes to mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am able to solve mathematics problems without too much difficulty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect to do fairly well in any math class I take.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always confused in my mathematics class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Attitudes Toward Mathematics Inventory (Part 2)

Directions: This inventory consists of statements about your attitude toward mathematics. Read each item carefully. Please think about how you feel about each item. Select the response that most closely corresponds to how each statement best describes your feelings.

* 7. Please answer each question:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel a sense of insecurity when attempting mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I learn mathematics easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I could learn advanced mathematics in school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have usually enjoyed studying mathematics in school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics is dull and boring.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to solve new problems in mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would prefer to do an assignment in math than to write an essay.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would like to avoid using mathematics in college.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I really like mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am happier in a math class than in any other class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mathematics is a very interesting subject.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am willing to take more than the required amount of mathematics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I plan to take as much mathematics as I can during my education.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The challenge of math appeals to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think studying advanced mathematics is useful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe studying math helps me with problem solving in other areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am comfortable answering questions in math class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A strong math background could help me in my professional life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I am good at solving math problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6

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APPENDIX E
STUDENT PERCEPTIONS ABOUT CULTURAL AWARENESS SURVEY

Student Perceptions about Cultural Awareness Survey

The following page contains survey items regarding student perceptions about cultural awareness:

* 8. Please answer each question:

	Strongly disagree	Disagree	Agree	Strongly agree
To better keep your interest, math classroom activities should relate to your culture/background experiences.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your culture/background is important to you.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your culture/background is made a part of regular math class instruction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Incorporating your cultural/background experiences into the math classroom will help you be academically successful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You have knowledge about cultures other than your own.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is necessary to learn about other people's cultures/background.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Math lessons and activities should relate and reflect your culture.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Math lessons and activities within the classroom relate to your culture/background experiences.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When a math lesson/activity relates to your culture/background experiences you perform better.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Agree	Strongly agree
You are culturally aware and understand and how other cultures relate to you.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You do well on math activities that relate to you.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You have a strong sense of cultural identity and understand how this will help you be successful academically.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

(Developed by Brice Scott)

APPENDIX F
DESCRIPTIVE STATISTICS OF AFRICAN AMERICAN STUDENTS' SURVEY
RESPONSES

Descriptive Statistics^a

	N	Minimum	Maximum	Mean	Std. Deviation
Mathematics is a very worthwhile and necessary subject.	54	1	5	3.48	1.209
I want to develop my mathematical skills.	54	1	5	3.89	1.022
I get a great deal of satisfaction out of solving a mathematics problem.	54	1	5	3.30	1.253
Mathematics helps develop the mind and teaches a person to think.	54	1	5	3.41	1.073
Mathematics is important in everyday life.	54	1	5	3.31	1.210
Mathematics is one of the most important subjects for people to study.	54	1	5	3.46	1.145
High school math courses would be very helpful no matter what I decide to study	54	1	5	3.07	1.330
I can think of many ways that I use math outside of school.	54	1	5	3.20	1.219
Mathematics is one of my most dreaded subjects.	54	1	5	2.74	1.152
My mind goes blank and I am unable to think clearly when working with mathematics.	54	1	5	3.07	1.315
Studying mathematics makes me feel nervous.	54	1	5	3.19	1.245
Mathematics makes me uncomfortable.	54	1	5	3.26	1.262
I am always under a terrible strain in a math class.	54	1	5	3.06	1.309
When I hear the word mathematics, I have a feeling of dislike.	54	1	5	3.13	1.332

It makes me nervous to even think about having to do a mathematics problem.	54	1	5	3.19	1.333
Mathematics does not scare me at all.	54	1	5	3.15	1.338
I have a lot of self-confidence when it comes to mathematics.	54	1	5	2.98	1.310
I am able to solve mathematics problems without too much difficulty.	54	1	5	2.83	1.194
I expect to do fairly well in any math class I take.	54	1	5	3.06	1.280
I am always confused in my mathematics class.	54	1	5	3.00	1.259
I feel a sense of insecurity when attempting mathematics.	54	1	5	3.22	1.239
I learn mathematics easily.	54	1	5	2.67	1.149
I am confident that I could learn advanced mathematics in school.	54	1	5	2.96	1.288
I have usually enjoyed studying mathematics in school.	54	1	5	2.54	1.239
Mathematics is dull and boring.	54	1	5	2.78	1.269
I like to solve new problems in mathematics.	54	1	5	2.81	1.199
I would prefer to do an assignment in math than to write an essay.	54	1	5	2.91	1.404
I would like to avoid using mathematics in college.	54	1	5	2.74	1.231
I really like mathematics.	54	1	5	2.50	1.240
I am happier in a math class than in any other class.	54	1	5	2.30	1.283
Mathematics is a very interesting subject.	54	1	5	2.74	1.277

I am willing to take more than the required amount of mathematics.	54	1	5	2.52	1.270
I plan to take as much mathematics as I can during my education.	54	1	5	2.80	1.392
The challenge of math appeals to me.	54	1	5	2.61	1.250
I think studying advanced mathematics is useful.	54	1	5	2.96	1.165
I believe studying math helps me with problem solving in other areas.	54	1	5	3.13	1.260
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	54	1	5	2.93	1.195
I am comfortable answering questions in math class.	54	1	5	2.87	1.275
A strong math background could help me in my professional life.	54	1	5	3.07	1.257
I believe I am good at solving math problems.	54	1	5	2.94	1.156
To better keep your interest, math classroom activities should relate to your culture/background experiences.	54	1	4	2.48	.841
Your culture/background is important to you.	54	1	4	2.93	.866
Your culture/background is made a part of regular math class instruction.	54	1	4	2.30	.768
Incorporating your cultural/background experiences into the math classroom will help you be academically successful.	54	1	4	2.46	.840

You have knowledge about cultures other than your own.	54	1	4	2.89	.769
It is necessary to learn about other people's cultures/background.	54	1	4	2.81	.826
Math lessons and activities should relate and reflect your culture.	54	1	4	2.43	.767
Math lessons and activities within the classroom relate to your culture/background experiences.	54	1	4	2.28	.834
When a math lesson/activity relates to your culture/background experiences you perform better.	54	1	4	2.54	.884
You are culturally aware and understand and how other cultures relate to you.	54	1	4	2.59	.813
You do well on math activities that relate to you.	54	1	4	2.61	.856
You have a strong sense of cultural identity and understand how this will help you be successful academically.	54	1	4	2.70	.816
Valid N (listwise)	54				

a. EthnicityRecode = African American

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