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## THE ROLE OF ETHNIC/RACIAL CLASSROOM DYNAMICS IN THE LEARNING ENVIRONMENT AND MATHEMATICS ACHIEVEMENT

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THE ROLE OF ETHNIC/RACIAL CLASSROOM DYNAMICS  
IN THE LEARNING ENVIRONMENT AND MATHEMATICS ACHIEVEMENT

BY

CHRISTINA STEPHENS

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF  
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IN

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2019

MASTER OF SCIENCE  
OF  
CHRISTINA STEPHENS

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UNIVERSITY OF RHODE ISLAND  
2019

## ABSTRACT

In the U.S., ethnic and racial disparities in education persist throughout K-12 education. Empirical research has linked classroom ethnic/racial structures and achievement, and the learning environment and achievement. However, few studies have considered the complex manner in which ethnicity/race may interact with the learning environment and its relation to student success across diverse groups. The current study investigated the role that ethnic/racial congruence between the student, teacher, and classroom could have on the learning environment and mathematics achievement. A multilevel regression approach examined if these factors predicted academic achievement. Secondary data were from The National Center for Teacher Effectiveness, collected between 2010-2013. This study drew from a purposeful sample of 1,851 fourth-grade mathematics students from diverse groups. It relied on a combination of student, teacher, and classroom data collected through administrative records, questionnaires, and surveys. Results indicated that: 1) student perceived conflict with teacher, 2) teacher beliefs about their students' math ability, 3) ethnic/racial congruency between a student and their classroom, and 4) ethnic/racial similarities between a teacher and their classroom significantly predicted *better* math test scores. However, ethnic/racial congruency between a student and their teacher was negatively related to math test scores. Additionally, when a student and their teacher were ethnically/racially congruent, there was more conflict and worse math achievement. These findings are aligned with prior work, highlighting that ethnic/racial classroom dynamics are related to the learning environment, and achievement.

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## **PREFACE**

This Master's Thesis is presented in Manuscript Format. It is original, unpublished, and independent work by the author, Christina Stephens. The research described was conducted under the supervision of my advisor, Dr. Asha Spivak. It is intended for submission to an academic research journal for publication.

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**“The Role of Ethnic/Racial Classroom Dynamics in the Learning Environment  
and Mathematics Achievement”**

by

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is prepared for submission to Cultural Diversity  
& Ethnic Minority Psychology Journal

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## CHAPTER 1

### INTRODUCTION

In the U.S., ethnic and racial disparities in various markers of student academic success are evident in early childhood and persist through K-12 education. The academic underperformance of minoritized ethnic or racial groups of students has persisted for decades, and these groups have faced a history of discrimination and marginalization (Curran & Kellogg, 2016; Hochschild & Shen, 2014; Morris & Perry, 2016; Reardon & Galindo, 2009). Due to the implications school success has for students' long-term outcomes related to income, health, and wellbeing (Emerson & Murphy, 2014; Hall et al., 2015; Kutateladze, Andiloro, Johnson, & Spohn, 2014), it is important to pinpoint what classroom experiences might allow for improvement in the quality of education for ethnically/racially diverse students (Benner, Graham, & Mistry, 2008).

Despite ethnic/racial achievement gaps narrowing after the implementation of school desegregation laws in the 1950s, and students from minoritized backgrounds continue to perform worse in academics (Morris & Perry, 2016). More recent government initiatives such as the *No Child Left Behind Act*, *Head Start*, and *Race to the Top* have all helped in equalizing access to education. These efforts have made improvements in K-12 grade education; however, there are still apparent ethnic/racial disparities in academic achievement (Curran & Kellogg, 2016; Hochschild & Shen, 2014). While the presence of high-quality education may promote better academic achievement, access may be restricted for ethnically/racially-minoritized students

(American Psychological Association [APA], 2012). Improving the education of minoritized students not only has potential to improve achievement but also to address societal inequities. Ethnic/racial disparities extend beyond education into other areas of society such as healthcare outcomes (Hall et al., 2015), rates of police detainment and incarceration (Kutateladze et al., 2014), and workforce matters such as hiring, pay, and upward mobility (Emerson & Murphy, 2014). Due to the social and economic advantages that education represents, including more income earned (Reardon, 2013) and higher college completion rates (Roderick, Coca, & Nagaoka, 2011), it is important to examine ways of improving academic success.

Previous empirical research has examined how the instructional environment, perceptions, behaviors, biases, and background characteristics of teachers and students may contribute in complex ways to the academic performance of students across ethnic/racial groups (Downer, Goble, Myers, & Pianta, 2016; Griffin, 2014; Mabin, 2016). Studies have also examined the relationship between ethnic/racial congruency within classrooms with academic achievement (Egalite, Kisida, and Winters, 2014). This concept considers how students, teachers, and classroom compositions may be ethnically/racially similar, or different. What remains unclear is how multiple dimensions of ethnicity/race congruency may contribute to educational outcomes. However, there may be a more dynamic relationship that further explains achievement disparities. There is also a need to improve understanding of how ethnicity/race congruency could change the relationship between the instructional environment and achievement. The current study expands on research by investigating this potentially complex interaction between ethnicity/race classroom congruency, aspects of the

learning environment, and academic achievement are related in a diverse sample of elementary school students. Recent research has continued to identify the need for studies to consider the influence of an ethnically/racially diverse instructional environment (APA, 2012).

The aim of the current study is to better understand how aspects of ethnicity/race congruency may explain the supportive nature that the learning environment offers to academic achievement. More specifically, this study explores how three different dimensions of ethnicity/race congruency may explain disparities in achievement found between African American, Hispanic, and White students. The study explores three dimensions of ethnicity/race congruency in the classroom: 1) student-teacher match, 2) student-classroom congruence, and 3) teacher-classroom congruence. Additionally, these dimensions may also further explain the influence the instructional environment may have on achievement. These three dimensions of ethnic/racial classroom composition will be considered first in the relation they have to math achievement; second, they will be examined in relation to the role they might play in influencing the learning environment's contribution to explain academic achievement. Aspects of the learning context were measured by: 1) student perceptions of conflict with teacher, 2) student perceptions of the quality of teacher instructional support to the individual student and the classroom, and 3) teacher beliefs about the math ability of students in their classroom. A multilevel regression approach was utilized to determine if these aspects of the learning environment predict and/or interact together with ethnic/racial dimensions of congruency to explain academic achievement.

## CHAPTER 2

### REVIEW OF LITERATURE

From a bioecological perspective, learning is a complex and interactive process between individuals, their many contexts, and time. According to this theory, contextual factors are key in developmental processes (Bronfenbrenner & Morris, 2006), including educational settings (Benner, Graham, & Mistry, 2008). An ecological systems perspective suggests that interactions and growth occur across multiple levels of environmental influence (Benner & Yan, 2015). While an educational environment is crucial to the academic achievement of children, personal characteristics and background may also influence learning. Additionally, students may also have had experiences outside of school settings that further influence the landscapes of their learning environment. For example, the positioning of social status, instances of racism, and also socialization with the same versus different ethnic/racial groups provide additional information about the context of development (Burchinal et al., 2011).

A main component of identity is related to ethnicity and race (Hughes, Watford, & Toro, 2016). Shaped primarily by self- and other-perceptions, social interactions, discrimination, and family beliefs and traditions, individuals develop an ethnic/racial identity (Moje & Martinez, 2007). This identity can inform the behaviors, values, and communication patterns a child exhibits in relation to their surroundings (Nagel, 1994). Their ethnic/racial identity is also intertwined with their larger social

identity. Additionally, the common ingroup identity model explains how people tend to relate and communicate more effectively with those whom they share similarities (Gaertner et al., 1993). These interpersonal experiences may enrich academic instruction and the quality of learning of students. Thus, when students are not in a learning context where their teachers or classroom peers are ethnically/racially similar to them, they may feel misunderstood, or there may be less accurate interpretations of student abilities and behaviors.

### **Achievement in Elementary Mathematics**

While academic achievement in multiple areas is important to the educational success of a child (Curran & Kellog, 2016; Marsh & Yeung, 1998), the current study focuses specifically on the subject of mathematics. Tate (1997) reported on the value of math education to ethnically and racially diverse students. The importance of mathematics education is clear when considering societal advancements in technology that can occur with better mathematical knowledge. Leon, Medina-Garrido, and Núñez (2017) provided support for the importance of high-quality math education. The results of their study indicated that the presence of higher quality math instruction was related to increased behavioral engagement in students (i.e. motivation, connectedness, attention) and also better academic achievement. It has been suggested that student engagement is an indicator of the quality of the learning environment and level of student connection to the classroom (APA, 2012). Furthermore, work from Gaspard et al. (2015) emphasized the positive implications that the cognitive skills developed as a result of mathematics instruction have on other academic subjects (i.e. reading and science). Specifically, achievement disparities in one subject area have also been

linked to disparities in math achievement across ethnic, racial, and socio-economic groups (Betancur, Votruba-Drzal, & Schunn, 2018; Morgan et al., 2016; Quinn & Cooc, 2015). Thus, an understanding of the interplay between demographic characteristics and mathematics achievement likely has many implications for overall student learning.

### **Ethnic/Racial Match of the Student, Teacher, and Classroom Composition**

In this study, ethnicity/race congruency will be considered among: 1) a student and their teacher, 2) students and their classroom, and 3) teachers and their classroom. Ethnic/racial congruency and diversity in classrooms are considered structural characteristics and may indirectly influence academic achievement through proximal processes (Benner, Graham, & Mistry, 2008). These processes in the classroom involve interpersonal communications that influence the context of learning (Banerjee, 2013). Work from Banerjee (2013) also found that greater diversity in the classroom was related to a worse learning context and worse academic outcomes for students. Thus, while the current study examines how factors of the learning environment are related to the outcome of achievement (Rucinski et al., 2019), these classroom ethnic/racial dimensions of classroom composition are being considered because their influence may further explain this relationship.

**Student-teacher ethnic/racial match.** Studies have examined the implications that ethnic/racial congruence between an individual student and their teacher have found mixed findings for the outcome of academic achievement (Driessen, 2015; Joshi, Doan, & Springer, 2018; Yarnell & Bohrnstedt, 2018). Benner and Yan (2015) reported that while classroom processes may infer a direct impact on academics, they

are really informed by structural characteristics within the context of learning. Additionally, ethnic/racial congruence between a student and their teacher has been linked to other educational outcomes, such as discipline. For example, Lindsay and Hart (2017) found that when students and teachers were ethnically/racially similar to each other, consequences of student-teacher conflict were less severe; this relationship was found to extend across elementary education through high school. However, this area of research has been mixed in linking this dimension of classroom structure with achievement (Driessen, 2015; Joshi, Doan, & Springer, 2018; Yarnell & Bohrnstedt, 2018). The direct implication of ethnic/racial congruence between students and teachers and academic achievement has also been studied by Egalite, Kisida, and Winters (2014). This study found that ethnic/racial similarity had only a small effect on improving reading and math achievement test scores for African American and White students. A limitation of these findings addressed by the current study is the consideration of the quality of the learning environment. While there are possible benefits when a student and their teacher ethnically/racially match, research should continue to examine how these structural characteristics are interacting with the classroom context.

**Student-classroom ethnicity/race congruency.** The educational environment and academic achievement may be further enhanced when there is consideration for ethnic/racial similarity between students and their classroom. As Benner and Yan (2015) suggest, structural characteristics of a group may also influence the educational processes occurring in a classroom. Diversity in the ethnic/racial composition may bring exciting opportunities to a classroom that allow for rich educational experiences

in the interactions between students with different ideas (Gurin et al., 2002). However, as the APA (2012) suggests, increased diversity may also intensify academic disparities. A study conducted by McKown and Weinstein (2008) similarly indicated that in the presence of structural diversity among students in the classroom, there may be an increased potential for teachers to report differential expectations, treatment, and educational outcomes. The relationship that these classroom structural characteristics have with achievement remains unclear due to the dual interactions that these structures may also have with the learning context.

**Teacher-classroom ethnicity/race congruency.** The ethnic/racial similarity a teacher has with their classroom may also play a role in the educational environment that is created. This is another structural dimension that a classroom might have that plays a role in the interactive learning processes that occur. Benner and Yan's (2015) study found that when a student and their teacher ethnically/racially matched, there was an increased sense of student involvement, which has positive implications for achievement. Studies such as that of Downer et al. (2016) provided support for increasing demographic similarities within the classroom. This study found that when students matched the ethnicity/race of their teacher, their behaviors were interpreted more favorably (Downer et al., 2016). In consideration of research in this area, a more effective learning environment with demographic similarities in the classroom may be a possible asset to increasing the quality of instruction.

There are also apparent challenges that may complicate research that examined classroom diversity or demographic similarity. For instance, many argue over a lack of diversity in the teacher workforce not only in terms of gender, but also

in ethnicity/race (APA, 2012). This may be an important step in the promotion of achievement across ethnic/racial groups of students. Despite this area of concern, Downer et al. (2016) further highlight the need for the current study to examine the role that ethnic/racial congruence may have in the classroom. There are apparent gaps in this area of research that might further address the role of ethnicity/race in educational equity. Driessen (2015) indicated a lack of studies that link minority group teachers to better minority student achievement and the contributing factors of this effect. Findings from Terenzini, Colbeck, Bjorklund, & Parente (2001) cited the lack of attention paid to classroom or structural diversity in relation to the learning context. This area could have implications for student learning, however, as Benner and Yan (2015) suggested, these structural characteristics in the classroom may have had an indirect relationship. Thus, when considering the ethnic/racial demographics of the classroom, it is crucial to examine interrelated processes, such as classroom interactions and their relation to achievement. The current study addresses this demand for new research in this area, as multiple types of ethnic/racial structural characteristics were considered.

### **Student-Teacher Conflict**

Student conflict with their teacher has been found to be disruptive of their own learning, or of the learning of their peers. Research suggests that frequent student conflict with their teacher may contribute to a worse relationship (Baker, Grant, & Morlock, 2008). Student-teacher conflict in the classroom has been found to be negatively correlated with academic achievement and can be telling of the quality of the classroom learning environment (Downer et al., 2016). Student-teacher conflict

can arise for numerous reasons. Findings from Downer et al. (2016) indicated that there were instances where conflict arose when there were misinterpretations in classroom interactions. Instances of problematic behaviors that are aversive to student learning can be indicative of not only the student's motivation for learning but also the relationship they might have with their teacher (Legault, Green-Demers, & Pelletier, 2006).

Student-teacher conflict may be amplified in the presence of ethnic/racial mismatch between the teacher and their students. Work from Bates and Glick (2013) found that African American students received more positive behavioral evaluations when their teacher matched their race. The APA (2012) further cited ethnic/racial inequities in discipline practices for minoritized students. More recent work from Lindsay and Hart (2017) further confirmed the link between classroom ethnic/racial congruence and student-teacher conflict by showing that demographic similarity led to less severe disciplinary outcomes. The current study will examine how ethnic/racial similarities within the classroom may connect student reporting of conflict with their teacher and math achievement. This contributes to a suggested need of linking student-teacher conflict in the classroom and student achievement, especially across ethnically/racially diverse students (Mattison & Aber, 2007).

### **Teacher Instructional Support**

A teacher is responsible for not only providing whole-group classroom instruction but should also aim to address the learning needs of each of their individual students. Students in the classroom can also be aware of the quality of their teacher's instructional support. A study conducted by Mabin (2016) used the Tripod Student

Survey (Tripoded, 2015) to examine individual student perceptions of teacher quality and the learning environment. The findings of this study were consistent with previous literature that found that more positive student views of teacher quality and the learning environment were related to better academic achievement (APA, 2012; Griffin, 2014). However, Mabin (2016) also found that this effect was especially present in the case of ethnically/racially diverse students, especially for White and African American students that matched the background of their teacher.

Increased research regarding how ethnically/racially diverse environments interact with the classroom context may lead to a better understanding of how to improve academic success across diverse student groups. Work by Fauth et al. (2014) reported that student ratings of classroom instructional quality may be a predictor of student achievement, however, there is a need to connect this association with ethnic/racial structures. Research has also found that the presence of group diversity must be met with a higher quality of instructional support (APA, 2012). The quality of classroom support in this area may further improve engagement within a school community. Student engagement is an indicator of connection to a classroom's content in a way that promotes learning and better academic outcomes (APA, 2012). Furthermore, student engagement has been found to improve in the presence of greater ethnic/racial diversity (Benner & Crosnoe, 2011). This could be because in a diverse learning environment, traditionally minoritized students have more peers that they are similar to. In sum, these findings further emphasize how the classroom structural composition may affect instructional support and its relationship with achievement.

## **Teacher Beliefs about Mathematics Ability of Students in Their Classroom**

Teacher beliefs about academic ability take into consideration the expectations that practitioners in education hold about their students. Multiple studies have examined the negative impact that low teacher expectations can have on student motivations, aspirations, and relationships with their teachers and even peers (Jacobs & Harvey, 2010; Walkey, McClure, Meyer, & Weir, 2013). These beliefs can form from interactions between members of the classroom and may be developed with some bias resulting from subjective interpretations (APA, 2012). Work by Fergus (2017) examined ethnic/racial mismatch between teachers and their students. It was found that teachers held lower expectations and more biased beliefs about their students when they were a different ethnicity/race. Due to the associations found between teacher expectations and student outcomes based on subjective evaluations, it is important to further examine how ethnic and racial dynamics explain disparities in education.

Examining the role that expectations have on student achievement may further explain cross-ethnic/racial discrepancies. Near term expectations (e.g., teacher beliefs in student proficiency in class concepts or grades) explained by Dabach, Suárez-Orozco, Hernandez, and Brooks (2018) were based on interpretations made from classroom interactions. They reported that teacher expectations were less positive for Latino immigrant students. Even though this study found structural explanations for differences in expectations, teachers typically explained their opinions using behavioral and observation-based reasons. Some research suggests that subjective evaluations of teacher judgments/beliefs can also influence later interpretations and

decisions made about students, such as academic placements (Irizarry, 2015). According to Meissel, Meyer, Yao, and Rubie-Davis (2017), teacher expectations can affect the classroom in terms of the difficulty of instruction, instructional pace, and level of support provided to students. Considering the implications of teacher expectations, it is important to further explore how to improve these beliefs that teachers hold about their students. Examining the ethnic/racial classroom composition as it relates to teacher beliefs could offer insight into the role that these types of expectations may have on academic achievement.

### **Current Study**

The current study examines dimensions of ethnic/racial congruency in relation to aspects of the learning environment and achievement in mathematics. These comparisons were examined in relation to indicators of the quality of classroom interactions occurring and math achievement. This study further explores the moderating role that ethnicity/race similarity between students, teachers, and the classroom composition might have between: 1) teacher beliefs about mathematics ability of students in their classroom, and mathematics achievement, and 2) student ratings of conflict with teachers and teacher instructional support in relation to math achievement. The aim of the current study is to examine the link between ethnicity/race and academic achievement in consideration of various interrelated classroom environmental factors. The following hypotheses are tested:

1. The presence of ethnicity/race *congruency* will be related to *better* achievement in mathematics. The three dimensions of congruency considered

are: a) student-teacher congruency, b) student-classroom congruency, and c) teacher-classroom congruency.

2. Ethnicity/race congruencies in the classroom are going to influence to what extent the learning environment may support better math achievement. The following interactions are considered:

- a. In the context of ethnic/racial congruence between students and teachers, students perceiving less conflict with their teacher will be more likely to have better student achievement in mathematics.
- b. In the context of ethnic/racial congruence between students and teachers, students perceiving better teacher instructional support to the individual student will be more likely to have better student achievement in mathematics.
- c. In the context where students *and* teachers are ethnically/racially similar to their classroom, students perceiving better student perceptions of teacher instructional support to the classroom will be more likely to have better student achievement in mathematics.
- d. In the context where teachers are ethnically/racially similar to their classroom, more positive teacher beliefs about mathematics ability in their classroom will be more likely to have better student achievement in mathematics.

## CHAPTER 3

### METHODOLOGY

This study draws on data from an evaluation by the National Center for Teacher Effectiveness (NCTE) (Kane, Hill, & Staiger, 2016). Access to this study was granted through the Inter-University Consortium for Political and Social Research (ICPSR). The study was conducted from 2010 to 2013 and contains data on a total of 10,334 fourth- and fifth-grade math students. The goal of this study, funded by the U.S. Department of Education, intends to develop effective measures of math instruction in elementary education. Data collected for this project includes administrative/demographic data, student questionnaires, teacher surveys, academic assessments, and observational data.

#### **Participants**

For the present study, data is derived from a subsample of 1,851 children who took part the NCTE study. Only data for fourth-grade students from the first year of collection (2010-2011) were selected for analyses. This purposeful sample is comprised of 51% African American ( $N = 944$ ), 27.1% White ( $N = 501$ ), and 21.9% Hispanic ( $N = 406$ ) students. Also, 50.4% ( $N = 932$ ) of the sample was female, 64.6% of the students received free or reduced lunch (FRL) ( $N = 1,196$ ), 19.7% were considered as having limited English proficiency (LEP) ( $N = 365$ ), and 11.6% were assigned special education status (SPED) ( $N = 215$ ).

The sample of students is from 108 classrooms in 34 schools from 3 school districts (in Georgia, Massachusetts, and Washington, D.C.). The mean classroom size for students in this sample is 21 students. The students included in this sample were ethnically and racially diverse at the classroom and school levels. The mean ethnic/racial breakdown of classrooms is 49.27% African American, 21.08% Hispanic, and 21.88% White. The mean breakdown of schools in the sample is 55.36% African American, 20.57% Hispanic, and 18.74% White. The sample of teachers ( $N = 104$ ) were 86.5% female, and 15.3% African American, 2.4% Hispanic, and 69.2% White. 13.1% of the sample of teachers had missing data for ethnicity/race.

The current study uses only participants from the 2010-2011 year of data collection due to math assessments and surveys differing between years of the NCTE study. Sampling criterion included only participants with data on measures of the dependent variable: academic achievement. Student participants were included if they had scores on the state math assessment and the alternative math assessment (AMA). Additionally, student participants missing data on their ethnicity/race were also excluded.

### **Measures**

The current study relies on a combination of student, teacher, and classroom data. Student and teacher demographic information was obtained through school administrative records and questionnaires, respectively. To gather information about teacher beliefs about student ability in mathematics in the classrooms, the curriculum alignment survey was used. This survey was administered to teachers in the spring. The student survey scales measuring teacher instructional support to the student, and

teacher instructional support to the classroom, and student perceived conflict with the teacher were derived from this measure. This student survey was administered to students by their teachers or site coordinator and was a version of the Tripod Student Survey (Ferguson, 2009). The anonymity of the students' responses was maintained through submitting the completed surveys in sealed envelopes. Scale construction from this measure, and principle component analyses were conducted and explained in Appendix B and C.

**Ethnicity/race congruency between the student and teacher.** The ethnicity or race of students and teachers was categorized as White, African American, or Hispanic (coded as 0, 1, or 2, respectively). From this information, a variable was created that compares the ethnicity/race of the student with their teacher; this computed variable was considered as a match (coded as 1) or a mismatch (coded as 0).

**Ethnicity/race congruency between the student/teacher with the classroom.** Ethnic/racial similarities were also considered between students with their classroom as well as teachers with their classroom. For the student-classroom congruency, a student's race was compared to the ethnic/racial composition of their classroom. From this, a variable was computed to determine the percentage of a student's classroom that shared the same-ethnicity/race. The teacher-classroom congruency was computed in a similar way, but considered the ethnicity/race of the teacher.

**Teacher beliefs about mathematics ability of students in their classroom.** This construct was measured through data on the curriculum alignment survey (Kane, Hill, & Staiger, 2016). Within this measure, teachers were shown 14 math problems

and their correct answers. They were then asked to estimate what percentage of their class would get the math problem correct. Responses ranged from 0 to 100, depending on the percentage of the class they believed capable of answering the question correctly. Examples of items from this measure are included in Appendix A. An average of the 14 items was calculated to indicate the teachers' level of confidence in their students' abilities. The average score on this variable was a 58.02%.

An internal consistency estimate of reliability was computed for the fourteen items measuring teacher beliefs about math competency of students in their classroom ( $\alpha = .88$ ). Additionally, the dimensionality of the 14 items from the teacher belief measure was analyzed using a principal component analysis. Initial analyses indicated that none of the items from this measure were highly skewed. Only two of the 14 items had kurtosis. One factor was rotated using a Varimax rotation procedure, and it accounted for 40.94% of the item variance (with an Eigenvalue of 5.732).

**Student survey scales on student-teacher conflict and teacher instructional support.** Scales were derived from selected items from the revised Tripod Student Survey, developed by Ferguson (2009) and reported good reliability. For each item on this measure, students rated their agreement to statements on a Likert scale ranging from 1 (totally untrue) to 5 (totally true). This measure is a widely validated measure of classroom-level ratings (Tripoded, 2015). The first scale, about student conflict with the teacher ( $N = 3$  items), will measure student's self-reported perception of interpersonal conflict that occurs with their teacher in the classroom (e.g. My behavior in this class is good). Next, the measure of teacher instructional support to the individual student examines responses of one item from the survey (My teacher really

cares how well I do in math). This evaluates the student-reported quality of math instruction they receive from their teacher. Finally, teacher's instructional support to the classroom ( $N = 10$  items) measured student perceptions of the quality of interactions between their teacher, teaching assistants, the classroom, and their peers (e.g. My teacher explains difficult math problems clearly). All items used for these scales are reported in Appendix B.

Internal consistency estimates of reliability were also considered for the student survey scales conceptually constructed on student-teacher conflict and teacher instructional support to the classroom. Reliability was fair for each of the scales: a) student-teacher conflict ( $\alpha = .74$ ), and b) teacher instructional support to the classroom ( $\alpha = .72$ ). Neither of the scale items were highly skewed. Four of the 10 items on the teacher instructional support to the classroom did have kurtosis. Principle component analyses were conducted for the measure of student-teacher conflict and teacher instructional support to the classroom. Output tables for this testing are included in Appendix C, which confirm the factorability of these scales.

**Mathematics achievement.** In the current study, the dependent variable of mathematics achievement will be examined in terms of a) the state math test and b) the alternative math assessment. The state test scores come from standardized assessments of student subject knowledge in mathematics. Subsequently, the Harvard Research team and Educational Testing Services (ETS) developed the Alternative Math Assessment (AMA) used in the NCTE study. The AMA was designed to measure improvements in math skills resulting from teacher instructional practices and professional development initiatives. This measure was scored by ETS and aligns with

fourth- and fifth-grade Common Core standards in math (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Many math problems on the AMA also appeared on the curriculum alignment survey where teachers predicted what percentage of the classroom would answer correctly. Each of these two assessments of math achievement were considered in terms of a z-score.

### **Data analysis plan**

Data analyses were conducted using the Statistical Package for the Social Sciences (SPSS) software. Descriptives and frequency analyses were run to examine the demographic characteristics of the sample. Descriptives were also run on the ethnicity/race congruency variables to ensure diverse distributions. Additionally, analyses were conducted on the learning environment scales to examine if the variables are normally distributed. Reliability testing and principal component analyses were also conducted for the student survey scales and the measure of teacher beliefs about mathematics ability of students in their classroom. A multilevel regression approach was used to consider multiple predictive variables at the student and classroom level. To gain further understanding of how dimensions of classroom composition can explain how aspects of the learning environment might influence student achievement, moderation analyses were conducted. A robust cluster analyses by classroom was utilized to account for the clustered structure of the data.

In multilevel analyses, to account for confounding variables, a series of 5 student-level covariates were considered. Covariates were selected because of their prior associations to academic achievement found in prior research. Studies that

examined how academic achievement differs across gender, minoritized groups, special education, language, and subsidized lunch status with academic achievement typically reported significant disparities (Morrissey, Hutchison, & Winsler, 2014; National Center for Education Statistics [NCES], 2005; Robinson & Lubienski, 2011; Skiba et al., 2008). The following variables were examined were gender (1 = male, 0 = female), free-reduced lunch status (1 = yes; 0 = no), special education status (1 = yes; 0 = no), limited English proficiency status (1 = yes, 0 = no) and if the student was a minoritized ethnicity/race (1 = yes, 0 = no).

## CHAPTER 4

### FINDINGS

#### **Initial Analyses**

Descriptive analyses were conducted on the sample to ensure normal distribution, and diversity in responses. The three dimensions of ethnicity/race congruency demonstrated a fair amount of variation. In the sample, 35.1% ( $N = 649$ ) of students have the same ethnicity/race as their teacher, while 51.8% did not ( $N = 959$ ). The remaining portion of the sample did not have data on the teacher's ethnicity/race. Of the 649 matches between students and their teachers, 425 of the matches occurred for White students, 220 matches were in the case of African American students, and 4 for Hispanic students.

Additionally, the average percentage of ethnic/racial classroom representation for students in the sample was 52.66%. Between ethnic/racial groups the average percent of similarity with their classroom for African American students was 62% (Hispanic students: 41.61%; White students: 44.10%). For teachers in the sample, the average percent of ethnic/racial classroom similarity was 52.66%. Additionally, African American teachers had an average similarity of 40.86% with their classroom (Hispanic teachers: 21.82%; White teachers: 43.02%). Descriptives statistics for these variables and the measures of the learning environment are reported in Table 1.

**Table 1.** Descriptive statistics of ethnicity/race congruency & learning environment variables

Variable	Mean	SD	Min.	Max.	N
Student-classroom similarity	.53	.26	.04	1	1851
Teacher-classroom similarity*	.38	.28	.0	1	1608
Teacher belief of math ability*	58.02	15.37	10.17	100	1762
Student-teacher conflict	3.99	.99	1	5	1810
Teacher instr. support to individual student	4.67	.76	1	5	1808
Teacher instr. support to classroom	4.28	.55	1.40	5	900

Note. \*Level 2 (classroom-level) variables.

A multilevel regression approach was conducted to examine variance in mathematics achievement scores in consideration of multiple contextual characteristics at the student- and classroom-level. Multilevel regression is valuable to the current study as it accounts for dependency for that is nested (i.e. students within classrooms). Additionally, this method also considers interactions among student-level variables, classroom-level variables, and cross-level variables in relation to outcomes for the outcome of math test scores (Heck, Thomas, & Tabata, 2014).

### **Unconditional Models**

Considering the strategy of Field (2009) an unconditional model was run first with maximum likelihood estimation to consider how much variance of the dependent variable (the state math assessment and AMA) could be explained by within- and between-classroom differences. Results indicated that the majority of the variance was due to individual student characteristics. Results indicated between classroom variance significantly explained the state math test (ICC = 3.38%) and the alternative math test (ICC = 13.08%).

### **Conditional Models**

**Addition of covariates.** A series of demographic student-level covariates and predictor variables were added into a random intercepts model using restricted maximum likelihood estimation (Heck, Thomas, & Tabata, 2014). The following covariates added into model were all categorical variables set as fixed effects: gender, FRL status, SPED status, LEP status, and minoritized status to examine their relationship with student math achievement scores across classrooms. Results for this testing is reported for both the state math assessment, and alternative math assessment, in Table 2, and Table 3 respectively.

**Addition of predictors.** In the same model as the covariates, the main effects of the independent variables were also examined. The following student-level predictors were entered into the model using group mean centering as fixed effects as suggested by Enders and Tofighi (2007): a) student conflict with teacher, b) teacher instructional support to the individual student, c) teacher instructional support to the classroom, and d) student to classroom similarity. Also, the classroom-level predictors of: e) teacher beliefs about student math ability in their classroom, and f) teacher to classroom similarity were entered as fixed effects using grand mean centering; this method is consistent with prior work that discusses centering procedures for level 2 variables (Enders & Tofighi, 2007; Field, 2009). Additionally, the main effect of student-teacher ethnic/racial congruence (a categorical variable) was also included in this model.

### **Moderation Models**

Next, interactions were added separately into the conditional models to examine the potential moderating effects of the three dimensions of ethnicity/race

congruency. The ethnic/racial similarities between the student and teacher, student and classroom, and teacher and classroom were purposefully considered in relation to specific predictors depending on their conceptual fit together. Results are reported in Table 4, which considers the state math assessment, and Table 5 that considers the AMA.

### **Results of the Conditional Model**

The main effects of the conditional model are reported for the state math test and AMA, in Table 2, and Table 3 respectively. All of the student-level covariates were significant predictors of mathematics scores on the state assessment and the AMA. Additionally, the main effects of student conflict with teacher and teacher beliefs about math ability in their classroom both significantly predicted better student math achievement on the state test and AMA. These significant associations were positive, indicating that a more positive student perception of conflict with the teacher and more positive teacher beliefs about classroom math ability were associated with higher math test scores.

Finally, the dimensions of student-classroom and teacher-classroom congruency were significant and had a positive relationship with state math test scores. This indicates that for these dimensions of ethnic/racial classroom composition, increased ethnic/racial classroom similarities were related to higher math achievement. Alternatively, the main effect of student-teacher ethnic/racial match was negatively related to both the state test and AMA outcomes. This means that in the presence of a match between the student and their teacher, students performed worse on math tests.

**Table 2.** Conditional model on state mathematics assessment outcomes

Variables	<i>B</i>	<i>t</i> -ratio	<i>p</i>
<b>Student-Level Covariates (L1)</b>			
Male (M=0, F=1)	0.12	3.15	.002
FRL (N=0, Y=1)	- 0.18	- 2.45	.015
SPED (N=0, Y=1)	- 0.46	- 7.20	.000
LEP (N=0, Y=1)	- 0.26	- 4.64	.000
Minority (N=0, Y=1)	- 0.51	- 6.61	.000
<b>Student-Level Predictors (L1)</b>			
Teacher instructional support to the individual student	0.02	0.74	.458
Student conflict with teacher	0.13	6.19	.000
Teacher instructional support to the classroom	0.07	1.78	.075
<b>Classroom-Level Predictors (L2)</b>			
Teacher beliefs about mathematics ability in their classroom	0.01	2.53	.002
<b>Dimensions of Ethnic/Racial Composition</b>			
Student-classroom similarity (L1)	0.27	2.21	.002
Teacher-classroom similarity (L2)	0.57	3.22	.002
Student-teacher congruence (L1)	- 0.35	- 4.60	.000

**Table 3.** Conditional model on alternative mathematics assessment outcomes

Variables	<i>B</i>	<i>t</i> -ratio	<i>p</i>
<b>Student-Level Covariates (L1)</b>			
Male (M=0, F=1)	0.11	2.76	.006
FRL (N=0, Y=1)	- 0.14	- 3.01	.003
SPED (N=0, Y=1)	- 0.39	- 6.30	.000
LEP (N=0, Y=1)	- 0.22	- 3.96	.000
Minority (N=0, Y=1)	- 0.56	- 7.58	.000
<b>Student-Level Predictors (L1)</b>			
Teacher instructional support to the individual student	- 0.04	- 0.16	.874
Student conflict with teacher	0.14	6.50	.000
Teacher instructional support to the classroom	0.06	1.62	.105
<b>Classroom-Level Predictors (L2)</b>			
Teacher beliefs about mathematics ability in their classroom	0.02	- 5.45	.000
<b>Dimensions of Ethnic/Racial Composition</b>			
Student-classroom similarity (L1)	0.17	1.42	.155
Teacher-classroom similarity (L2)	0.18	1.09	.280
Student-teacher congruence (L1)	- 0.40	6.83	.000

### Results of the Moderation Analysis

One significant interaction occurred at the student level, between the student-teacher ethnic/racial match and student conflict with teacher for the AMA outcome. No other test of moderation was significant. A more detailed examination of this interaction is shown in Figure 1, where the association between math test scores and student conflict with teacher is plotted for students that matched and did not match the

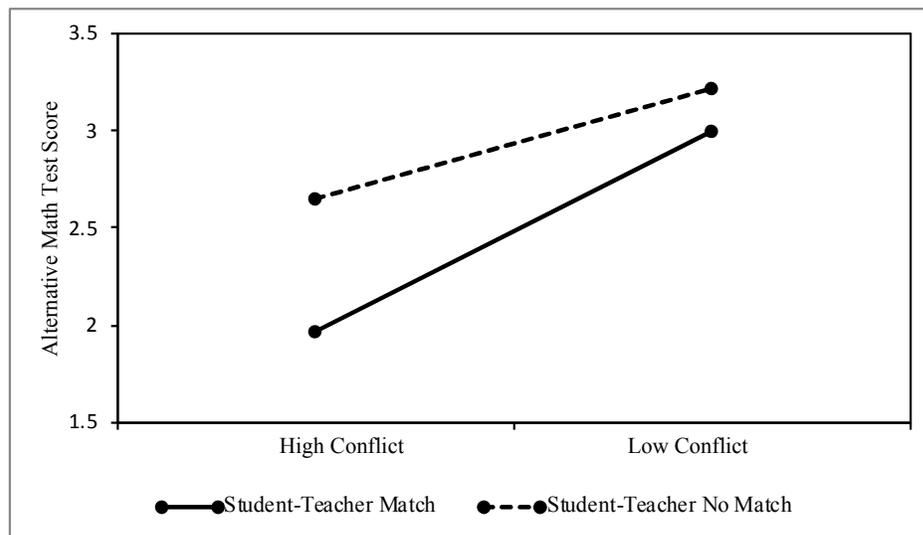
ethnicity/race of their teacher. Student-teacher conflict was defined in the plot by the minimum and maximum values (Preacher, Curran & Bauer, 2006).

**Table 4.** Moderation models in relation to state mathematics assessment outcomes

Variables	<i>B</i>	<i>t</i> -ratio	<i>p</i>
<b>Level 1 Interactions</b>			
Student-teacher match & Student conflict with teacher	0.37	0.84	.402
Student-teacher match & Teacher instr. support to the individual student	0.04	0.67	.502
Student-classroom similarity & Teacher instr. support to the classroom	0.19	0.73	.464
<b>Cross-Level Interaction</b>			
Teacher-classroom similarity & Teacher instr. support to the classroom	0.13	1.02	.306
<b>Level 2 Interaction</b>			
Teacher-classroom similarity & Teacher beliefs about mathematics ability in their classroom	0.01	.673	.502

**Table 5.** Moderation models in relation to alternative mathematics assessment outcomes

Variables	<i>B</i>	<i>t</i> -ratio	<i>p</i>
<b>Level 1 Interactions</b>			
Student-teacher match & Student conflict with teacher	- 0.09	1.98	.048
Student-teacher match & Teacher instr. support to the individual student	- 0.03	- 0.54	.588
Student-classroom similarity & Teacher instr. support to the classroom	0.31	1.23	.217
<b>Cross-Level Interaction</b>			
Teacher-classroom similarity & Teacher instr. support to the classroom	0.07	0.54	.588
<b>Level 2 Interaction</b>			
Teacher-classroom similarity & Teacher beliefs about mathematics ability in their classroom	0.00	0.16	.873



**Student Conflict with Teacher and Value of Student-Teacher Match**

**Figure 1.** Plot of Student-Level Interaction. The relationship between alternative math assessment scores and perceived student conflict with teacher as a function of student-teacher ethnic/racial congruence.

## **Summary of Results**

There were significant, positive relationships between: 1) student conflict with teacher, and 2) teacher beliefs about classroom math ability that indicated when there were better perceptions of these aspects of the learning environment there were better outcomes on the state test and AMA. Also, increased ethnicity/race congruency between: 1) students and their classroom, and 2) teachers and their classroom predicted better scores on the state math test outcome. In addition to these findings, there was a negative significant relationship that indicated that the presence of an ethnic/racial match between a student and their teacher predicted worse outcomes on the state test and AMA outcomes. Finally, there was a significant interaction between student-teacher ethnic/racial match and student perceived conflict with their teacher that predicted AMA outcomes.

## CHAPTER 5

### CONCLUSION

While there are great implications for the promotion of academic achievement, specifically in the subject of mathematics, little is known about ethnic/racial classroom dynamics, and the influence that the learning environment may have on achievement. This study looked at how ethnic/racial similarities within a classroom might explain achievement, and how aspects of the learning environment could relate to achievement in math. This study found that the presence of less conflict between students and teachers, and more positive teacher beliefs about student academic ability, led to better achievement. The results also indicated that the presence of each of the three dimensions of ethnic/racial congruency related to mathematics outcomes. The presence of ethnicity/race similarities between the student-classroom and teacher-classroom led students to perform better on math. However, student-teacher congruency predicted worse math test outcomes. Furthermore, ethnic/racial congruence between a student and their teacher explained the relationship between student-teacher conflict and math achievement. This result demonstrates that dimensions of ethnic/racial composition in the classroom may go beyond the connection between aspects of the learning environment and academic success. These significant findings occurred in even when considering other student characteristics previously linked to achievement (Morrissey, Hutchison, & Winsler, 2014; NCES, 2005; Robinson & Lubienski, 2011; Skiba et al., 2008).

These findings regarding the three dimensions of ethnic/racial classroom composition provide further reason to explore how the structural composition of a learning environment may have an influence on academic success (Benner, Graham, & Mistry, 2008; Egalite, Kisida, & Winters, 2014; Yarnell & Bohrnstedt, 2018). The results are partially consistent with the first hypotheses that the presence of ethnic/racial congruency in the classroom would be related to better achievement in mathematics. These findings are aligned with some prior work suggesting that an increase in classroom diversity might contribute to potential miscommunications and differential treatment with teachers that influence academic outcomes (McKown & Weinstein, 2008). Although the presence of an ethnic/racial match between a student and their teacher was related to worse math test scores, this may further indicate the need to examine different types of demographic matches (APA, 2012; Joshi, Doan, & Springer, 2018).

It is important to address the dynamic relationship of ethnic/racial classroom composition and the learning environment as they influence achievement. Results of this study suggest that classroom structures can interact with the learning environment to further explain achievement. However, the second hypothesis was only partially supported, thus providing further reason to explore the indirect impact that classroom structures might have on learning processes (Benner & Yan, 2015). Results indicated that when students were ethnically/racially similar to their teachers, there were less positive student perceptions of conflict, and this led to worse academic achievement. This may have implications because conflict within a classroom can be indicative of the student-teacher relationship quality and more importantly, academic success

(Downer et al., 2016). Thus, it is important to examine how classroom learning processes such as conflict might further explain the structural context of ethnic/racial demographics.

One limitation of this study lies in the exclusion of participants outside of the first year of data collection. This was because there were changes made to the teacher belief measure used by the researchers across years of the study. Additionally, a more dynamic consideration of student-teacher ethnic/racial congruence should be used to compare the occurrence of a match (or no match) across groups to fully explore demographic similarities (e.g. a White student with an African American Teacher vs. an African American student with a White teacher) (Joshi, Doan, & Springer, 2018). Finally, this study could have been further enhanced if a diverse sample of teachers was available, however this remains consistent with the reported lack of diversity in the education workforce throughout the U.S. (APA, 2012).

There were however, a multitude of strengths that exist in this study. One strength was the multilevel regression approach that considered relationships at the student- and classroom-level (Field, 2009; O'Dwyer & Parker, 2014). This method accounted for nested data to consider differences between math classrooms. Additionally, the sampling method did establish a diverse sample of student participants, thus adding strength to the generalizability of this study. This study provides further evidence that ethnic/racial similarities between students, teachers, and their classroom may explain achievement. Also, the interaction found between student-teacher ethnic/racial match and student conflict with teacher does contribute to

an area of empirical need that links classroom demographics and learning processes together to explain achievement (Terenzini et al., 2001).

The results indicate that there could be an even more complex relationship between the learning environment and academic outcomes when considering the structure of a classroom. However, additional empirical work is necessary not only to further explore these dimensions, but also to consider other contributing factors. Perhaps the finding that student-teacher congruence related to worse test scores was due to the difficulty to tease apart ethnicity/race and socioeconomic status (SES) (Quintana & Mahgoub, 2016; Palardy, Rumberger, & Butler, 2015). Additionally, traditionally minoritized groups of students typically attend lower performing schools with a lower quality of teacher instruction (Palardy, Rumberger, & Butler, 2015). Continuing to explore the possible influence that ethnicity/race, SES, and the classroom environment may have on achievement could get at a better understanding of academic disparities.

When the complex role that ethnicity/race may have to student's academic success is understood, this area of research may then inform future experimental interventions contributing to educational practices and policies. The implications that could occur with continued research in this area suggest that the promotion of cultural competency in teachers and students could enhance learning (DeJaeghere & Cao, 2009). Cultural competency training as part of preservice teacher education curriculums and later inservice professional development initiatives could contribute to skill development in culturally sensitive communication, instructional strategies, and appropriate activities (Bryd, 2016; DeJaeghere & Cao, 2009; Siwatu, 2007). This

becomes especially important in light of the finding that teacher-classroom ethnic/racial similarities led to better academic success. Considering the persistence of ethnic/racial disparities in education, it is important to continue to understand the factors that influence differences in educational experiences to promote positive growth for all students.

## APPENDICES

### Appendix A Sample Curriculum Alignment Survey Items

3. Consider the following problem from the student assessment:

What number should go in the  to make this number sentence true?

$$8 + 4 = \square + 7$$

A. 19  
B. 12  
C. 5  
D. 4

The correct answer to this problem is C.

- a. Approximately what percentage of **your students** being tested today will choose the correct answer?

%

Lin is going to the county fair tonight. His mother gave him \$24 to spend on ride tickets. Tickets for fast rides cost \$3 each, and tickets for slow rides cost \$2 each.

Lin plans to spend all of the money his mother gave him on fast-ride tickets. What is the total number of fast-ride tickets that Lin can buy?



Which statement could represent the word problem above?

A. number of fast-ride tickets =  $24 \times 3$   
B. number of fast-ride tickets =  $24 \div 3$   
C. number of fast-ride tickets =  $24 \times 2$   
D. number of fast-ride tickets =  $24 \div 2$

- A. What percentage of your students being tested today do you think will choose the correct answer (Answer B)? \_\_\_\_\_

## Appendix B

### Scales Derived from the Revised Tripod Student Survey

#### **A) Student-Teacher Conflict (3 items)**

- BEH01: My behavior in this class is good.
- BEH02\_REV: My behavior in this class sometimes annoys the teacher.
- BEH03\_REV: My behavior is a problem for the teacher in this class.

#### **B) Teacher Instructional Support to the Individual Student (1 item)**

- CAR02: My teacher really cares how well I do in math.

#### **C) Teacher Instructional Support to the Classroom (10 items)**

- CHA01: In math, my teacher doesn't let people give up, even if the work is hard.
- CHA02: My math teacher wants understanding, not just memorization of problem solution steps.
- CHA03: My teacher tells students to explain their answers to math questions
- CHA04: My teacher pushes us to think hard about math.
- CNF02: My teacher tells us what we are learning and why.
- CLA01: My teacher explains difficult math problems clearly.
- CLA02: My teacher has several good ways to explain each topic in math.
- CLA03: In math, my teacher knows when the class understands, and when we do not.
- CLA04: My teacher explains math in very orderly ways.
- CAR01: I like the way my teacher treats people when they need help with math.

## Appendix C

### Principle Component Analyses on Student Scales Constructed from Tripod Student Survey

#### A. Student Conflict with Teacher

##### Communalities

	Initial	Extraction
BEH 01 My behavior in this class is good.	1.000	.580
BEH 02: Reverse Coded My behavior in this class sometimes annoys the teacher	1.000	.705
BEH 03 Reverse Coded: My behavior is a problem for the teacher in this class.	1.000	.698

Extraction Method: Principal Component Analysis.

##### Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.983	66.090	66.090	1.983	66.090	66.090
2	.594	19.803	85.893			
3	.423	14.107	100.000			

Extraction Method: Principal Component Analysis.

##### Component Matrix<sup>a</sup>

	Component
	1
BEH 01 My behavior in this class is good.	.761
BEH 02: Reverse Coded My behavior in this class sometimes annoys the teacher	.840
BEH 03 Reverse Coded: My behavior is a problem for the teacher in this class.	.836

Extraction Method: Principal Component Analysis. 1 Components extracted.

## B. Teacher Instructional Support to the Classroom

### Communalities

	Initial	Extraction
CHA 01 In math, my teacher doesn't let people give up, even if the work is hard.	1.000	.266
CHA 02 My math T wants understanding, not just memorization of problem solution steps.	1.000	.318
CHA 03 My teacher tells students to explain their answers to math questions.	1.000	.193
CHA 04 My teacher pushes us to think hard about math.	1.000	.154
CLA 01 My teacher explains difficult math problems clearly.	1.000	.262
CLA 02 My teacher has several good ways to explain each topic in math.	1.000	.355
CLA 03 In math, my teacher knows when the class understands, and when we do not.	1.000	.413
CLA 04 My teacher explains math in very orderly ways.	1.000	.328
CNF 02 My teacher tells us what we are learning and why.	1.000	.353
CAR 01 I like the way my teacher treats people when they need help with math.	1.000	.307

### Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.947	29.470	29.470	2.947	29.470	29.470
2	.970	9.703	39.172			
3	.904	9.041	48.214			
4	.868	8.675	56.889			
5	.805	8.048	64.936			
6	.771	7.707	72.643			
7	.736	7.361	80.004			
8	.7055	7.050	93.681			
9	.663	6.627	93.681			
10	.632	6.319	100.000			

Extraction Method: Principal Component Analysis.

**Component Matrix**

	Component
	1
CHA 01 In math, my teacher doesn't let people give up, even if the work is hard.	.516
CHA 02 My math T wants understanding, not just memorization of problem solution steps.	.564
CHA 03 My teacher tells students to explain their answers to math questions.	.439
CHA 04 My teacher pushes us to think hard about math.	.393
CLA 01 My teacher explains difficult math problems clearly.	.511
CLA 02 My teacher has several good ways to explain each topic in math.	.596
CLA 03 In math, my teacher knows when the class understands, and when we do not.	.642
CLA 04 My teacher explains math in very orderly ways.	.573
CNF 02 My teacher tells us what we are learning and why.	.594
CAR 01 I like the way my teacher treats people when they need help with math.	.554

Extraction Method: Principal Component Analysis. 1 Components extracted.

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