ABSTRACT

PITCHFORD, KAYONNA DO’SHAN. Classroom Instructional Practices and Middle Grades Mathematics Achievement in the U.S.: A Secondary Analysis of TIMSS 2007 Data. (Under the Direction of Dr. Jessica DeCuir - Gunby.)

This study investigated the relationships between classroom instructional practices, as reported by students, and student mathematics achievement, in the specific context of U.S. eighth grade classrooms. The study utilized quantitative methods to analyze the 2007 Trends in International Mathematics and Science Study (TIMSS) for the U.S. sample, comparing the frequency of use of the classroom instructional practices listed in the Student Questionnaire to student achievement scores. The study also considered the influences of student gender, socio-economic status, and race/ethnicity on the achievement of students.

It was found that: (1) student reports of classroom instructional practices varied significantly by gender, socio-economic status, and race/ethnicity, (2) a multiple regression equation including a combination of student background characteristics and student reports of the frequencies of classroom instructional practices reliably predicted student mathematics achievement, and, (3) student socio-economic status and student race/ethnicity demonstrated much stronger relationships to achievement than gender or than many of the classroom instructional practices.

The current study provided additional information about the use of classroom instructional practices and their relationships to student achievement in U.S. eighth grade classrooms. The study also provided quantitative evidence that while gender achievement gaps may be closing, student SES and race/ethnicity remain important factors in achievement. Potential implications of the study include new studies into achievement gaps and a direction for further research into specific instructional practices.
Classroom Instructional Practices and Middle Grades Mathematics Achievement in the U.S.: A Secondary Analysis of TIMSS 2007 Data

by
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A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy

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DEDICATION

To Peggy.
BIOGRAPHY

Kayonna began her post-secondary education at The University of North Carolina at Greensboro as a North Carolina Teaching Fellow in 1992. She graduated in 1996 with a Bachelor of Science degree in Elementary Education and began her teaching career. After moving to Fayetteville, North Carolina in 1999 with her husband and children, she continued with her teaching career and then joined the NSF-funded Teaching Excellence and Mathematics (TEAM II) project in 2001. Her participation in this project sparked her interested in mathematics and mathematics education. Throughout the five years she participated in the project, Kayonna was given the opportunity to increase her own mathematics knowledge, change her teaching practices, assist with editing a chapter in a nationally-published mathematics textbook, and assist with designing and conducting state-wide professional development sessions on the changing North Carolina Standard Course of Study. During the same time, she attained Middle Childhood Generalist National Board Certification in 2002, and received her Master’s Degree in Elementary Education from Fayetteville State University in 2004.

In 2005, Kayonna joined the NSF-Funded North Carolina Partners for Improving Mathematics and Science (NC-PIMS) project as a Mathematics Lead Teacher for her school. During the three years of her involvement the project, Kayonna continued to increase her own mathematics knowledge and her experience providing professional development. Near the end of the project, she was selected as a Regional Lead Teacher for NC - PIMS, and
assisted with revising previously presented professional development modules in preparation for school districts to sustain the presentation of the modules on a local level.

In 2007, Kayonna joined Partners for Mathematics Learning. This program also sought to continue to improve the instruction and learning of mathematics by developing professional development modules for teachers focused on increasing teachers’ math knowledge, along with providing information and activities for teaching math. During this project, Kayonna continued to provide professional development for teachers at several sites across the state. In the third summer of the project, Kayonna participated in more of the entire professional development process, from concept development, to writing, to training dissemination team members, and, finally, to participating as a dissemination team member to train teachers. In addition to helping to develop other teachers, she also began her Ph. D. studies at North Carolina State University in Raleigh, NC in 2007, for her own development.

Since 2007, Kayonna has successfully renewed her National Board Certification, has been selected as the Teacher of the Year for her school, and has been named as one of three state mathematics finalists for the prestigious Presidential Award for Excellence in Mathematics and Science Teaching for 2012. She was also named one of 10 finalists for the Burroughs Wellcome Fund Career Award for Science and Mathematics Teachers for 2012.

This dissertation is the next step in her long-term academic and personal plans. After completion of her degree, Kayonna plans to spend one year focusing on her classroom teaching, then pursuing her next goal of obtaining a post-doctorate position to continue her studies and research interests, or teaching in a school of education at a nearby university.
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CHAPTER 1:
INTRODUCTION

Overview

Student mathematics achievement is influenced by many factors. However, since what happens inside the classroom is the daily work of teachers and students, the role of instructional strategies in the classroom is especially important to consider. Some studies have shown a significant influence of classroom instructional practices on student math achievement, mostly on a small-scale basis. This information is not easily transferred into national trends, and must be interpreted with the context of the particular study.

The purpose of this study is to examine the relationships between classroom instructional practices and student mathematics achievement among eighth grade middle school students in the U.S. The study uses quantitative methods to engage in the secondary analysis of a large, national dataset. The study is meant to provide increased understanding of the relationships between classroom instructional practices and student achievement for educators and policymakers on the national level.

This chapter presents the background context for the study, including the study problem, research questions, and conceptual framework. The chapter concludes with an overview of the remaining chapters and their content.

Research Problem

The mathematics achievement of students in the United States has been a topic garnering major concern for decades. Published reports, such as A Nation at Risk, have raised concerns about the educational inadequacies of high school and college graduates and called
for educational reform in order to improve the ability of the U.S. to compete internationally (Gardner, 1983). The more recent *Adding it Up* report (National Research Council, 2001) also called for reform of mathematics instruction in elementary and middle schools.

Reform efforts in mathematics education have been attempting to address these concerns for over 30 years, however. For example, the National Council of Teachers of Mathematics (NCTM), an organization founded in 1920 to promote educational excellence in mathematics, has a long history of developing standards to address the teaching and learning of mathematics. Beginning with *An Agenda for Action: Recommendations for School Mathematics of the 1980s* (NCTM, 1980), NCTM has also been in the forefront of school mathematics reform. This initial effort at developing recommendations for teaching mathematics addressed several areas of mathematics education including the need for more problem solving opportunities, an increase in the use of calculators and computers, varied evaluation methods that address the goals of the mathematics program, and a high level of professionalism in mathematics teachers (NCTM, 1980). The most recent version of recommendations, *Principles and Standards for School Mathematics* (NCTM, 2000), provided educators with broad Content (Numbers and Operations, Algebra, Geometry, and Data Analysis and Probability) and Process Standards (Problem Solving, Reasoning and Proof, Communication, Connections, and Representation) to the describe what and how students in each grade band were now expected to experience mathematics. Additionally, the Principles described the features of Equity, Curriculum, Teaching, Learning, Assessment and Technology that were characteristic of a high-quality mathematics program (NCTM, 2000).
This entire publication is often referred to as the *Standards*, and provides the basis of the descriptions of *Standards*-based instructional practices endorsed and recommended by NCTM.

Specifically for middle grades, NCTM recommended an increased focus on geometry and algebra, integrated into the other domains, with a decreased focus on computation (NCTM, 2000). Teachers of middle grades students should also provide students with the opportunity to continue to work with numbers in context to solve problems; formulate their own questions for experiments and data collection; use calculators, including graphing calculators; and use computers. Furthermore, students should develop mathematical communication and problem solving skills by working in pairs and small groups, explaining their own problem solving strategies, making connections between mathematical ideas and applying mathematical ideas to real world experiences and to other discipline areas. NCTM described the kinds of mathematics they recommended for students and the ways in which students should learn as their “vision for school mathematics,” in which students are actively engaged in learning challenging mathematics topics (NCTM, 2000, p.3).

Although NCTM has been reflective of the views of many experts in the field of mathematics education, these same views and resulting practice changes have been slow to reach the classrooms (e.g., Stigler & Hiebert, 1997). As a result, changes in mathematics teaching and learning over the last 20 years of reform efforts have been virtually undetectable. Reasons for such a lack of change may range from a lack of training for teachers (e.g., Furner, 2004) to reluctance from teachers to embrace changes to the
educational methods that are familiar to them (e.g., Manaster, 1998). Until clearer connections between Standards-based instructional practices and high performance on assessments are made, such instructional changes may continue to elude those advocating for more and better mathematics education for students.

**Study Purpose**

The purpose of this study is to investigate the relationships between instructional practices (as perceived and reported by students) and mathematics achievement using data gathered during the 2007 administration of Trends in Mathematics and Science Study (TIMSS). This study is intended to build upon and extend the findings of recent studies in several ways. First, many previous studies investigating the relationships between instructional practices and middle school mathematics achievement have examined data from other nations (e.g., House, 2001, 2004; Sabah & Hammouri, 2010) or compared data from the U.S. to other nations (e.g., House & Telese, 2008; Leung, Yung & Tso, 2005; O’Dwyer, 2005). Although TIMSS is meant to provide data for such comparative analyses, existing studies frequently provide conflicting, difficult to interpret results, often attributed to differences in the educational systems, languages, or general culture of the countries (e.g., Ce, 2005). The current study will focus exclusively on the U.S. results, avoiding comparisons to other nations.

In addition to international studies, other recent, nationally representative studies have examined these variables using National Assessment of Educational Progress (NAEP) data (e.g., Wenglinsky, 2002, 2004). Although it is often desired to analyze data from more than
one source in order to make broad generalizations, few studies used TIMSS contextual and achievement data to thoroughly investigate U.S. middle grades performance. The current study will utilize TIMSS data to add to what is known from studies of NAEP data about the state of middle grades mathematics achievement in the U.S.

Also, the previous studies of middle school mathematics practices and achievement in the U.S. have used databases from 2003 or earlier, leaving a significant gap in the literature addressing more current practices and achievement results. The current study will utilize results from the 2007 administration of TIMSS, providing information from the most recent available findings.

Finally, there is a lack of studies investigating the links between instructional practices, such as those described in the *Principles and Standards for School Mathematics* (NCTM, 2000), and student achievement on a large scale, especially, specifically, at the U.S. middle school level. Much of what is known is contained in official reports from nationally administered exams (e.g., Hiebert et al., 2003), or from smaller studies regarding specific educational programs and curricula (e.g., Spillane & Zeuli, 1999). The current study will extend the literature on relationships between instructional practices and student achievement on a large scale for this grade band.

**Research Questions**

The current study will specifically build upon and extend previous studies. Specifically, the study will use student questionnaire responses to examine the correlations between student reports of instructional practices and student achievement, followed by
regression analyses investigating the extent to which achievement scores can be predicted by instructional practices, as in House and Telese (2008). This study will address the following research questions:

1. What are the relationships between instructional practices as reported by students and student background characteristics as demonstrated on the 2007 U.S. eighth grade administration of TIMSS?
   a. What are the relationships between instructional practices as reported by students and gender?
   b. What are the relationships between instructional practices as reported by students and the highest parental level of education of the mother?
   c. What are the relationships between instructional practices as reported by students and race/ethnicity?

2. Which combination of variables (GENDER, SES, RACE, classroom instructional practices) best predicts eighth grade student mathematics achievement on the 2007 administration of TIMSS?
   a. Which of the possible seventeen classroom instructional practices reported by students are most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by reported classroom practice?
b. Which student background variables are most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by student background?

c. Which combination of student background variables and classroom instructional practices is most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement?

**Conceptual Framework**

This study is based upon three conceptual components: (1) classroom instructional practices in the middle school mathematics classroom; (2) student background characteristics; and (3) student mathematics achievement. The dependent variable of student mathematics achievement is of greatest interest in the research questions, while the relationships between the remaining variables are also considered to provide further analysis and context. Classroom instructional practices are considered singularly to determine differential effects on student achievement. The relationships between student background characteristics of gender, socio-economic status (SES), race/ethnicity, and the reports of classroom instructional practices are explored in research question one. The relationships between classroom instructional practices, student background, and student mathematics achievement are explored in research question two. The remainder of this section discusses the three conceptual components. A detailed review of the literature is included in Chapter 2.
Classroom Instructional Practices and Student Achievement

Studies of the use of classroom instructional practices found differing uses by grade levels. For instance, primary (K – 3) teachers were more likely to use manipulatives than teachers in older grades, while intermediate (4 – 6) teachers were more likely to use calculators than other grades, K – 8 (Henke, Chen, & Goldman, 1999). Also, video studies of U.S. teachers in grade eight revealed that the majority of student seatwork time was spent on practicing the routines and procedures that were introduced by the teacher (Hiebert et al., 2003; Jacobs et al., 2006; Stigler & Hiebert, 1997). Reform methods, such as allowing students to “grapple” with the mathematics, cooperative learning, and problem-based instruction much less frequently in classrooms than lecture and drill (McKinney & Frazier, 2008; Spillane & Zeuli, 1999).

The choice of classroom instructional practice is important due to links to student achievement (Wenglinsky, 2002). Practices such as writing equations and functions, reviewing homework, and using calculators has been positively related to student mathematics achievement, while working in groups was negatively related to achievement (House & Telese, 2008). However, the use of a Standards-based curriculum for at least two years resulted in higher student achievement than the use of other curricula, at least on a small scale, demonstrating a need for sustained reform efforts in order to determine the true impact of such programs (Revs et al., 2003).

A few previous studies have attempted to specifically classify practices such as the ones in the large dataset by their reflections of characteristics of reform and traditional
practices (e.g., Tomoff, 1999). Due to vague descriptions of the practices in the survey, no such absolute determinations are used in the study, though. Instead, although some references are made to practices that may or may not relate to Standards-based instruction, classroom instructional practices are treated individually, with separate relationships to student achievement explored. Also, since observations of classroom instructional strategies are not available with the regular TIMMS administrations, reports of classroom strategies obtained from responses to the Student Questionnaire are used in the study.

**Student Background Characteristics and Student Achievement**

In addition to educational practices, student background characteristics are very highly related to student performance, perhaps greater than any other factor (Goldhaber & Brewer, 1999). Gender, SES, and race/ethnicity have been shown to affect achievement in middle grades math, with boys traditionally outperforming girls (Brookhart, 1997; Pong & Pallas, 2001; Xin Liang, 2010), and students with a greater SES outperforming other students (Rodriguez, 2004; Tomoff, 1999; Wang, 2004). Additionally, White/Black and White/Hispanic achievement gaps have persisted over decades (e.g., Rodriguez, 2004), but may also demonstrate different relationships to achievement when combined with SES. For instance, differences in family SES was less important than school SES for minority students, with few differences in achievement seen among different SES levels (Kaya & Rice, 2010; Pong & Pallas, 2001; Sirin, 2005; Wang, 2004). In this study, student gender and race/ethnicity as reported on the Student Questionnaire will be used as background characteristics. Since free or reduced lunch status is not available in the student-level data,
mother’s highest level of education will be used as a measure of student SES. This approximation is supported by literature identifying the links between the mother’s highest level of education and student achievement (Pong & Pallas, 2001; Rampey, Dion, & Donahue, 2009; Rodriguez, 2004; Tomoff, 1999; Wang, 2004).

The conceptual framework for this study is displayed in Figure A-1. The study supposes influences of race/ethnicity, SES, gender, and classroom instructional practices on student achievement in mathematics. Possible relationships between race/ethnicity and SES on classroom instructional practices will be explored to determine if students of different races/ethnicities and SES levels perceive the emphases of different instructional practices. The results of the study will describe the relationships between student gender, SES, race/ethnicity, classroom instructional practices, and student achievement.

Overview of Study Methodology

The current study utilizes a portion of the large-scale, Trends in Mathematics and Science Study (TIMSS) 2007 dataset and quantitative methods to explore the research questions. Specifically, the U.S. eighth-grade sample is used to provide determination of student gender, measures of student socio-economic status (SES), determination of student race/ethnicity, the frequencies of classroom instructional strategies used, and student mathematics achievement scores. The 2007 dataset was chosen because it was the most recent TIMSS U.S. national dataset made available for secondary analysis. TIMSS Instruments used in this study include the Student Questionnaire, which provides the background and contextual information, and the mathematics assessment, which provides the
mathematics achievement data. All classroom instructional practice items were answered based on a four-point Likert scale, which were recoded to a two-point scale for analysis. Mother’s highest level of education is used to approximate student SES, and is recoded to represent three groups from 0 to 2 for analysis. Student’s derived race/ethnicity is recoded into four groups for this study (White, Black, Hispanic, and Other). Highest International Benchmark Reached, a five-level categorization of relative student scores ranging from Below Basic to Advanced, was used to provide a reference for the estimates of student mathematics achievement (Table 2). Correlations and a multiple regression were used to address the research questions.

The nature of the variables of interest and the research questions determined the analysis methods used in this study. All of the variables were nominal or ordinal in nature. After recoding, SES was comprised of three levels (0, 1, and 2), race/ethnicity included 4 levels (White, Black, Hispanic, and Other), and gender remained at two levels (Boys and Girls). Student mathematics achievement, as measured by the highest international benchmark reached, included five levels. A simple correlation was used to determine the strength and direction of each of the relationships between gender, SES, and the reporting of instructional practices for the first research question, while a multiple regression was used to generate an equation for prediction mathematics achievement using gender, SES, race/ethnicity, and classroom instructional practices in answer to the second research question. Assumptions for each data analysis method and the procedures for meeting the assumptions are further discussed in Chapter 3.
**Dissertation Overview**

The current chapter provides an introduction to the study, including the research problem, the research purpose, the research questions and hypotheses, the conceptual framework, and the study’s methodology. The remainder of the dissertation is organized into four additional chapters, followed by references and appendices.

Chapter 2 presents the literature pertaining to the variables of interest. Particular attention is paid to studies that used previous TIMMS administrations and other large datasets, and to those studies which otherwise addressed the specific variables in this study for the U.S. eighth grade population. The literature is presented in three sections: (1) Classroom Instructional Practices in the Middle Grades; (2) Classroom Instructional Practices and Student Achievement; and (3) Effects of Student Characteristics and Background on Achievement. Both small-scale and large-scale studies are presented and discussed.

Chapter 3 describes the methodology used to answer the research questions in detail. The 2007 TIMMS dataset is discussed, each of the variables is quantified, and the strategies used to answer the questions are presented. This chapter also includes a description of how the assumptions for each study method were met, and the detailed steps that were taken to answer each research question.

Chapter 4 presents the findings by research question. Interpretations of those findings are also offered. Quantitative results of the analyses are presented for further discussion in Chapter 5.
Chapter 5 discusses the results by research question, presents information of significance, and elaborates upon important considerations for policy and future research.
CHAPTER 2:
LITERATURE REVIEW

The 2007 TIMSS Student Questionnaire asked students to respond to background contextual items, including rating the frequency with which they experienced seventeen different classroom instructional strategies in their mathematics lessons (Table 7). The following review of the literature attempts to illuminate conclusions from previous studies involving specific instructional practices in the middle grades, followed by a discussion of the literature pertaining to student background characteristics. The chapter concludes with a discussion of the limitations of the literature in the review.

Classroom Instructional Practices in the Middle Grades

NCTM’s Teaching Principle states that, “Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well” (NCTM, 2000, p. 16). Teachers accomplish this feat through the use of appropriate and worthwhile tasks that require students to engage in the mathematics to be learned. A mathematical task is “a classroom activity, the purpose of which is to focus the students’ attention on a particular mathematical idea,” (Stein et al., 1996, p. 460). Such tasks may be approached using a variety of methods, such as counting, drawing, or writing equations (NCTM, 2000). Task implementation also includes the choices of products, processes, and resources that students are able to use.

It is through the implementation of specific tasks that the instruction in mathematics happens. Instruction can be defined as “the methods and processes by which pupils’ behavior
is changed,” and is heavily influenced by the teacher’s own conception of education and knowledge of student needs and characteristics (Airasian, 1991, p. 75). The teacher’s conception of education leads to the selection of delivery systems, instructional materials, assessments, and curricular content emphases that reflect the conception, which is highly individualized to the teacher. Instructional practices encompass how a teacher uses the curriculum, time, and instructional materials that are available on a regular basis. Each resource is an important component in planning considerations, and a teacher’s effective use of the resources is an important component in student achievement (Mullis et al., 2005).

Another NCTM Principle, the Learning Principle, states, “Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge,” (NCTM, 2000, p.20). NCTM emphasizes the use of discourse, reasoning, and exploration of mathematical ideas and deemphasizes the use of memorization of facts and procedures in the classroom. NCTM supposes that students who are challenged with appropriate tasks are more likely to persevere in solving them and become more confident in seeking their own solution paths to problems, while the memorization of facts and procedures without understanding produces learning that is “fragile” (NCTM, 2000, pp.20-21). Teachers must choose the ways in which they structure the learning activities for their students, and the methods they will use to deliver the content.

A direct-instruction lecture, for example, is considered a part of a delivery system. A delivery system is “the means by which instruction is provided to learners,” and can include grouping practices such as whole-group, small-group, or individualized instruction, as well as
the use of resources as in computer-aided instruction or adaptive technology. These instructional decisions are heavily influenced by the adoption of a perspective that guides the development of the specific activities in the learning sequence (Dick, Carey, & Carey, 2009) which guides the teacher to adopt reform practices, traditional practices, or some combination of the two.

Despite the call by NCTM and other reform efforts for students to learn more and deeper mathematics, there has been a general reluctance of teachers to make the shift to Standards-based learning experience for their students. Providing support for their reluctance are many studies that seem to imply that students in classrooms where such learning is taking place are in danger of not learning “the basics,” and that the students will not be able to access the more difficult mathematics that lies ahead in advanced courses (Sfard, 2003). Projects of Standards-based learning may be abandoned because of unexpected decreases in student achievement on standardized tests without thorough investigations into other factors that may have impacted scores, such as a high rate of teacher and administrator turnovers in the project (Hiebert, 2003). Research supporting the use of NCTM standards in classrooms often bemoans the lack of training for teachers and the inconsistent implementation that seems to accompany lackluster results. As a result, studies of how NCTM Standards have been implemented into classrooms generally find that few U.S. teachers teach mathematics in a manner consistent with reforms.

According to the research, the trend may be moving more towards the use of the Standards, however slowly, due to a change in teachers’ beliefs. For example, Furner (2004)
administered a Standards Belief Instrument (SBI) to 41 seventh and eighth grade teachers in the southeast. This 16 item document used a four-choice scale to evaluate teachers’ levels of agreement to beliefs stated in NCTM’s *Curriculum and Evaluation Standards* (1989) and *Principles and Standards for School Mathematics* (2000). Although no significant difference in the knowledge of the standards was found between teachers with fewer than five years of experience and those with more than five years, the mean belief score was greater for the newer teachers (Furner, 2004). The author concluded that this result indicated that the increased use of the *Standards* in teacher education programs influenced the beliefs of new teachers, who were then more likely to incorporate *Standards*-based practices into their classrooms than experienced teachers. In this manner, the use of *Standards*-based practices may be slowly increasing as newer teachers enter the field.

Research into the specific instructional choices made by teachers, both novice and veteran, and the instructional strategies experienced by students has been conducted on many scales. The following sections discuss previous studies and reports on the instructional practices used in U.S. middle grades classrooms.

**TIMSS Video Studies**

Perhaps the most comprehensive studies of classroom instructional practices of eighth grade teachers were the TIMSS Video Studies of 1995 and 1999. In these studies of eighth grade instruction, classroom observations were combined with written data collection to present a picture of teaching that questionnaires were unable to capture (Jacobs et al., 2003). The 1995 study included classrooms in the U.S., Germany and Japan. The 81 U.S.
lessons were observed and scored according to the organization of the class, outside interruptions, the organization of classroom interactions, the structure of activity segments, and mathematical content (Stigler et al., 1999). It was found that while 70% of the U.S. teachers reported that their observed lessons reflected current ideas “a fair amount” or “a lot,” (Stigler et al., 1999), only about 20% of the lessons were coded as developing mathematical concepts and procedures, with about 95% of student seatwork time spent practicing routine procedures (Peak, 1996; Stigler et al., 1999; Stigler & Hiebert, 1997). The lessons generally consisted of two phases: acquisition, the phase in which the teacher demonstrated a concept or procedure, and application, the phase in which the students practiced the procedure with similar problems while the teacher assisted individual students (Stigler & Hiebert, 1997). The mathematical content of 89% of U.S. lessons was deemed “low quality,” while no lessons fell within the “high quality” range (Peak, 1996; Stigler et al., 1999). Furthermore, no instances of deductive reasoning were observed in the U.S. lessons (MacNab, 2000; Stigler & Hiebert, 1997, p. 65). Instead, many definitions, theorems, and properties were presented and practiced (Manaster, 1998).

The 1999 TIMSS Video Study revealed no large differences in classroom environments or major policy shifts between 1995 and 1999 (O’Dwyer, 2005). In this sample of 83 U.S. lessons, 94% of the lessons involved a review of previous material; with 53% of the lesson time spent reviewing. Furthermore, 28% percent of the lessons consisted entirely of the review of previous content. These findings suggest that limited opportunities are available for U.S. students to learn and practice new content, restricting the amount of
subject matter learned in the eighth grade year. Another finding was that although 45% of the lessons involved students choosing their own solution methods for problems, only 17% of the lessons included publicly presenting and examining alternative solution methods developed by students. In addition, once again, although more than 75% of the U.S. teachers reported a familiarity with the NCTM Standards, students were observed engaging in deductive reasoning in only 10% of the lessons, while students spent the majority of their time repeating procedures demonstrated by the teacher (Hiebert et al., 2003; Jacobs et al., 2006). Furthermore, no U.S. lessons were deemed “high quality” overall by the observers (Hiebert et al., 2003, p. 200). In all, U.S. lessons were equally focused on review of old content and introducing new content through learning and practicing procedures to solve problems (Hiebert et al., 2003).

An important point to remember for the Video Studies is that the observations of just one lesson per teacher, at just one point in the year, were conducted in classrooms not included in the achievement tests (Jacobs et al., 2003). Although the outcomes of the 81 U.S. lessons in 1995 and the 83 U.S. lessons in 1999 revealed prevailing patterns of instruction across schools and systems for 8th grade students, it is possible that other sampled lessons may have presented different results.

**Nationally representative datasets**

In addition to the TIMSS Video Studies, reports and studies using the TIMSS regular administration, NAEP data, and the Teacher Follow-Up Survey to the Schools and Staffing Survey have also described the state of education in U.S. middle school classrooms. All of
these large datasets include nationally representative data that may be generalized to the population of U.S. students. Specifically, results including the 8th grade U.S. population are reported and discussed in this section.

First, studies have found that certain delivery systems may be more prevalent in American mathematics classrooms than other systems overall. Specifically, Wenglinsky (2002) used the student reports of classroom instructional practices from the 1996 National Assessment of Educational Progress (NAEP) administration to describe the classroom experiences of U.S. eighth graders. It was found that about 80% of the students reported solving problems using routine algorithms, about 75% solved problems that addressed real-world situations at least once a week, and few solved problems in groups or worked with partners in the classroom (Wenglinsky, 2002). In addition, all of the students reported taking a test at least once a month, with more than half of the students reporting test items that required written extended responses.

The choice of instructional methods may be influenced by subject and grade level. For instance, Henke, Chen, and Goldman (1999) utilized the Teacher Follow-Up Survey to the Schools and Staffing Survey administered 1994 - 1995 to investigate the instructional practices in a nationally representative sample of K-12 schools. They found that high percentages of mathematics teachers reported the use of recall questions (91.2%) and teacher-facilitated discussion (86.1%) as instructional strategies (Henke, Chen, Goldman, 1999). Also, teachers in grades 7-8 were least likely to have students solve problems with several answers or assign projects or experiments for homework than teachers on other
levels. In addition, mathematics teachers overall were the least likely to link school and the real world (48.1%), order events or things and explain the order (24.0%), use problems with several answers (40.7%), and assign projects or experiments for homework (12.0%) (Henke, Chen, & Goldman, 1999). Mathematics teachers were most likely to use problems with different solution methods in class (71.2%), with teachers in grades 4-6 reporting the most frequent use of these problems of all of the grade levels (67.8%) (Henke, Chen, & Goldman, 1999).

A propensity for traditional methods was also found in the teacher reports of instructional practices for TIMSS 1999. Gonzales and colleagues (2000) found that teachers reported the use of several practices “almost always” or “pretty often.” These practices included: the teacher showing how to solve a problem (94%), students working on worksheets or from textbooks (86%), students using calculators (49%), students working on math projects (29%), and using everyday items to solve problems (23%) (Gonzales et al., 2000). Of these practices, three (using calculators, working on math projects, using everyday items to solve problems) are consistent with Standards-based instruction. However, an examination of the emphases these practices received shows that teachers placed much greater emphasis on the traditional practices of teacher demonstration and students working on worksheets or from textbooks than more interactive and student-centered strategies.

Similar to Wenglinsky (2002), Swanson and Stevenson (2002) also used NAEP 1996 data to investigate the pedagogical techniques, topic and skill emphases, and use of assessments that were consistent with the NCTM Curriculum and Evaluation Standards.
They found that although the majority of variation in practices was found at the classroom and school levels, the use of Standards-based practices were more prevalent in classrooms emphasizing advanced content with experienced teachers. In other words, students in eighth grade algebra or pre-algebra courses taught by experienced teachers were more likely to experience the 16 Standards-based practices on the NAEP questionnaire more often than other eighth grade students. Along with Henke, Chen, and Goldman (1999), these differing results emphasize the need for further studies addressing specific grade levels and subjects areas.

Differing results were also found in the reports of classroom instructional practices between students and teachers in the TIMSS report using the 2007 dataset utilized in this study. For instance, while 72% of U.S. eighth grade students reported memorizing formulas and procedures in half of the lessons or more, only 37% of the teachers reported the same amount of emphasis (Mullis et al., 2007). Other examples of inconsistencies between student and teacher reports include working on fractional and decimals (44% and 63%, respectively), writing equations and functions (73% and 46%, respectively), and interpreting data in tables and graphs (57% and 16%, respectively). Student and teacher reports were much closer on items such as explaining answers (79% and 77%, respectively) and students deciding their own procedures for solving problems (46% and 44%, respectively). Studies have shown that teacher reports do not always accurately reflect classroom practice, however (Mayer, 1999), and the truth probably lies somewhere between the student reports and the teacher reports.
Without observations, though, precise and accurate reports of instructional practices are difficult to obtain.

**Other studies of instructional practices**

In addition to nationally representative studies, smaller studies have sought to describe current mathematics instructional practices, with similar results. For instance, Spillane and Zeuli (1999) found that only 4 of the 25 teachers who reported using reform-based instructional practices were doing so consistently. This study utilized the TIMSS 1995 Teacher Questionnaire along with interviews and observations of elementary and middle grades mathematics teachers. Teachers were described as fitting into one of three patterns. The teachers in Pattern 1 were those who demonstrated the most complete and consistent use of *Standards*-based instruction. These teachers set up tasks that allowed students to “grapple” with the mathematics, structured lessons so that students were doing the work of mathematics (making conjectures, problem-solving, and justifying ideas), and emphasized mathematical discourse that reinforced the belief that mathematics was more than just a set of procedures to be learned and replicated (Spillane and Zeuli, 1999). The other 21 teachers in the study used a few of the reform-oriented practices in inconsistent manners (Pattern 2), or incorporated some reform efforts into otherwise traditional instruction (Pattern 3). For the most part, their task and classroom discourse choices reflected a strong procedural and computational focus, although recommended practices such as the use of small groups, manipulatives, and calculators were incorporated into some of the lessons. This study again
points to the difficulty experienced by teachers to accurately report their own instructional practices and the need for observation to verify those practices.

McKinney and Frazier (2008) also found greater use of traditional teaching methods with their examination of the use of instructional practices of middle school teachers in high-poverty schools. The 64 teachers in the sample were in attendance at an NCTM meeting, and volunteered to complete the survey during the last session of the conference. The survey asked teachers to rate their use of 44 instructional practices on a scale from “Never” to “Very Frequently”. It was found that high percentages of these teachers also used traditional practices such as lecture (75%); drill and practice (96.8%); and algorithms, procedures, and rules (88.8%) “Frequently” or “Very Frequently.” Conversely, fewer teachers used NCTM-recommended practices such as cooperative learning (45.3%), manipulatives (17.2%), and problem-based learning (49.6%) with the same regularity (McKinney & Frazier, 2008). One interesting note is that 100% of the teachers sampled did report the use of calculators “Very Frequently,” however no follow up questions were provided to clarify teachers’ responses. Although these teachers also engaged in self-reporting, their reports coincided more closely with the observations in Spillane and Zeuli (1999) and the data from Henke, Chen, and Goldman (1999), which followed national trends in instruction.

On a slightly larger scale, Kim, Crasco, Blank, and Smithson (2001) examined teachers’ responses to the Survey of Enacted Curriculum to determine the use of reform-oriented instructional methods in 20 urban elementary and middle schools from eight school districts. In this study, teachers reported that the greatest amount of instructional time (about
20%) was spent in lectures or classroom discussion and small group work, with the percent of time students spent in individual student work (about 17%) following closely behind (Kim, Crasco, Blank, & Smithson, 2001). Other instructional activities, such as attending to administrative routines, student demonstrations, reviewing or working on homework, and taking a test or quiz, were reported to each take about 15% of the instructional time in class.

All of the previous studies paint a picture of the instructional environment in which U.S. students learn mathematics. Overwhelmingly, the results describe classrooms in which students more often continue to learn through lecture, drill, and practice than exploration, discourse, and cooperative learning methods. The next section highlights the consequences of these teacher decisions by investigating the relationships between specific learning methods and strategies and student achievement.

**Classroom Instructional Practices and Student Achievement**

According to NCTM, students who engage in worthwhile tasks can learn important mathematical ideas with understanding through reasoning and classroom discourse (NCTM, 2000, p. 21). Ideally, this understanding should translate into student learning and achievement. The following studies discuss the links between classroom instructional practices and student achievement. The discussion begins with first summarizing large-scale studies on many practices, followed by examining important studies regarding the specific topics of task selection, cooperative learning, use of technology, assessment, and homework.
TIMSS and NAEP results

Several large-scale reports and studies have found varying relationships between instructional practices and student achievement in the middle grades. This section contains TIMSS and NAEP reports of nationally representative sample results. For reference, comparisons to International Benchmark Scores for TIMSS and achievement levels NAEP are conveyed for their corresponding studies and reports.

TIMSS. The relationships between instructional practices and student achievement on the national level can be traced back through previous versions of TIMSS. For example, in reporting the results of TIMSS 1995, Beaton and colleagues (1996) found that the mean achievement scores of students who practiced computation in “most lessons” or “every lesson”, according to teachers’ reports, was lower than students who practiced computation “never or almost never” or in “some lessons” (Beaton et al., 1996). Similar results were found for teachers reporting that their students engaged in reasoning tasks in “every lesson” as opposed to “some lessons” or “most lessons” (Beaton et al., 1996). Although teachers and students differed in the reporting of the frequency of calculator use in the classroom, the more frequent use of the calculator was also related to greater achievement in both reports. In contrast, teacher reports of the use of computers for “most or every lesson” were related to higher student achievement than student reports of the use of computers “always or pretty often”. Interestingly, students reporting computer use “always or pretty often” also received lower mean achievement scores than those who reported the use of computers “never” or “once in a while”. Finally, on a three-point scale ranging from “once in a while/never” to
“almost always,” students reporting taking a quiz or test “pretty often” scored higher than students reporting “once in a while/ never” or “almost always.”

Compared to the 1995 International Benchmark levels of Top 10%, Top Quarter, and Top Half, these student achievement results indicate that the more frequent use of Standards-based activities that included emphasizing reasoning tasks were related to higher achievement levels than more traditional practices such as practicing computations. Specifically, students whose teachers reported practicing computation less frequently or engaging students in reasoning tasks more frequently achieved a mean score within the Top Half level. Meanwhile, students whose teachers reported the practicing computation more frequently or engaging students in reasoning tasks less frequently achieved a mean score below the Top Half level. Students who reported the use of computers “once in a while” or taking a test “almost always” also achieved a mean score within the Top Half range. The mean achievement scores for students in the remaining practices in this discuss were below the Top Half range.

Also, in reporting the results from TIMSS 1999, Mullis and colleagues (2000) described the relationships between teacher emphasis in certain areas and student achievement through indices of emphasis. Again, students of teachers who placed a high emphasis on mathematics reasoning and problem solving through more frequent use in the classroom achieved at a higher level than students whose teachers placed a medium amount of emphasis or low emphasis on the topic (Mullis et al., 2000). Similarly, students whose teachers placed high emphasis on calculator use in class and on mathematics homework
achieved at higher levels than those whose teachers placed less emphasis on those areas. In contrast, students reporting computer use “almost always” or “pretty often” in class achieved at lower levels than students reporting computer use “once in a while” or “never”. When compared to 1999 International Benchmark levels of Top 10%, Upper Quarter, Median, and Lower Quarter, it is evident that although the use of Standards-based activities such as mathematics reasoning and problem solving and using calculators were related to greater achievement, the differences in achievement did not influence the International Benchmark reached in 1999. Specifically, the mean achievement scores of students for each of the practices in this discussion were contained within the Top Half range.

Similar results were found for the teachers’ emphasis on homework in the TIMSS 2003 data. In particular, students whose teachers placed a high emphasis on homework with greater frequency and duration of assignments once again scored higher than students whose teachers placed medium or low amounts of emphasis on homework (Mullis, et al., 2003). When compared to the 2003 International Benchmark levels of Advanced, High, Intermediate and Low, the data demonstrates that medium or high homework emphases are related to the Intermediate level, while a low emphasis is related to the Low International level. Unfortunately, the TIMSS 2003 Mathematics Report did not include scores related to the other instructional practices on the Student Questionnaire, so no conclusions can be made about the relationships between additional practices and student achievement using the information in the report.
More specifically, House and Telese (2008) used the 2003 TIMSS 8th grade sample to investigate student and instructional factors related to student achievement in algebra. They found that the more frequent use of several instructional strategies on the Student Questionnaire was related to student achievement. Specifically, frequently writing equations to represent functions, more frequent review of homework during lessons, using calculators, and students working problems on their own were most positively related to greater student achievement (House & Telese, 2008). In contrast, practices such as working on fractions and decimals, having a quiz or test, cooperative learning, listening to the teacher lecture, interpreting data in tables or graphs, and relating learning to the real world were negatively associated with U.S. student achievement in algebra (House & Telese, 2008). Although it is expected that writing equations would correlate positively with algebra achievement, the negative relationship between cooperative learning and relating learning to the real world and student achievement warrants further investigation.

Finally, in the TIMSS 2007 International Mathematics Report, student achievement levels were once again reported for the amount of emphasis the teachers placed on homework, but not on specific classroom instructional practices (Mullis, Martin & Foy, 2007). Once again, it was found that students whose teachers reported a high emphasis on homework scored higher than students whose teachers placed medium or low amounts of emphasis (Mullis, Martin & Foy, 2007). Compared to the International Benchmark levels of Advanced, High, Intermediate, and Low, the data again shows that although greater emphasis on homework yields greater mean scores, the International Benchmark level that is reached is
largely unaffected by homework frequency and duration. Specifically, while the mean scores of students were contained within the Intermediate range for all reports of homework emphasis, a low homework emphasis was related to the minimum mean achievement score for the range, whereas the mean scores for medium and high emphases were further within the range.

The previous discussion of results from TIMSS data reveals several classroom instructional practices related to higher student achievement. First, students whose teachers reported a high emphasis on homework by assigning longer assignments more frequently score higher than students whose teachers did not (Beaton et al., 1996; Mullis et al., 2000; Mullis et al., 2003; Mullis, Martin & Foy, 2007). Also, specific practices such as reasoning (Beaton et al., 1996; Mullis et al., 2000) and calculator use (House & Telese, 2008; Mullis et al., 2000) were also related to greater student achievement. TIMSS classroom practice and student achievement relationship data is incomplete, however, with differences in data collection and reporting across the administration years. To continue to investigate national trends, NAEP data is also considered.

**NAEP.** Reports from the National Assessment of Educational Progress, also known as *The Nation’s Report Card*, demonstrate trends in mathematics classroom instructional practices and student achievement. For reference, NAEP identifies three levels of student achievement: Basic, Proficient, and Advanced. These levels of achievement are reported for some instructional practices, however, like TIMSS, not all instructional practices have student achievement scores for all years of administration. For example, mean student
achievement scores related to teachers’ reports of calculator use are reported for 1992, 1996
and 2000, while mean student achievement scores for teachers’ reports of computer use and
students’ reports of calculator use, homework practices and textbook use are reported for
1996 and 2000 (Braswell et al., 2001). No student achievement data is offered for specific
instructional practices in the 2003 and 2005 reports (e.g., Braswell et al., 2003; Perie et al.,
2005).

NAEP reports identify similar trends in the relationships between certain instructional
practices and student achievement found in TIMSS data. For instance, students of teachers
reporting calculator use “every day” outperformed students whose teachers reported less
frequent use of calculators in 1992, 1996, and 2000 (Braswell et al., 2001). These results are
similar to students’ reports, with students reporting the use of calculators “every day”
outscoring students reporting less frequent calculator use in 1996 and 2000 (Braswell et al.,
2001). Also, students reporting no time spent on homework in 2000 achieved at a lower
mean score than any other level of homework, although students reporting spending 15
minutes a night scored higher than students reporting longer homework times (Braswell et
al., 2001). Interestingly, students reporting working problems from a textbook “every day”
in 1996 and 2000 scored higher than students working less frequently from textbooks. Also,
students reporting discussing problem solving methods with other students everyday scored
lower in 1996 and 2000 than students reporting less frequent discussions, except for students
reporting “never or hardly ever” to the item in 2000 (Braswell et al., 2001).
Discussing problem solving methods with other students is consistent with Standards-based instruction, while working problems from textbooks is generally considered a traditional practice. Compared to the NAEP achievement levels, the student mean score for each of the reported frequencies were contained within the Basic range, indicating no effect of frequency on the proficiency level reached for any of the practices. These results support the need for more specific investigations into how specific practices are implemented in the classroom in order to determine the actual nature of the implementation and the resultant impacts on student achievement.

Wenglinksy (2002) also utilized the 1996 NAEP dataset to further investigate the links between instructional practices and achievement. This study found that practices related to hands-on learning and higher-order thinking skills, which are both consistent with Standards-based instruction, were positively related to U.S. eighth grade mathematics achievement. Specifically, students of teachers who used hands-on learning activities weekly achieved at a level that was “72% of a grade level ahead in mathematics” than other students (Wenglinsky, 2002, p. 27). Also, students exposed to higher-order thinking skills “a lot” were “39% of a grade level ahead in mathematics” beyond their peers (Wenglinsky, 2002, p. 27). Later, Lubienski and colleagues (2008) examined NAEP 2003 results and found that the use of calculators was positively related to student achievement at grade 8.

The previous studies just begin to investigate the links between specific instructional practices and student achievement on mathematics with large-scale, nationally representative
datasets. The following studies further describe and elaborate upon specific classroom instructional practices and their links to student achievement.

Peer collaboration and cooperative learning

One item on the TIMSS 2007 Student Questionnaire addressed the frequency at which students worked in groups in the mathematics classroom (IEA, 2007). Previously discussed studies indicate that cooperative learning is used in U.S. eighth grade mathematics classroom less frequently than more traditional practices (McKinney and Frazier, 2008), and the more frequent use of cooperative learning is sometimes related to lower student achievement (Braswell et al., 2001). Other studies point to the benefits of cooperative learning in the classroom. For example, in *Synthesis of Research on Cooperative Learning*, 61% of the 67 studies investigated demonstrated greater achievement with cooperative learning than in control classes, while 37% of the studies revealed no significant differences between the groups, and only 1 of the studies reported a control group that outperformed the experimental group (Slavin, 1991). The synthesis included studies from grades 2-12, across major subject areas, and from different types of schools. Similar to calculator use, though, cooperative learning effects on student achievement are dependent on factors such as the specific method that is used and how cooperative learning is implemented in the classroom (National Research Council, 2001; Slavin, 1991; Webb, 1991; Johnson et al., 2000). The following studies summarize the relationships between specific cooperative learning methods, including particular aspects of cooperative learning, and student achievement.
In a meta-analysis conducting nearly 200 comparisons of cooperative learning and traditional methods, Johnson and colleagues (2000) investigated eight specific cooperative learning methods and their effects on student achievement across all levels of school:

1. Jigsaw
2. Cooperative Integrated Reading and Composition
3. Learning Together
4. Group Investigation
5. Team Assisted Individualization
6. Student Teams Achievement Division
7. Constructive Controversy
8. Teams – Games - Tournament

The study found that each of the investigated methods was related to significantly higher student achievement when compared to more traditional methods of competitive or individualistic learning (Johnson et al., 2000). It was also found that the specific cooperative learning methods of Learning Together and Constructive Controversy resulted in the greatest effect sizes when compared to competitive and individualistic methods of instruction.

Similarly, Slavin and colleagues (2009) also found that a specific cooperative learning method, Student Teams Achievement Division, positively impacted student achievement.

In addition to the finding that specific models of cooperative learning are related to student achievement, specific aspects of cooperative learning are also related to student achievement. Webb’s (1991) review of 17 studies linked peer verbal interactions in small
groups to student achievement in mathematics classrooms in grades 2-11. The study found that the quality of student explanations when giving help was important to achievement. For example, elaborated explanations were more helpful than simply sharing the answer or providing non-content help such as pointing out the correct page number or repeating teacher directions (Webb, 1991). Also, students in classes that received instruction and practice in basic communication and helping skills achieved at higher levels than students in classes that did not receive the instruction, due to the ability to provide elaborated explanations (Webb, 1994).

Perhaps the most important aspects of successful cooperative learning relates to goals and accountability, however. According to Slavin (1991), successful cooperative learning is dependent on group goals and individual accountability to raise achievement (p.76); students work as groups, not just in groups. Students are more motivated to assist each other with group rewards, leading to greater group cohesion (Slavin, 2011). Specific cooperative learning methods, such as Jigsaw in which students become experts in a topic, then share their expertise with their groups, also more positively affect student achievement when associated with group rewards (Slavin, 2011). The Student Teams Achievement Division method in which students work in heterogeneous teams to master material and demonstrate individual mastery on a quiz, has also shown greater positive effects on student achievement than in control groups (Slavin, 2011). Studies related specifically to mathematics, however, have found inconsistent results concerning the relationships between group goals and individual accountability (Davidson & Kroll, 1991). Specifically, group goals without group
rewards may raise student achievement as effectively as group goals with rewards in certain
conditions (Davidson & Kroll, 1991).

The previous studies of cooperative learning point towards a positive impact on
student achievement. Although not an exhaustive review of the large cooperative learning
base, these studies contribute greater specificity to the methods and uses of cooperative
learning that simple items addressing the frequency in which students work in groups are
unable to capture.

**Homework**

Another common instructional practice is the assignment of homework. Homework is
often assigned to provide additional practice and to assess learning (Mullis et al., 2005).
Homework assignments require monitoring and review for the greatest impact (National
Research Council, 2001). While a high teacher emphasis on homework is positively related
to student achievement (Beaton et al., 1996; Mullis et al., 2000; Mullis et al., 2003; Mullis,
Martin, & Foy, 2007), the choice of homework assignments is also important. For example,
using worksheets as homework is negatively related to achievement in mathematics
(Rodriguez, 2004). However, if no homework is assigned, U.S. students often do not study
and review on their own (Stevenson, 1998).

In an in-depth study of homework practices of teachers, students, and parents,
Cooper, Lindsay, Nye, and Greathouse (1998) identified several areas in which the
relationships of homework to student achievement differed by grade level. For example, in
grades 6-12, positive correlations were found between the amount of homework completed
and achievement for class grades. Class grades for this group could also be predicted from standardized test scores, and parent, teacher, and student attitudes towards homework. Additionally, on the same grade levels, teachers who possessed positive attitudes toward homework, or teachers whose students attained low scores on standardized tests assigned more homework.

Similarly, Brookhart’s (1997) study of the classroom assessment environments of about 3,000 middle and high school students using the 1987-1991 Longitudinal Study of American Youth (LSAY) found differing relationships between homework practices and student achievement by grade level. Specifically, the hours of homework assigned and the percentage of homework completed on time were positively related to students’ achievement for mathematics in grades 7-12. Also, while the percentage of homework corrected and returned was negatively related to achievement in grades 8-10, a positive relationship was demonstrated in grade 7 (Brookhart, 1997).

Taken in conjunction with the data from large-scale studies, overall, homework practices have shown inconsistent relationships to mathematics student achievement in the middle grades.

**Technology**

According to NCTM, the use of technology can positively affect students’ learning of mathematics by helping students focus on reasoning and problem solving without heavy computational burdens (NCTM, 2000). Technology can also assist teachers in adapting mathematics instruction for diverse learners and support students in learning abstract
concepts (NCTM, 2000). Two types of technologies are addressed in the TIMSS Student Questionnaire; calculators and computers. The following studies address the use of these technologies in mathematics classrooms and their impacts on student achievement in more detail than is available from the TIMSS and NAEP questionnaires.

**Calculators.** As demonstrated in TIMMS and NAEP results, calculator use is positively related to student achievement in mathematics (Braswell et al., 2001; House & Telese, 2008; Mullis et al., 2000; Lubienski et al., 2008; Wenglinsky, 2002). Frequent calculator use has also been shown to support student problem solving without negatively affecting computational skills (National Research Council, 2001). Teachers also believe that the use of calculators leads to better understanding of mathematical concepts by students, generates interest in mathematical tasks, and improves student performance in mathematics (Brown et al., 2010).

Other studies have determined that how and when a calculator is used is just as important as how often it is used in the classroom, however. For example, Loyd (1991) investigated the calculator use of students on four types of math test items: 1) items with difficult computations in which calculators were useful, 2) items with easy calculations, 3) items in which the process of solving the problem was sought instead of one correct answer, and, 4) items in which calculator use was difficult, such as items involving fractions. The students allowed to use the calculators performed better on the first three items than students who were not allowed to use calculators, although the results for the fourth item type were not significant (Loyd, 1991). Also, in a secondary analysis of NAEP data, Walcott and
Stickles (2012) found that students who reported calculator use on problem solving items outperformed other students on more than half of the problem solving items, but performed worse on non-computational items when attempting to use the calculator. Students were required to determine the items on which the calculator would be more beneficial (problem solving items) or unnecessary (non-computational items). Both of these studies point to the need for students to not only have access to calculators, but to also have experience discerning when calculators would and would not be useful for solving problems.

Computers. Inconsistent effects on student achievement have been reported for computer use in the mathematics classroom in large-scale studies (Beaton et al., 1996; Mullis et al., 2000). One reason for inconsistent results is that computer use in math classrooms has been rare, according to reports. For example, only 4% of the lessons in 1995 and 1% of the lessons in 1999 were reported to use computers in the TIMSS Video studies (Jacobs et al., 2006). Also, 54% of students had teachers who reported that no computers were available for mathematics in 2003 (Mullis et al., 2004).

Similar to calculator use, the methods in which computers are used in instruction are also important to student achievement. For instance, in a meta-analysis of 700 empirical research studies on the impact of educational technology on student achievement, Schacter (1999) found that students with access to specific types of technologies that assisted instruction, integrated learning, and emphasized higher-order thinking skills scored higher on researcher-constructed, standardized, and national tests than students simply subjected to drill and practice computer activities using technology. Even more specifically, Roschelle and
colleagues (2010) investigated the effect of the SimCalc replacement unit on student learning of functions. The program incorporated visual and linguistic representations to animate the effects of functions on characters on the screen. Findings from the study include significantly higher gains from pretest to posttest in the SimCalc groups, especially on the more advanced mathematics items (Roschelle et al., 2010). Studies of computer use generally emphasize the need for computer activities to reinforce and help students build upon important mathematical ideas through exercises in higher-order thinking.

**Assessment**

One TIMSS 2007 Student Questionnaire item addresses the frequency of which students take a quiz or test in class. Quizzes and tests are types of assessments. Written classroom assessment practices consist of the use of specific assessments and assessment item types. These assessments and assessment items may be classified into two groups; objective test items, or alternative assessments. Objective test items include all items that can be scored as simply correct or incorrect (Dick, Carey, & Carey, 2009). Objective items may include selected response items and some such as some fill-in-the-blank, constructed response items. Selected response items are those which offer choices from which a student must choose an answer. Multiple-choice, matching, and true/false items generally fall into this category (Reynolds, Livingston, & Wilson, 2009). Objective tests and items are often considered more traditional methods of assessment.

Alternative assessments, on the other hand, may include some constructed-response items, such as short-answer and essay items, in addition to performance assessments, and
portfolios (Dick, Carey, & Carey, 2009). These items consider more than simply correct or incorrect responses, and generally provide more information about student understanding through explanation or demonstration. The TIMSS 2007 mathematics assessment included a mixture of multiple-choice and constructed response items to determine student achievement.

Assessment that is an integral part of the instructional sequence also assists students in learning content through review and reflection (Mathematical Sciences Education Board & National Research Council, 1993; NCTM, 2000). Assessment products should provide teachers with meaningful information about student knowledge and understanding, and provide students with data about how they performed and where mistakes were made. Teachers should then provide an opportunity for students to review and correct the errors (MSEB & NRC, 1993; NCTM, 2000). This use of assessments as learning tools is consistent with the understanding of formative assessment practices.

Studies of assessment practices in middle grades mathematics generally reveal many varied methods used in the classroom. For example, Mertler’s (2000) study of the classroom assessment practices of 625 Ohio teachers found that although traditional, objective types of assessment were used more often in middle and high school grades than in elementary, elementary and high school teachers used the multiple-choice format for test items more often than in the middle grades. Also, McMillan’s (2001) study of 1,483 teachers in grades 6-12 found that middle grades utilized commercial tests more often than teacher-developed test, with constructed response items least used in mathematics across grade levels.
The relationships between classroom assessment practices and student achievement are reflected in the TIMSS 2007 reports. Those indicated that the 50% of U.S. eighth grade mathematics students whose teachers reported the use of constructed responses “only or mostly,” achieved a higher mean score than those reporting “about half constructed and half multiple-choice” items or those reporting “only or mostly multiple-choice” items (Mullis et al., 2008, p.312). These results are not surprising, though, as the TIMSS 2007 achievement tests included a mixture of item types, and it is expected that students with more experience with constructed items would be better equipped to answer such items with a greater proficiency than those who have little such experience, as found in Silver and Stein (1996).

Also, negative relationships have been found regarding the percentage of classroom time devoted to testing in grades 8-10, while a positive relationship was demonstrated in grade 7 (Brookhart, 1997). Additionally, the use of teacher-made tests is more inconsistently related to student achievement than published tests (Rodriguez, 2004). However, no conclusions can be made regarding particular test formats and item types.

One specific finding in Wenglinsky’s (2002) work related to the practice of including real-world problems on classroom assessment. It was found that the greater use of assessments which asked students to solve real-world problems yielded lower achievement results (Wenglinsky, 2002). This finding seemingly contrasts with Wenglinsky’s later 2004 finding that solving more real-world problems was related to reducing the achievement gap between minority and non-minority students. The discrepancy can be explained through interpretation of the results, however. For instance, the nature of the achievement gap dictates
that minority students achieve at lower levels than other students. Using real-world problems with lower achieving students will show a negative correlation between these types of problems and achievement, but studies of the rate of change in achievement could demonstrate a positive relationship between these types of problems and an improvement in achievement, even if the resulting achievement levels remain lower in one population than another. As with other instructional practices, more information is needed regarding the specific aspects of classroom assessment and their relationships to student achievement.

**Standards-based curricula and achievement**

Studies investigating the relationships between Standards-based curricula and student achievement have mainly been conducted on a program-by-program basis. Specifically, two National Science Foundation (NSF) – funded curricula have been developed for middle grades and largely investigated; the *Connected Math Program* (CMP) and *MATH Thematics* (Nie et al., 2009). Teachers using CMP tend to place a greater emphasis on building conceptual understanding and providing students with opportunities to apply mathematical concepts to problem solving situations than teachers using more traditional programs (Moyer et al., 2011). Similarly, the Quantitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) project focuses on tasks that provide students with opportunities to build and practice conceptual understanding, reasoning, and problem solving skills (Silver & Stein, 1996). For example, students in this program are often asked to provide an explanation in addition to finding a solution to a problem and are allowed to or expected to work together (Silver & Stein, 1996). The
common feature of *Standards*-based curricula and programs is the building of student understanding of “important mathematics through explorations of real-world situations and problems” (Nie et al., 2009 p. 788). The remainder of this section discusses the results of studies of *Standards*-based curriculum programs and their relationships to student achievement.

Reys and colleagues (2003) compared the achievement of students using *Standards*-based curricula (*MATH Thematics* and *Connected Math*) to students whose districts did not use such curricula. They found that eighth grade students who had used the *Standards*-based curriculum for at least 2 years experienced significantly higher achievement on several subtests of their state examination than students who did not use the program. Post and colleagues (2008) found similar results with 3 years of student use of the same programs. Additionally, it was found that each of the 5 school districts in the study scored above the national norm on an achievement test for problem solving, although four out of five districts scored below the norm for procedures (Post et al., 2008). The researchers contributed the results to a decreased emphasis on computation and procedures in the reform curricula.

Similarly, Riordan and Noyce (2001) found that middle grades students who used reform-based mathematics curricula outperformed students using traditional curricula on exams for a different state. Likewise, a study of the achievement of students in the QUASAR program found that QUASAR students achieved at significantly higher levels on NAEP items than students who were not in the program (Silver & Stein, 1996). Specifically, the students, who attended “disadvantaged, urban” schools, performed as well or better than the
national sample for statistics and probability, algebra, and function items (Silver & Stein, 1996, p. 508).

The results of the achievement studies indicate that students in Standards-based program do learn the mathematics necessary to be successful on large-scale, high-stakes assessments. The results also indicate that students who report using classroom instructional practices that are related to Standards-based instruction more often should perform at least as well, if not better, on assessments such as TIMSS as students who do not report the frequent use of the same practices.

Not all studies found positives effects of reform curricula, though. For instance, Slavin and colleagues (2009) found no support for choosing reform curricula over other textbooks, such as Saxon Math. Also, the reduction of teacher guidance with reform curricula may allow novice and intermediate learners to build and internalize mathematical misconceptions and misunderstandings (Kirschner et al., 2006). However, the evidence provided by studies of reform curricula and programs generally suggests learning benefits for students by building greater conceptual understanding of mathematical concepts (e.g., Silver & Stein, 1996).

Effects of Student Characteristics and Background on Achievement

Student characteristics and background may have a profound effect on achievement, often with impacts greater than any other factors, teacher, school, or otherwise (Goldhaber & Brewer, 1999). This section discusses the specific relationships of gender mother’s highest level of education, and student race/ethnicity on student achievement.
Gender

Student characteristics, such as gender, have shown to be related to achievement, with boys traditionally outperforming girls (Brookhart, 1997), especially in mathematics in the secondary grades (Pong & Pallas, 2001; Xin Liang, 2010). Such patterns may have begun to disappear, however. For example, in a meta-analysis of 242 world-wide studies investigating the relationships between student gender and mathematics performance in children through adults, Lindbergh and colleagues (2010) found no significant gender differences and questioned the need for single-sex mathematics classrooms. Also, in an investigation using the National Education Longitudinal Study (NELS: 88), Scafidi and Bui (2010) found that gender not have an overall effect on students’ mathematics achievement test scores in the U.S.

Likewise, Reports for the 2007 administration of TIMMS also describe a narrowing of the achievement gap between males and females for U.S. eighth graders. Specifically, males in this sample scored an average of 4 points higher than females, which is not a statistically significant difference (Gonzales et al., 2009). More recently, in an evaluation of TIMSS and PISA achievement data, Kane and Mertz (2012) found that the gender gap in eighth grade mathematics performance was essentially non-existent in several nations, including the U.S. The researchers also concluded that mathematics achievement was no longer a male-dominated area. In fact, they found that boys were beginning to underperform to girls in many wealthy nations (Kane & Mertz, 2012).
NAEP results, however, illustrate a slightly different image of the gender achievement gap in the U.S. The reports of NAEP trend data that tracks differences in student achievement from 1973 to the present indicate that the gender achievement gap has experienced no significant change since 1994, with a 4 point mean difference in mathematics achievement favoring males (Rampey, Dion, & Donahue, 2008). NAEP 2011 main assessment results indicate smaller gaps, however, reporting the largest achievement gap between genders as a 2 point advantage towards males from 1996 to 2009, shrinking to a 1 point advantage in 2011 (National Center for Education Statistics, 2011). Even more interesting is the fact that in 1992 and 1996, a one-point score difference favoring females was found. Score differences were not statistically significant for 1990 through 2000 (NCES, 2011), so this advantage can be considered as no more than an interesting note.

Overall, the literature on gender differences implies a closing of the gender achievement gap in recent years for middle grades mathematics. The exception of the NAEP data warrants further investigation to determine reasons for its failure to reflect the international trends towards the elimination of statistical differences in achievement by gender, however. Specifically, more information is needed to determine possible differences in tested curriculum and other factors that may differentially affect student achievement test results on the various test instruments by gender.

**Socioeconomic status**

Studies of family background, such as parental levels of education, could be considered as part of a family’s socioeconomic status (SES). The SES levels refer to access
to opportunities such as well-paying jobs and resources (American Psychological Association, 2010). Education has long been one method for improvement of access to jobs and other resources. In general, more educated parents are often considered to belong to a higher SES level than less educated parents, due to the ability to provide the financial and time resources to support their children academically (APA, 2010).

Parents’ backgrounds have also been shown to be strongly related to student achievement (Mullis et al., 2005). Parents’, especially mothers’, level of education has been proven to be an important factor when evaluating U.S. student performance on international assessments (e.g., Xia, 2010) and other nationally-representative exams (e.g., Rampey et al., 2008). For instance, students whose mothers attain higher educational levels generally score higher on TIMSS in mathematics than students whose mothers do not, especially in the U.S. (Pong & Pallas, 2001; Rodriguez, 2004; Wang, 2004). Tomoff’s (1999) study of U.S. TIMSS data confirmed the importance of parental education. This study found that parental level of education accounted for 60% of the variance in problem-solving scores of eighth grade mathematics students, more than any other factor, including instruction.

Similar results have been found in NAEP data, with children of more educated parents scoring higher on the mathematics assessment than children of less educated parents (Rampey et al., 2008). More specifically, eighth grade mathematics students who reported that at least one parent graduated from college scored higher than students whose parents did not graduate from college on each NAEP trend administration from 1978 to 2008 (Rampey et al., 2008). Furthermore, students who reported “did not finish high school” as the highest
parental level of education achieved at the lowest levels across the same years (Rampey et al., 2008).

The effects of SES may differ for different school levels and composition, however. For example, an analysis of data from the Longitudinal Study of American Youth (LSAY), Brookhart (1997) found differential effects of SES on mathematics achievement, with high school mathematics achievement more greatly affected by SES than junior high school mathematics achievement. Similar results were also found by Sirin (2005) in a review of the literature on SES and student achievement. It was also concluded that neighborhood SES level effects on student achievement were greater than individual family effects, due to the effects on neighborhood schools (Sirin, 2005). Due to the effects of SES on achievement, with children in higher SES levels demonstrating greater achievement in mathematics than children in lower SES levels, it is important to consider this factor when investigating student achievement.

**Race and ethnicity**

Student race and ethnicity are also related to student achievement. The existence of racial/ethnic achievement gaps has persisted into recent years despite efforts to address achievement disparities between minority and majority student groups. These gaps have especially been revealed in both large-scale assessments.

Nationally-representative datasets, such as TIMSS and NAEP, have revealed persistent gaps in mathematics achievement by race and ethnicity. For instance, statistically significant differences in mathematics achievement between White and Black and White and
Hispanic students have been reflected in TIMSS eighth grade mathematics data since 1995 (Gonzales et al., 2009). The gaps were narrower in 2007 than in 1995 for both combinations of race/ethnicity, however. Specifically, the mean difference in mathematics achievement between White and Black eighth grade students has narrowed from 97 points in 1995 to 76 points in 2007, while the mean difference between the achievement of White students and Hispanic students narrowed from 73 points in 1995 to 58 points in 2007 (Gonzales et al., 2009).

NAEP results generally echo those of TIMSS in relation to racial or ethnic achievement gaps. For instance, NAEP trend data reports a Black/White achievement gap as large as 46 points in 1973 and as small as 24 points in 1986 (Rampey, et al., 2008). Results demonstrate fluctuations in the gaps, however, with differences narrowing from 1973 to 1986, then widening to 32 points in 1999, and narrowing again to 28 points in 2008 (Rampey et al., 2008). White/Hispanic results demonstrate even more variations in score gaps with a narrowing from 35 points in 1973 to 19 points in 1986, a widening to 22 points in 1990, a slight narrowing to 20 points in 1992, a widening to 25 points in 1994, and another narrowing to 23 points in 2008 (Rampey et al., 2008). In both cases, achievement gaps narrowed from 1973 through 1986 then widened again, with wider gaps found in 2008 than in 1986. These results indicate persistent achievement differences in the mathematics achievement of U.S. eighth graders on trend items, especially since 1986, despite the many efforts that have been implemented to close the gaps within the last 27 years.
Similarly, NAEP main assessments data also reports a slight narrowing of racial/ethnic achievement gaps in recent years. For example, NAEP recorded the largest recent Black/White gap as 41 points in 1996, and the smallest as 31 points in 2011, while the largest Hispanic/White gap was 31 points in 2000, and the smallest was 23 points in 2011 (NCES, 2012). Again, the reports indicate variations in the achievement gaps, however, with a widening of the Black/White gap between 1990 and 1996 and the Hispanic/White gap between 1990 and 2000. Taken together, NAEP trend and main assessment reports indicate highly inconsistent differences in achievement between racial/ethnic groups over several years, with a slight trend towards a narrower achievement gap in recent years.

**Interactions between gender, race/ethnicity, and SES**

Although reports may illustrate differential effects of gender, race/ethnicity, or SES on student achievement, many studies have explored the effects of the different combinations of these student characteristics on achievement. The following studies describe some of the work completed in this area.

First, although SES has shown strong relationships to student achievement, those relationships may differ according to race or ethnicity. For instance, family SES is not as strongly related to academic achievement for minorities as it is for non-minority students, (Kaya & Rice, 2010; Pong & Pallas, 2001; Sirin, 2005; Wang, 2004). This finding has been explained as a result of the less variance in SES variables for minority students. Also, the lowest SES White students consistently scored higher than the highest SES Black students on
NAEP in 1990 and 1996, demonstrating a stronger relationship of race/ethnicity than SES to achievement (Lubienski, 2002).

Both student race/ethnicity and SES have also shown stronger relationships to achievement than gender. For instance, McGraw, Lubienski, and Strutchens (2006) found greater achievement differences between racial groups than between genders within groups on NAEP results from 1990 to 2003. They concluded that gender gaps favoring males were inconsistent across race/ethnicity and SES, with the only significant differences found between White males over White females and Hispanic males over Hispanic females in 2003 (McGraw et al., 2006). With a difference of 1 point, and an effect size of 0.03, these results can be viewed as negligible, however.

Kane and Mertz (2012) also found that a mother’s educational and economic statuses were more highly related to student achievement than gender. Instead of a strong relationship of achievement to the gender of the student, they found stronger relationships between the educational and economic levels of the mothers of the students. In other words, more educated, wealthier mothers were better able to monitor and assist the learning of their children, than less educated, less wealthy mothers, regardless of the gender of the child (Kane & Mertz, 2012). These results may be related to the general narrowing of achievement gaps recently demonstrated by gender, but not by SES.

Summary

Studies investigating student achievement are incomplete without the consideration of student characteristics of race/ethnicity, gender, and SES, as each of these characteristics
demonstrate differential relationships to student achievement. For instance: White students tend to achieve at higher levels than Black or Hispanic students (e.g., NCES, 2012); boys achieve at a higher level than girls, although this gap seems to be closing (e.g., Kane & Mertz, 2012); and students from higher SES levels achieve at higher levels than students from lower levels (e.g., Rampey et al., 2008).

Additionally, SES demonstrates weaker relationships to achievement than race/ethnicity, but stronger relationships to achievement than gender. Specifically, White students in the lowest SES level may achieve at higher levels than Black students at the highest SES level (Lubienski, 2002). Also, gender differences in achievement are dwarfed by SES level achievement differences (McGraw et al., 2006), with boys and girls in higher SES categories achieving at greater levels than boys and girls in lower SES categories (Kane & Mertz, 2012). Considering the importance of student backgrounds demonstrated in the literature, including student characteristics in the study will illuminate important differences between groups and provide references for comparisons of study results.

**Limitations of the Instructional Practice-Student Achievement Literature**

Although many studies have investigated links between instructional practice and student achievement, study results are inadequate to inform policy for two reasons. First, a limited number of studies focused on the U.S. using TIMSS 2007 data are available. Also, video studies using TIMSS data and published reports presented percentages of time spent engaging in specific classroom instructional practices, leaving links to higher or lower-
performing nations to inferences based on national scores. The current study seeks to address these gaps in the literature.

**Lack of U.S. Studies Involving TIMS 2007**

A search of “studies of TIMSS 2007 U.S.” in the Google Scholar database revealed over 1,200 results, but a quick review of the first 5 pages of results indicated a lack of empirical studies focusing on the U.S. population using the TIMSS data. Instead, the pages were filled with reports of the TIMSS data, technical reports for using the data, studies of the data of other nations, and comparative studies involving the U.S. and other nations. The first 50 entries in this informal search were ordered according to relevance, yet only elicited 1 study exclusively using the TIMSS 2007 U.S. mathematics database. In contrast, 27 of the entries focused on countries other than the U.S. or involved the comparison of U.S. results to other countries. Although comparative analysis is one of the intended uses of the dataset and provides important benefits, the large amount of nationally-representative data available in the database provides opportunities for in-depth studies of U.S. results within the context of the American culture. The study seeks to address this gap in the literature through utilizing a portion of the rich U.S. dataset to illuminate the state of education in the U.S. beyond reports.

**TIMSS Reports Lack Specific Links to Achievement**

As mentioned previously, a large number of reports of TIMSS 2007 data are available. These reports summarize much of the data, including providing percentages for many contextual and achievement factors addressed in the study. The reports also begin to make links between specific factors and student achievement. The information provided by
official reports help researchers and policymakers to begin to compose a more complete understanding of the factors in the study and the results. The reports do not, however, fully investigate and describe the relationships among factors and how those relationships relate to student achievement. For these investigations, secondary analysis of the TIMSS data is necessary. The current study helped addressed this gap in the literature by using secondary analysis to investigate the links among factors of interest (GENDER, SES, RACE, and classroom instructional practices as reported by students) and their relationships to student mathematics achievement.
CHAPTER 3:

METHODOLOGY

The purpose of the study is to examine the relationships between classroom instructional practices as perceived by students and mathematics achievement on a national scale. The relationships will be examined in the U.S. eighth-grade context. Important impacts of the student characteristics of gender and highest parental education level on student achievement are also considered.

This chapter discusses the methods used to achieve the purpose of the study and answer the research questions. It includes the following sections: (1) research questions and hypotheses; (2) research design; (3) study population and sample; (4) instruments; and (5) detailed data analysis procedures.

Research Questions and Hypotheses

This current study addresses the following research questions:

1. What are the relationships between instructional practices as reported by students and student background characteristics as demonstrated on the 2007 U.S. eighth grade administration of TIMSS?
   a. What are the relationships between instructional practices as reported by students and gender?
   b. What are the relationships between instructional practices as reported by students and the highest parental level of education of the mother?
c. What are the relationships between instructional practices as reported by students and race/ethnicity?

2. Which combination of variables (GENDER, SES, RACE, classroom instructional practices) best predicts eighth grade student mathematics achievement on the 2007 administration of TIMSS?

a. Which of the possible seventeen classroom instructional practices reported by students are most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by reported classroom practice?

b. Which student background variables are most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by student background?

c. Which combination of student background variables and classroom instructional practices is most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement?

It is hypothesized that although no differences will exist in the reports of classroom practices by gender, SES, or race/ethnicity, reports of practices related to the statements in *Principles and Standards for School Mathematics* will account for greater positive variance
in mathematics achievement than practices more related to traditional learning, or to learning methods not specified in the *Standards* document.

**Research Design**

The study relies on secondary analysis of data from the TIMSS 2007 U.S. eighth grade administration. This non-experimental research design involves no intervention. Instead, relationships between existing independent and dependent variables and variations within those variables are studied in the absence of intervention from the researcher or others. Due to the many possible confounding variables that may affect student achievement, though, this study also does not seek to explain direct causal relationships between classroom instructional practices and student mathematics achievement. The study instead explores the relationships between classroom instructional practices as reported by students and mathematics achievement through the use of correlational analyses and describes the extents of those relationships.

**Population and Sample**

The data for this study is drawn from the 9,723 U.S. eighth grade students participating in the 2007 administration of the Trends in Mathematics and Science Study (TIMSS). TIMSS has been administered every four years since 1995. This international assessment of the mathematics and science achievement of 4th, 8th, and 12th grade students has collected data on strengths and weaknesses in performance in specific content and cognitive domains, along with gathering contextual information through student, teacher, school, and curriculum questionnaires (Mullis et al., 2005). TIMSS allows researchers to
track changes in instructional practices, the effects of policy implementation, the changes in contexts for learning, and the relationships of each change to student achievement in many different nations.

The international guideline for the target population for 2007 specified “all students enrolled in the grade that represents 8 years of formal schooling,” with a mean age of at least 13.5 years (Jonas, 2008, p.78). In the U.S., this target population consisted of eighth graders. A sample of students was drawn using a two-stage stratified cluster design in which the first stage consisted of the school and the second stage consisted of intact classrooms within those schools, resulting in a sample size of 7,377 students (Olson, Martin, & Mullis, 2008).

TIMSS utilizes different sampling weights to ensure that study results are representative of the population. Six separate weighting variables are available, based on the goals of study (Table 1). For this study the Total Student Weight, TOTWGT, will be used. This sampling weight ensures the proportional representation of the students in the sample to the population estimates for the country, allowing researchers to make generalizations about the population using the results from the sample (Foy & Olson, 2009, p. 104).

The U.S. 8th grade sample was selected for this study because of sustained efforts to impact teachers’ classroom instructional and assessment methods through many, varied programs nationwide, including major reform efforts such as the implementation of the Principles and Standards (NCTM, 2000). In addition, the U.S. has proved an enigma with the relationships of student, classroom, and school factors on achievement in comparative studies, necessitating the study of U.S. student results apart from other countries. Eighth
grade was chosen over fourth grade or twelfth grade because it represents the mid-point of U.S. schooling. Also, eighth grade students should be able to answer questions about classroom activities more accurately due to greater levels of maturity and experience than students in the fourth grade. In addition, students of all abilities and achievement levels are represented in middle school, unaffected by the school dropout rates that affect high school samples. In all, the U.S. eighth grade sample most likely represents the academic achievement of our youth.

**Instruments**

The TIMSS studies collected data about achievement and instruction using five instruments. Achievement information was gathered from student responses to test questions for mathematics and science in grades four, eight, and twelve. Contextual information was gathered using separate questionnaires completed by students, their teachers, and their principals. Large-scale information about the educational system of the nation was gathered using a Curriculum Survey. The study will utilize student achievement results and the Student Questionnaire to investigate effects of instruction on student achievement.

Student scale scores used to determine student achievement will be collected from the results of the TIMSS eighth grade mathematics test, which was drawn from the 2007 item bank. First, the test items were developed according to the content framework, which included the content strands of Number, Algebra, Geometry, and Data and Chance, along with the cognitive domains of Knowing, Applying, and Reasoning (Ruddock, O’Sullivan, Arora, & Erberber, 2008). The resulting 2007 TIMSS mathematics item bank consisted of
215 multiple choice (n=117) and constructed response (n=98) items. The multiple-choice items were assigned 1 score point each, and constructed response items, which required students to solve the problem and explain their solution processes, were assigned 1 to 2 points each, according to the complexity of the problem (Mullis & Martin, 2008; Mullis, et al., 2005; Ruddock et al., 2008). As a result, multiple choice items contributed 117 total score points; while constructed response items contributed 121 score points to the grand total of 238 score points for the entire item set.

The items were then organized into 28 blocks of trend items from previous assessments and new items developed for the 2007 administration, and compiled into 14 student booklets (Ruddock et al., 2008). One block of trend items and one block of new items were included in each student mathematics or science test booklet. Each mathematics block consisted of 11-18 items, depending on the number of multiple-choice and constructed response items included, with the total number of mathematics items per booklet ranging from 22-36. Students were allotted a total of 45 minutes to complete the mathematics portion of the test. Additionally, if students regularly used calculators in the classroom, they were allowed, but not required, to use the same calculators on the exam (Ruddock et al., 2008).

In addition to the exam questions, the Student Questionnaire was included in the test booklet (Johansone & Newschmidt, 2008). This questionnaire consisted of 21 questions which addressed student background information, such as demographic information, as well as student beliefs and attitudes toward mathematics and science (Mullis et al., 2005; NCES, 2007). The questionnaire also gathered information about student out-of-school activities and
family background, including parents’ highest level of education. Most importantly for this study, the questionnaire also asked students about the activities they experienced in their mathematics and science classrooms, including the frequency of which they experienced different instructional practices. Students responded to each item using a four-point rating scale ranging from “every or almost every lesson”, to “never.” About 30 minutes were allotted for the completion of the questionnaire with additional time provided as necessary (Erberber et al., 2008; Johansone & Newschmidt, 2008).

U.S. TIMSS achievement and context questionnaire data files are provided by two different organizations. The international database is provided by the TIMSS & PIRLS International Study Center located at Boston College. This database includes all of the TIMSS data for each nation that administered the assessment. Consistent, international coding and naming conventions are used for the variables in this database, which is meant for international comparative studies. Survey questions and variable labels specific to the U.S. are not included in this database. The U.S. national data files are provided by NCES. This database contains only U.S. student achievement and questionnaire information. The database also includes national adaptations to contextual questionnaires and variable labels specific to the U.S. data. Although the international database has been recently released for TIMSS 2011, the U.S. public-use national data files are not yet available, as of the date of this study.

The current study will utilize the 2007 U.S. public-use national data files provided by NCES, which includes the U.S. adaptation of the Student Questionnaire. This U.S.
adaptation includes questions related to race/ and ethnicity, which are not included in the international version. In addition, the national descriptions of the highest parental levels of education, which are described and coded differently in the international version, provide more familiar levels for ease of interpretation and discussion. Both versions of the Student Questionnaire are located in the appendix.

Variables

Student Achievement Variables

Student achievement scores on the 2007 TIMSS are reported as plausible values. These values are meant to estimate the achievement of students with like characteristics and response patterns on large-scale tests, such as TIMSS. Plausible values encompass student gender, the testing language, the student’s classroom, and the student’s country, along with other background variables identified by principal component analysis, and sets a standard metric with a mean of 500 and a standard deviation of 100 to provide comparable scores of subgroups of students and achievement estimates of the TIMSS population as a whole between test administration cycles (Foy, Galia, & Li, 2008; Williams et al., 2009). A total of 173 of primary conditioning variables and principal components were retained for the 2007 U.S. sample. Five plausible values are reported for each student on overall achievement, as well as each of the specific content domains of number, geometry, algebra, and data and chance, and the cognitive domains of knowing, applying, and reasoning (Foy, Galia, & Li, 2008; Williams et al., 2009).
In addition to student plausible values, TIMSS researchers also developed international benchmarks for mathematics achievement. The levels were calculated for each of the five overall plausible values and provide additional information for better interpretation of achievement scores. Four international benchmark levels are identified in the TIMSS 2007 International Mathematics Report: Advanced, High, Intermediate, and Low (Martin et al., 2008). In addition, a fifth, unnamed category is present in the dataset, which is identified by the researcher as Below Basic, as shown in Table 2.

A correlation matrix was first conducted to determine the benefits of using each of the five plausible values over using one score. It was found that the scores were so very highly correlated that results would be identical to very similar, and that although TIMSS researchers suggest running an analysis five times, one for each plausible value, the current study’s interest in general relationships would not benefit from such an analysis. Consequently, this study will use the international benchmark levels for plausible value 2, which was the most highly correlated to the other values for analysis, as shown in Table 3.

**Student Background Variables**

Three student grouping variables were derived from responses to the Student Questionnaire; gender, race/ethnicity and student SES. Information regarding variables from the questionnaire, such as gender, race/ethnicity and student SES, has been identified as an important factor to student achievement (Brookhart, 1997; Pong & Pallas, 2001; Xia, 2010; Xin Liang, 2010).
First, a student’s gender (GENDER) was derived from the response to the question about gender. The original codes of 1 = “Girl,” and 2 = “Boy,” were retained. Interpretation of analysis means closer to 1 denotes an advantage towards girls, and analysis means closer to 2 denotes an advantage towards boys. Table 8 displays the descriptive statistics for GENDER in the original data.

Next, a student’s racial background (RACE) was derived from a composite variable created by TIMSS researchers that combined the student’s racial and ethnic backgrounds. Using racial and ethnic background information, seven categories were created: “White, Not Hispanic”; “Black, Not Hispanic”; “Hispanic”; “Asian”; “Native American”; “Pacific Islander”; and, “2 or More Races” (Williams et al., 2009). For this study, the codes of 1 = “White, Not Hispanic,” n = 3873; “2 = “Black, Not Hispanic,” n = 949; and, 3 = “Hispanic”, n = 1787 were retained, while the remaining races/ethnicities were combined and recoded as 4 = “Other,” n = 673 to provide a larger sample for this category for analysis. These four categories were chosen to illustrate any differences in achievement between the two largest minority groups and the majority group, while including smaller minority groups in the analysis as their own category. Although specific conclusions may not be drawn from this last, composite group, the results of the study will include any broad achievement differences between this group and the others.

Finally, a student’s socioeconomic status was estimated from the mother’s highest level of education. The decision to use the mother’s highest level of education to estimate SES was twofold. First, free or reduced lunch status is reported by TIMMS on the
school level, not on the student level, which is used by this study. Secondly, free or reduced lunch status is computed strictly using family income and size. Although there are strong relationships between parental education and family income, higher levels of parental education may have important benefits beyond higher income, including the ability to directly assist students with schoolwork or by providing important background-building experiences such as visits to museums, festivals, and reading aloud to young children. These experiences relate more to the “time availability to provide children with academic support,” identified by the American Psychological Association (2010), than to economic availability, since many resources of these activities are free. Highly educated parents may more likely be more involved in providing these experiences for their children, regardless of their employment statuses in an unstable economic climate. Also, documented evidence of a relationship exists between student achievement and mother’s educational level, especially in the U.S. (Pong & Pallas, 2001; Rodriguez, 2004; Wang, 2004), similar to the evidence of the relationships between school levels of free or reduced lunch statuses and achievement (Mullis, Martin, Foy & Arora, 2012; NCES, 2011). Therefore, the mothers’ highest level of education is used to estimate SES in this study.

TIMSS researchers developed eight response choices for the question regarding mother’s highest level of education, ranging from “Finish Elementary or Did Not Go to School” to “Finish MS or Higher” A response of “I Don’t Know” was also available to students, as shown in Table 4. During preliminary data screening, it was found 22.8% of students chose the “I don’t know” response to the question addressing mother’s highest level
of education. Combined with the 1.3% who did not respond, an education level was missing for almost one-fourth of the sample (see Table 5). To avoid changing the characteristics of the data by deletion or imputation of a mean or other estimated score, a third category of “I Don’t Know/Missing” was created to include in the analyses. This third category was meant to preserve the data in the chance that the students who did not respond with an education level were different in some way than the students who did report a parental education level.

Mother’s education levels (SES) was redefined into three categories for analysis; I Don’t Know/Missing, High School or Less, and Beyond High School (Table 6). These three levels were chosen to detect any differential effects on student achievement by parental education level.

**Instructional Practices**

Instructional practices were derived from responses to the Student Questionnaire. Seventeen instructional practices were included in the questionnaire, as shown in Table 7. Students responded whether they used each practice (1) “Every or almost every lesson,” (2) “About half the lessons,” (3) “Some lessons,” or, (4) “Never.” In preparations for analysis, the variable labels were changed to better reflect each practice, also shown in Table 7.

Six practices relate most to Standards-based instruction, according to their clarifying statements: EXPLAIN, RELATE, DECIDE, WORKGROUPS, USECALC, and USECOMP. Four practices relate most to traditional instruction: NOCALC, MEMORIZE, LECTURE, and WORKONOWN. The remaining seven practices (FRACDEC, GEO, INTERPRET, REPRESENT, REVIEWHW, BEGINHW, and QUIZTEST) closely fit neither group, based
on their clarifying statements. However, the clarifying statements leave much to reader interpretation. Since definitive groups of classroom practices cannot be created using the clarifying statements, each classroom instructional practice is evaluated individually to detect differential effects on student achievement by practice.

**Data Analysis**

This section discusses the analysis of the data. First, data analysis software is discussed, followed by an overview of data screening and preparation steps. Next, specific assumptions are tested for the multiple regression model. Finally, analysis plans for each research question are presented and summarized.

**Data analysis software**

The current study utilizes two one data analysis software package and one add-on application to the package. PASW Statistics18, formerly referred to as SPSS Statistics, serves as the main data analysis software for this study. An advantage of this data analysis system is the ability to utilize a point-and-click method in addition to or as a substitute for entering command syntax to run analyses and generate reports (SPSS Inc., 2009). In addition to PASW, the study will also utilize the International Database Analyzer (IDB) provided by the International Association for the Evaluation of Educational Achievement (IEA). This add-on program works within the PASW program to analyze data from a variety of large-scale studies, including TIMSS. Important features of this application involves the automatic selection and inclusion of weighting and other sampling variables necessary for reliable analysis of complex samples and the automatic calculation of variances for plausible values.
(IEA, 2012). The major limitations of the application include the inability to recode or transform variables, conduct screening procedures, or conduct analysis methods other than calculating means or percentages, performing correlations, and performing regression analyses. Also, default settings for regression include only the Enter method, and output is generally limited to reports of standard errors instead of p-values. For these reasons, both PASW 18 and the IDB Analyzer are used and compared, where appropriate, for the current study. Sample IDB Analyzer syntax is displayed in Figure A – 6.

**Data screening and preparation**

Data screening is necessary to ensure that appropriate conclusions are drawn from analysis (Vannatta & Mertler, 2010). Prior to any analysis, data must be screened for missing data, normality and outliers. In addition to screening, the reliability of the questionnaire document is also important to determine.

**Missing data.** Missing data were identified using the Descriptive Statistics – Frequencies procedure in PASW. The analysis of GENDER, RACE, and instructional practices indicated no more than 2% missing cases on any one variable. Missing data for SES were previously analyzed and addressed.

First, since only two possible responses existed for the GENDER variable, “Boy” or “Girl,” the cases with missing responses on this variable were deleted. Fifty-eight total cases were affected by this deletion, with 7319 cases retained for analysis. Table 8 displays the descriptive statistics for GENDER in the original data. Similarly, although seven possible responses existed for RACE: “White, Not Hispanic”; “Black, Not Hispanic”; “Hispanic”;
“Asian”; “Native American”; “Pacific Islander”; and, “2 or More Races,” RACE could not be reliably estimated with a median or mean value (Table 9). Therefore, the cases with missing information on the RACE variable were also deleted. This step resulted in the deletion of only 39 new cases, with a remaining sample size, n = 7282. Tables 10 and 11, respectively, display the descriptive statistics for GENDER and RACE after the deletion of missing cases on each variable.

Finally, missing values for the classroom instructional practices were recoded to the median for each practice. Only four response choices existed for each classroom practice: (1) “Every or almost every lesson,” (2) “About half the lessons,” (3) “Some lessons,” or, (4) “Never.” The median value was chosen over the mean value for the recoding these variables, given that the mean of the responses would have created an additional, decimal category value with very few cases for each practice that did not exist in the original data. Table 12 displays the descriptive statistics for instructional practices in the original dataset. Table 13 displays the descriptive statistics for instructional practices after recoding missing values to the median value for each practice.

Normality. Skew and kurtosis values can indicate the normal distribution of a population. Skew values indicate the degree of symmetry of the distribution around its mean, while kurtosis values indicate the degree of “peakedness” of the distribution (Mertler & Vannatta, 2010). Skew and kurtosis values equal to 0 indicate a perfectly normal distribution.
Normality plots with tests were conducted using the Explore procedure in PASW to determine multivariate normality. Although the Kolmogorov-Smirnov results indicated non-normal distributions, examination of the skewness and kurtosis values, along with the Q-Q Plots and histograms, indicated near-normal distributions for most of the combinations of instructional practices and SCORES, and no transformations were conducted. Similar results were found for each level of RACE, SES, and GENDER by SCORES. Examination of the skewness (-0.054) and kurtosis (-0.374) values and histograms also indicated a near-normal distribution of the dependent variable, SCORES.

**Outliers.** Cases with extreme values, when compared to other cases, are considered outliers in a dataset. These cases may distort the distribution of the data, greatly affecting the analysis results (Mertler & Vannatta, 2010). In this study, univariate outliers were identified through the examination of the frequencies of responses in the categories of variables. Instructional practices were first recoded to “1” (Fewer than half of the lessons) and “2” (Half of the lessons or more). Using this method, one classroom instructional practice, P17 (We use computers), was identified as having greater than a 90-10 split between the half of the lessons or more and fewer than half of the lessons categories, with 8.9% and 91.1%, respectively. As a result, the variable was not considered for further analysis. Examinations of SCORES, SES, and GENDER revealed no categories with greater than a 90 – 10 split between them, and all levels and variables were retained for analysis. Table 14 displays the descriptive statistics for the recoded instructional practices.
Univariate outliers were identified though an examination of boxplots created within PASW. First, univariate outliers were detected within the levels of SES by SCORES using the multivariate analysis procedure. The outliers were addressed by transforming the scores for the outlying cases to the highest or lowest acceptable value for the SES level. Specifically, SCORES level 5 was transformed to a value of 4 for SES levels 0 and 1, while SCORES level 1 was transformed to a value of 2 for SES level 2. Figure A – 2 displays the detection of outliers for SES by SCORES.

Next, outliers for RACE by SCORES were detected and also recoded to the highest or lowest acceptable value for each level. Specifically: 113 cases were recoded from SCORES 1 to SCORES 2 for RACE level 1; 9 cases were recoded from SCORES 5 to SCORES 4 for RACE level 2; and, 5 cases were recoded from SCORES 5 to SCORES 4 for RACE level 3. No outliers were found for RACE level 4. Figure A-3 displays the detection of outliers for RACE by SCORES. Also, no univariate outliers were identified for the final grouping characteristic of GENDER by SCORES, as shown in figure A - 4.

Finally, multivariate outliers further investigated using Mahalanobis Distance for \( df = 20 \). No additional outliers were identified when compared to the \( \chi^2 \) critical value of 38.247.

**Reliability.** Reliability, reported as coefficients between the values of .00 and 1.00, relates to the amount of measurement error in the test scores and the internal consistency of the test. For this study, Cronbach’s alpha was used to test the reliability of the original questionnaire items regarding instructional practices. The Cronbach’s alpha statistic for instructional practices in the original database was 0.918 for \( n=7377 \). After data preparation
and recoding, only 2 levels, Half of the Lessons or More and Fewer than Half of the Lessons, existed for the instructional practices for n=7282. Cronbach’s alpha for the recoded practices was a slightly lower 0.754. This level is considered an acceptable value for dichotomous items since estimates of reliability are usually lower for such items than for items with more response choices (Gall, Gall, & Borg, 2007).

**Testing of Assumptions**

Data analysis tests are reliant on basic assumptions to ensure the results are meaningful and accurate. Two main tests are used in this study; correlation and a multiple regression analysis.

**Correlation.** A partial correlation statistic describes the magnitude and direction of relationships between variables while controlling for other variables that may also affect the relationship (Gall, Gall, & Borg, 2007). For this test, basic assumptions, such as data free from error, missing values, and outliers apply. Each of these assumptions has been previously addressed in the preparation of the data for subsequent analysis.

**Multiple Regression.** In the current study, a multiple regression analysis will be used to generate an equation to predict student mathematics achievement based on student background characteristics and student reports of classroom instructional strategies used.

Several assumptions must be met to generate valid results for a multiple regression analysis, all of which were addressed during the data preparation procedures. Once assumptions were met, the nominal (GENDER, RACE) and ordinal (SES) student background variables were recoded to dummy variables in preparation for regression
analysis. Specifically, values were assigned to Girls, SES levels 0 and 1, and race/ethnicity categories 2 through 4. Using this method, Boys, SES Level 2, and White serve as reference categories for the research questions.
CHAPTER 4: RESULTS

The current chapter presents the data analysis results in four sections. The first section includes a discussion of significance testing and effect sizes. The second section summarizes the variables in the study and their descriptive statistics. Section three presents the data analysis descriptions and results by research question. The final section provides an overall summary and interpretation of the findings.

Significance Testing and Effect Size

This section summarizes the use and interpretation of significance testing in research. Important issues include hypothesis testing and the interpretation of effect sizes.

Hypothesis testing involves a prediction of the nature of the relationship between groups on specific variables, followed by the collecting and analyzing of data to test those predictions and to draw inferences about the larger population. The null hypothesis states that there is no difference between the groups in the study on the variable of interest, or that any differences detected represent random chance or sampling error (Mertler & Vannatta, 2010). Research hypotheses, on the other hand, state that there are differences between the groups, and that those differences are not attributable to random chance or error. Hypothesis testing involves testing and rejecting or failing to reject the null hypothesis.

Researchers use statistical tests to determine whether to reject or fail to reject the null hypothesis. The results of the statistical tests are reported with significance levels and effect sizes to assist in this decision. Significance levels are probability values that the researcher
will reject the null hypothesis when it should not be rejected (a Type I Error), and an effect size describes the amount of difference in groups as measured in units of standard deviation (Mertler & Vannatta, 2010).

The current study uses probability ($p$) values of .05, .01, and .001 to determine and describe significance. Effect sizes are interpreted according to the common convention considering an effect size of .2 small, .5 medium, and .8 large (Mertler & Vannatta, 2010). Effect sizes are summarized in Table 15.

**Study Variables**

This section provides a context for the study and its findings. It presents an overview of the variables that comprises student mathematics achievement, the grouping variables of gender and mother’s highest level of education, and the classroom instructional practices reported by students.

As discussed in chapter 3, the U.S. national public-use data files were accessed from NCES and some data were recoded to better reflect the ordinal nature of the variables. The basic data analysis assumptions of missing data, outliers, normality, and reliability were assessed using skewness, kurtosis, box plots, and Cronbach’s alpha. Inconsistencies and violations were addressed through recoding and transformations. The PASW statistical analysis software program (SPSS, 2009) was used to screen and analyze the data, along with TIMSS’ add-on, the IDB Analyzer (IEA, 2009). A summary of descriptive statistics and assumption tests for each variable is presented below.
International Benchmark Reached

TIMSS researchers identified four international benchmarks for mathematics achievement, Low, Intermediate, High, and Advanced. An additional level that included scores that did not reach a benchmark was identified as Below Basic by the researcher. A greater percentage of U.S. eighth grade students (36%) reached the Intermediate benchmark than any other single level in 2007. The fewest students reached the Advanced level, at just 5.7% of the sample. General test assumptions were met: skewness and kurtosis values indicate a near-normal distribution with skewness -.001 and kurtosis -.560, no missing values were present, and no remaining outliers were found after recoding. Descriptive statistics for SCORES are summarized in Table 16.

Gender

Students responded either Girl (1) or Boy (2) to the item addressing gender on the questionnaire. Cases with missing responses on this variable were deleted from the analysis. The sample was roughly evenly divided between girls and boys. No outliers were present. The variable was recoded as a dummy variable to represent Girl (1), with Boy (0) as the reference category. Descriptive statistics were previously summarized in Table 10.

Race and Ethnicity

TIMSS researchers derived student race and ethnicity from two questions on the student questionnaire. The first question asked students to report ethnicity by responding “Yes, I am Hispanic or Latino,” or “No, I am not Hispanic or Latino.” The second question requested a racial classification of “White,” “Black or African American,” “Asian,”
“American Indian or Alaska Native,” and/or “Native Hawaiian or other Pacific Islander.” Students were permitted to choose one or more of these racial classifications. TIMSS researchers combined the responses from the two questions to derive student race as “White, not Hispanic” “Black, not Hispanic” “Hispanic,” “Asian,” “Native American,” “Pacific Islander,” or “2 or More Races” (Williams et al., 2009).

The general testing assumptions regarding missing values and outliers were met. First, cases with missing values on this variable were deleted. Secondly, univariate outliers were detected and recoded. Although RACE was not normally distributed, the large sample size (n = 7282) minimized any effects of the distribution on the analysis (Allison, 1999).

**Socio-Economic Status**

Mother’s Highest Level of Education was chosen to estimate a student’s SES over TIMSS’ Index of Parent’s Highest Level of Education due to the literature that indicated that a mother’s educational level was more influential to student achievement than the father’s, especially in the U.S (Pong & Pallas, 2001; Rodriguez, 2004; Wang, 2004). According to student reports on this item, slightly more mothers completed post-secondary education than did not (Table 6). This comparison must be interpreted with caution, however, due to the large percentage of students who did not respond to the item or responded “I don’t know.” These students were combined with student with missing values on the item to create a third group, SES level 0. SES level 0 most likely includes mothers across educational levels, so it is not assumed that these levels fully represent the educational differences in the groups. Descriptive statistics for SES were previously displayed in Table 6.
General testing assumptions were met for SES. First, although the kurtosis value indicated a rather flat distribution, the skewness value was an acceptable -.292, and attempts at transformations only increased the skew. Secondly, missing values were combined with the “I don’t know” responses to create a third category for analysis, eliminating all missing data. Finally, outliers were addressed by recoding SCORES for the levels of SES that demonstrated outliers to the highest or lowest acceptable score.

**Instructional Practices Reported by Students**

Students were asked to respond to items addressing 17 instructional practices on a scale from 1 (Every or almost every lesson) to 4 (Never) (Table 7). Missing values on these items were recoded to the median value for each practice (Table 13).

The responses for the classroom instructional practices items were recoded to 1 (Fewer than half of the lessons) and 2 (Half of the lessons or more) for comparison (Table 14). Results of the recoding indicated that five of the practices (GEO, RELATE, DECIDE, WORKGROUPS, and USECOMP) were reported by the majority of students as occurring in fewer than half of the lessons, while each of the remaining 12 practices were more often reported by students are occurring in half of the lessons or more. All of the practices were reported within acceptable response splits except for USECOMP. This practice was dropped from further analysis due to the greater than 90-10 split in the responses (Table 14). Reliability was measured with a Cronbach’s alpha of 0.754, which is acceptable for dichotomous variables.
Summary of Findings

In summary, eighth grade mathematics students in the U.S. reported 12 of the 17 instructional practices as occurring in half of their lessons or more. According to these reports, 4 of the 5 practices that occurred in fewer than half of the lessons were close to evenly split between fewer than half of the lessons and half of the lessons or more.

The items measuring the classroom instructional practices were considered reliable and worthy of further analysis, except for the USECOMP item, which was deleted from the analyses due to a large categorical split in the responses. Final distributions for GENDER, SCORES, and SES met basic assumptions for nominal or ordinal variables and were retained for use in subsequent analyses.

Analysis for Research Question 1: Instructional Practices and Student Characteristics

RQ1: What are the relationships between instructional practices as reported by students and student background characteristics as demonstrated on the 2007 U.S. eighth grade administration of TIMSS?

a. What are the relationships between instructional practices as reported by students and gender?

b. What are the relationships between instructional practices as reported by students and the highest parental level of education of the mother?

c. What are the relationships between instructional practices as reported by students and race/ethnicity?
The first research question investigated the relationship between classroom instructional practices as reported by students and student background characteristics. The purpose of this question was to determine if reports of instructional practices differed across student background characteristics. Significant differences existed in the student reports of instructional practices by GENDER, SES, and RACE. Finding details are presented according to hypothesis.

**Hypothesis 1.1: Classroom Instructional Practices and Gender**

*H1.1: The relationship between classroom instructional practices reported by students does not differ significantly by gender.*

This hypothesis investigated the relationship between student reports of classroom instructional practices and gender. The hypothesis was rejected since significant differences were found for seven of the sixteen classroom instructional practices. Analysis within PASW 18 revealed weak correlations, however, with no values equal to or greater than |0.1| (Table 17). For the significant correlations, EXPLAIN, RELATE, DECIDE, and LECTURE were reported more often by boys, while REPRESENT, MEMORIZE, and QUIZTEST were reported more often by girls. Gender differences on reporting for the remaining eight classroom instructional practices were not significant. As shown in Table 18, correlations repeated within IDB Analyzer demonstrated similar results in the magnitudes and directions of the relationships between gender and instructional practices.
Hypothesis 1.2: Classroom Instructional Practices and SES

H1.2: The relationship between classroom instructional practices reported by students does not differ significantly by SES.

This hypothesis examined the relationship between student reports of classroom instructional practices and SES as estimated by the mother’s highest level of education. Dummy variables for SES levels 0 and 1 were used in order to detect more specific differences in reports of instructional practices by SES level. SES level 2 served as the reference category and the results of the analysis describe reports of SES levels 0 and 1 as compared to reports of SES level 2.

For instance, as shown in Table 19, reports of twelve of the sixteen classroom instructional practices varied significantly compared to SES level 2 for SES level 0, while reports of 5 practices varied significantly for SES level 1 compared to SES level 2. Specifically, FRACDEC, GEO, INTERPRET, REPRESENT, MEMORIZE, RELATE, DECIDE, REVIEWHW, WORKONOWN, WORKGROUPS, BEGINHW, and USECALC were reported as occurring in half of the lessons or more by students in SES level 2 more often than by students at SES level 0. Also, while NOCALC was reported as occurring in half of the lesson or more by students in SES level 1 more often than students in SES level 2, the remaining significant differences in reports of REPRESENT, MEMORIZE, REVIEWHW, and USECALC were reported more often by students in SES level 2 as occurring at the same frequency. Again, although the hypothesis was rejected, the significant
Hypothesis 1.3: Classroom Instructional Practices and RACE

H1.3: The relationship between classroom instructional practices reported by students does not differ significantly by RACE.

This hypothesis examined the relationship between the student reports of classroom instructional practices and student race/ethnicity. Dummy variables for RACE categories 2 (Black), 3 (Hispanic), and 4 (Other) were used to detect specific differences in reports of instructional practices by RACE. RACE category 1 (White) served as the reference category and the results of the analysis describe the classroom instructional strategy reports of minority students (Black, Hispanic, and Other) as compared to reports of White students.

For instance, as shown in Table 21, reports of 7 of the sixteen classroom instructional practices varied significantly between White students and Black students, reports of 11 practices varied significantly between White students and Hispanic students, and reports of 3 practices varied significantly between White students and students in the Other category. Specifically, Black students reported NOCALC, EXPLAIN, RELATE, DECIDE, and QUIZTEST as occurring in half of the lessons or more often than White students, while White students reported REVIEWHW and BEGINHW more often. Also, Hispanic students reported NOCALC, FRACDEC, GEO, and RELATE as occurring in half of the lessons or more often than White students, while REPRESENT, MEMORIZE, EXPLAIN, REVIEWHW, WORKONOWN, BEGINHW, and USECALC were reported...
more often by White students. Finally, more students in the Other category reported MEMORIZE and WORKGROUPS in half of the lessons or more more often than White students, while White students reported USECALC more often. Again, the hypothesis was rejected with significant, albeit small, differences in the reports of classroom practice by RACE. The greatest difference in reports occurred between White students and Hispanic students. Specifically, White students reported the use of REVIEWHW in half of the lessons or more 11.8% more often than Hispanic students. Similar IDB Analyzer results in magnitude and direction are summarized in Table 22.

**Analysis for Research Question 2: Classroom Instructional Practices and Student Characteristics Predicting Student Mathematics Achievement**

*a. Which of the possible seventeen classroom instructional practices reported by students are most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by reported classroom practice?*

*b. Which student background variable (GENDER, SES, or RACE) is most influential in predicting student mathematics achievement? Does the obtained regression equation allow for a reliable prediction of student mathematics achievement by student background?*

*c. Which combination of student background variables and classroom instructional practices is most influential in predicting student mathematics achievement? Does*
the obtained regression equation allow for a reliable prediction of student mathematics achievement?

This second research question investigated the relationships between student background characteristics and the classroom instructional practices reported by students, and the influence of those variables on student mathematics achievement. Findings showed significant relationships for 10 instructional practices. Also, RACE was a better predictor of mathematics achievement than SES, and accounted for a greater variance in mathematics achievement scores than any of the reported classroom instructional practices. GENDER did not demonstrate significant relationships to mathematics achievement. Details for the findings are presented according to hypothesis.

Default settings for IDB Analyzer include commands for the Enter method in regression analyses. Since the current study uses a Stepwise method, IDB Analyzer results will be summarized in the text for comparison of the relative strengths of the models for each hypothesis; however analysis results using PASW 18 will be discussed and presented in detail.

**Hypothesis 2.1: Classroom Instructional Practices and Student Achievement**

*H2.1: Each of the instructional practices significantly relate to the prediction of student mathematics achievement.*

A stepwise multiple regression was conducted to test which classroom instructional practices predicted student mathematics achievement. The stepwise method enters each independent variable in descending order of correlation with the dependent variable,
continually reassessing the contribution of the variable at each of the subsequent steps. Regression results indicated an overall model of 14 practices that were significant predictors of student mathematics achievement, $R^2 = .120, R^2_{adj} = .118, F (14, 7267) = 70.635, p < .001$ (Table 23). This model accounts for only 11.8% of the variance in scores, however. Regression results in IDB Analyzer reported similar results, $R^2 = .14, R^2_{adj} = .14$. F-values and $p$-values were not reported. Bivariate and partial correlation coefficients between each classroom instructional practice and SCORES from PASW 18 are presented in Table 24.

The hypothesis was rejected, as results indicated that two of the tested instructional practices (FRACDEC and WORKGROUPS) were not included in the model. Also, the overall model significantly predicted student achievement although DECIDE, NOCALC, EXPLAIN, and BEGINHW did not individually produce significant effects on achievement. The seventeenth practice, USECOMP, had been previously deleted from the analysis due to greater than a 90–10 categorical response split.

**H2.2: GENDER will not significantly predict student mathematics achievement as measured by the highest mathematics international benchmark reached. SES and RACE will significantly predict student mathematics achievement as measured by the highest mathematics international benchmark reached.**

This hypothesis described the influence of the GENDER, SES, and RACE variables on student mathematics achievement. It was expected that while GENDER would not significantly contribute to the model, SES and RACE would. The dummy variables that were
created were used for this analysis, with Boy, SES Level 2, and White serving as reference categories for GENDER, SES, and RACE, respectively.

A stepwise multiple regression was conducted to test this hypothesis. Regression result indicated an overall model of 14 practices that were significant predictors of student mathematics achievement, $R^2 = .202, R^2_{adj} = .201, F (5, 7276) = 367.25, p < .001$ (Table 25). This model accounts for about 20% of the variance in scores. IDB Analyzer results confirm the greater relative strength of this model to the previous model, $R^2 = .20, R^2_{adj} = .20$.

Bivariate and partial correlation coefficients between SES, GENDER and SCORES from PASW 18 output are presented in Table 26.

The hypothesis was not rejected due to the significant contributions of SES and RACE to the model. Specifically, when compared to White students, Hispanic students were associated with a score that was .744 International Benchmarks lower, and Black students were associated with a score that was .992 International Benchmarks lower. Also, students in SES level 1 scored .357 International Benchmarks lower than students in SES 2, and students in SES 0 scored .297 International Benchmarks lower than students in SES 2, after taking into account a student’s race/ethnicity as Black or Hispanic. Finally, students in the Other category for RACE scored .201 International Benchmarks lower than White students, after taking into account differences in SES. Results indicate that RACE and SES significantly predict student achievement. GENDER, however, did not enter into the regression equation, and do not significantly predict student achievement.
Hypothesis 2.3: Background Characteristics, instructional Practices and Mathematics Achievement

**H2.3:** A combination of background characteristics and classroom instructional practices will significantly contribute to the model predicting student mathematics achievement as measured by the highest international benchmark reached on the 2007 administration of TIMSS.

This hypothesis meant to investigate the relationship between the student background characteristics, reported classroom instructional practices and mathematics achievement. It combines the previous two hypotheses in order to determine if a stronger model can be made using both background and classroom practice variables.

A stepwise multiple regression was conducted to test this hypothesis. Regression results indicated an overall model incorporating SES, GENDER, and RACE categories of student characteristics and 11 classroom instructional practices as significant predictors of student mathematics achievement, \( R^2 = .272, \ R^2_{\text{adj}} = .270, F(17, 7280) = 159.804, p < .001 \) (Table 27). The coefficients in this model indicated the strongest associations between RACE categories Hispanic, \( \beta = -.66, t(7264) = -25.72, p < .001 \), and Black, \( \beta = -.92, t(7264) = -28.92, p < .001 \), and student achievement. Two instructional strategies, REPRESENT, \( \beta = .34, t(7264) = 12.00, p < .001 \), and RELATE, \( \beta = -.22, t(7264) = -10.07, p < .001 \) entered next into the equation, followed by SES 1, \( \beta = -.30, t(7264) = -12.82, p < .001 \) and SES 0, \( \beta = -.25, t(7264) = -9.38, p < .001 \). This model accounts for 27.2% of the variance in scores. IDB Analyzer results confirm the greater relative strength of this model to the previous models, \( R^2 \)
The complete list of coefficients for SES, GENDER, classroom instructional practices, and SCORES from PASW 18 output is presented in Table 28.

Summary of Findings

To summarize, analysis of research hypotheses indicated that SES, RACE, and several instructional practices reported by students were significantly related to student mathematic achievement. The relationships between student characteristics and reported instructional practices showed that while boys were more likely to report more frequent use of four of the practices, girls were more likely to report more frequent use of three practices, with no significant differences found for the remaining eight practices. Student reports for classroom instructional practices also varied by SES and RACE. It was also found that SES, RACE, and GENDER could be used along with reported classroom instructional practices to produce a model that more reliably predicts student mathematics achievement than classroom instructional practices or student background characteristics alone.

Overall Summary and Interpretation of Key Findings

This section discusses the key findings and provides interpretations based on previous research and connections within the study. More detailed discussion is provided in the following chapter.

The first key finding is that student reports of instructional practices significantly differed by gender, mother’s highest level of education, and student race/ethnicity. Although the differences were very small according to conventional correlation levels, they demonstrated significant, inconsistent relationships across student background
characteristics. Specifically, EXPLAIN, RELATE, DECIDE, and LECTURE were reported more often by boys, while REPRESENT, MEMORIZE, and QUIZTEST were reported more often by girls. FRACDEC, GEO, INTERPRET, REPRESENT, MEMORIZE, RELATE, DECIDE, REVIEWHW, WORKONOWN, WORKGROUPS, BEGINHW, and USECALC were positively and significantly related to the mother’s highest level of achievement, with more frequent reports by students in SES level 2 than SES level 0. Also, students in SES level 2 reported REPRESENT, MEMORIZE, REVIEWHW, AND USECALC more often than students in SES level 1. Additionally, White students reported REVIEWHW and BEGINHW more often than Black students, REPRESENT, MEMORIZE, RELATE, REVIEWHW, WORKONOWN, BEGINHW, AND USECALC more often than Hispanic students, and MEMORIZE, and USECALC more often than students in the Other category. In other words, the reporting of instructional practices differs by gender, SES, and race/ethnicity.

Also, it was found that a regression equation could be generated that predicted student mathematics achievement using the variables of interest. Significant relationships were sustained in the regression equation for all but two of the classroom instructional practices, NOCALC and WORKGROUPS. The model combining student background characteristics and classroom instructional practices provided a slightly better prediction of student mathematics achievement ($R^2 = .272$) than a model with only background characteristics ($R^2 = .202$) or instructional practices ($R^2 = .120$). Similar to the previous results, RACE and SES demonstrated stronger relationships to student mathematics achievement than GENDER.
Test results suggest that student mathematics achievement is best predicted with a combination of background characteristics and instructional practices.

Finally, the regression model does not suggest that grouping instructional practices by those appearing in the Standards and those not appearing in the Standards will differentially predict student achievement. Specifically, although four of the ten instructional practices included in the model reflect statements in accordance with the Standards (RELATE, USECALC, INTERPRET, and DECIDE), only one of those practices, USECALC, $\beta = .12$, $t(7264) = 5.63, p < .001$, was positively and significantly related to student mathematics achievement. Conversely, more traditional practices, such as WORKONOWN, $\beta = .26$, $t(7264) = 9.29, p < .001$, and MEMORIZE, $\beta = .22$, $t(7264) = 9.10, p < .001$, demonstrated greater positive relationships to student achievement.
CHAPTER 5:
DISCUSSION

This chapter discusses the current study. First, the previous background chapters are summarized. Next, results and interpretations are presented. Finally, the limitations of the current study and recommendations for future studies are offered.

Summary of Previous Chapters

Much time and effort are spent to improve student mathematics achievement in the U.S., with much of this effort resulting in recommendations of specific classroom instructional practices for teachers to implement in order to maximize learning. Clear links between instructional practices and student achievement have proven elusive, however. In addition, previous large-scale studies tended to compare the U.S. results with other countries, instead of focusing on the factors that affect student achievement in the U.S.

The purpose of this study was to determine the nature of the relationship between classroom instructional practices as reported by students and student mathematics achievement. The context of the study included U.S. eighth graders. The specific instructional practices were analyzed, as well as the impact of the student characteristics of mother’s highest educational level, gender, and race/ethnicity on mathematics achievement.

According to the literature, researchers found that students in the U.S. tended to participate in lessons that reflected traditional views of learning and consisted of memorization of rules and procedures with few opportunities for thinking and reasoning (Ball et al., 2001; Stigler & Hiebert, 1997; Stigler et al., 1999). Teachers and other
stakeholders have been reluctant to implement reform-based practices for fear of students failing to learn “the basics” they deem necessary for success in higher-level mathematics (Sfard, 2003). As a result, change in mathematics classrooms has been slow. For instance, although teachers reported a change in instruction more reflective of reform practices, many practices were either implemented inconsistently, or were often merged with more traditional methods of instruction (Jacobson et al., 2006; McKinney & Frazier, 2008; Swanson & Stevenson, 2002).

Previous studies also found that classroom instructional practices were important to learning and that certain classroom instructional practices related to greater student achievement in mathematics. For example, instructional practices were found to have a greater effect size on achievement than teacher major or teacher professional development (Wenglinsky, 2002). Also, specific practices such as writing equations, reviewing homework, and frequent calculator use have been shown to positively affect achievement (House & Telese, 2008; Lubienski, Lubienski, & Crane, 2008).

Student background characteristics have also been shown to be closely related to student achievement, often at greater levels than teacher or school factors (Goldhaber & Brewer, 1999). Gender, mother’s highest level of education, and race/ethnicity has each been proven to impact achievement. Specifically, boys traditionally outperformed girls in middle grades mathematics (e.g., Xin Liang, 2010), students whose mothers attain higher levels of education outperform students whose mothers have less education (e.g., Pong & Pallas, 2001), and White students outperform Black or Hispanic students (e.g., Gonzales,
Gender gaps have recently decreased, however (e.g., Hyde et al., 2008), while SES-level and racial/ethnic achievement gaps have persisted.

The current study utilized secondary data analysis methods on the U.S. data from the 2007 TIMSS administration to answer the research questions. Correlations and multiple regression techniques were used to analyze the data. The specific technique aligned with the specific research question in order to evaluate the relationships of the variables. Assumptions for both methods were met, and the results were presented.

Several important findings resulted from this study. First, a differential relationship between reports of classroom instructional practices were found by both mother’s highest level of education and gender. The findings were significant, yet small when compared to conventional effect size levels (i.e., \( \leq 0.2 \)). In general, boys were more likely to report the use of four instructional practices (EXPLAIN, RELATE, DECIDE, and LECTURE) as occurring in half of the lessons or more, while girls were more likely to report the same frequency on three different practices (REPRESENT, MEMORIZE, and QUIZTEST). Also, students whose mothers achieved higher levels of education were more likely to report more frequent use of twelve of the sixteen different classroom instructional strategies (FRACDEC, GEO, INTERPRET, REPRESENT, MEMORIZE, REVIEWHW, RELATE, DECIDE, WORKONOWN, WORKGROUPS, BEGINHW, and USECALC).

Student reports of classroom practice also varied by RACE. Specifically, Black students reported NOCALC, EXPLAIN, RELATE, DECIDE, and QUIZTEST more often than White students, while White students reported REVIEWHW and BEGINHW more
often. Also, Hispanic students reported NOCALC, FRACDEC, GEO, and RELATE more often than White students, while White students reported REPRESENT, MEMORIZE, EXPLAIN, REVIEWHW, WORKONOWN, BEGINHW, and USECALC more often. Finally, students in the Other category reported MEMORIZE and WORKGROUPS more often than White students, while White students reported USECALC more often. This finding suggests small, yet significant, influences of gender, SES, and race/ethnicity on the student reporting of classroom instructional strategies.

These results raise important concerns for mathematical practice. First, differences in reports of classroom instructional practices are not expected by GENDER. Since boys and girls are in the same classrooms, why do their reports of classroom practices vary? The differences in reports between boys and girls were very small, but significant, with the greatest differences occurring in the reports of QUIZTEST, $r = .069$, $p < .001$.

Also, differences in student reports of classroom instructional practices by SES or RACE may reflect the use of differing practices by school based on student body characteristics, which may impact student achievement. When related to previous literature that identified achievement gaps by SES (e.g., Pong & Pallas, 2001) or RACE (e.g., Gonzales, 2009), differences in student reports of classroom practices by group revealed interesting patterns. For instance, according to previous literature and the current study, students at higher SES levels achieve at greater levels than other students. In the current study, students in SES level 2 also reported the use of REPRESENT, MEMORIZE, REVIEWHW, and USECALC significantly more often than each of the other groups.
Similarly, according to previous literature and the current study, White students achieve at higher levels than Black or Hispanic students. In the current study, White students also reported greater use of USECALC, REVIEWHW, and BEGINHW than Black or Hispanic students. The use of a calculator and a high emphasis on homework are both associated with greater achievement in the literature (e.g. Mullis, et al., 2003), which were both reported more often by students in SES level 2 and by White students.

One conclusion that can be drawn from the results is that poor students and minority students may experience different educational practices when compared to more affluent or White students, with an emphasis on computation without calculators. Conversely, White students and more affluent students benefit from the more frequency use of practices related to higher achievement, possibly increasing their achievement. Although small differences existed for the three reported practices, the results imply continued inequity in education, especially between racial/ethnic categories. If the perceived differences in the use of classroom practices are representative of actual practice, then perhaps teachers may begin to address the achievement gaps by incorporating the more frequent use of practices related to higher achieving groups.

In addition to the previous findings, the results also indicate that the classroom practices cannot be reliably grouped by their relationships to the Standards. Specifically, although four of the ten instructional practices included in the model reflected statements in accordance with the Standards (RELATE, USECALC, INTERPRET, and DECIDE), just one of those practices, USECALC, $\beta = .12, t(7264) = 5.63, p < .001$, was positively and
significantly related to student mathematics achievement. The other practices that were positively and significantly related to student achievement (REPRESENT, WORKONOWN, MEMORIZE, REVIEWHW) were generally associated with non-Standards-based instruction, as in WORKONOWN, $\beta = .26$, $t(7264) = 9.29$, $p < .001$, and MEMORIZE, $\beta = .22$, $t(7264) = 9.10$, $p < .001$, or neutrally associated, as in REVIEWHW $\beta = .15$, $t(7264) = 5.47$, $p < .001$, or REPRESENT $\beta = .34$, $t(7264) = 12.00$, $p < .001$. These findings indicate differing relationships between the individual practices and student achievement and do not indicate that grouping the practices by Standards-based and others would provide reliable predictions of student achievement.

Finally, a reliable regression equation was found that could predict student mathematics achievement using SES, GENDER, RACE and eleven of the sixteen classroom instructional practice variables (REPRESENT, RELATE, WORKONOWN, GEO, MEMORIZE, QUIZTEST, USECALC, REVIEWHW, INTERPRET, LECTURE and DECIDE). The resulting equation better predicted student achievement than background characteristics or classroom instructional practices separately. RACE figured prominently as the most closely linked predictor of student achievement, with significant differences found between White and Black or Hispanic students, followed by SES, with significant differences found between students in SES level 2 and students in other levels. GENDER, $\beta = -.06$, $t(7264) = -3.16$, $p = .003$, however, was linked to student achievement at a much weaker level, with a small, but significant advantage demonstrated towards males.
Along with the key findings of this study, important, secondary conclusions were made about the specific classroom instructional practices under investigation. Specifically, although insufficient detail is provided by the survey items about the manner in which each practice is implemented in the classroom, the results for practices most closely related to Standards-based instruction (WORKGROUPS, EXPLAIN, RELATE, USECALC, and USECOMP) present inconsistent patterns of implementation and inconclusive evidence of the effects of those practices on student achievement.

First, one finding of interest is the reported lack of opportunities for students to work in groups, as opposed to individually. For instance, only 44.1% of the students reported working in groups in half of the lessons or more, while 82.5% reported working on their own at the same frequency (Table 14). With the large research base generally touting the benefits of cooperative learning (e.g., Johnson et al., 2000), especially when paired with group goals and individual accountability (Slavin, 1991), it is again perplexing why group work is not used more frequently in classrooms. This lack of use may also relate to the absence of the practice in the multiple regression equation used to predict student achievement, demonstrating no relationship between WORKGROUPS and student achievement in the current study. The answer may lie in the amount of “knowledge and skill” it takes for teachers to effectively implement the practice (National Research Council, 2001), pointing towards a need for an increased emphasis on professional development.

Also, NCTM recommends relating what is learned in the classroom to students’ daily lives (NCTM, 2000). However, results of the current study demonstrate a significant and
negative relationship between RELATE, $\beta = -0.22$, $t(7264) = -10.07$, $p < .001$, and student achievement. Closer inspection of the data, though, reveals that only 46.6% of students reported relating what is learned in the classroom to daily life in half of the lessons or more. Taken together, the results indicate that students may not engage in the practice often enough to positively impact achievement.

Furthermore, although the use of technology has generally been shown to positively impact student performance (e.g., Braswell et al., 2001; Roschelle et al., 2010), only 60.7% of the students in the sample reported the use of calculators in half of the lessons or more. Results of the current study demonstrated a significant and positive relationship to student achievement for USECALC, $\beta = 0.122$, $t(7264) = 5.63$, $p < .001$. Given clear evidence of the benefits of calculator use on student achievement in the literature and the current study, one would expect a greater percentage for its usage in the classroom.

Even more disparagingly, although computer use has also been demonstrated as a promising practice for raising student achievement when incorporating factors other than drill and practice (e.g., Schacter, 1999), only 8.9% of the students reported the use of computers in half of the lessons or more (Table 14). The percentage of students reporting the use of computers in half of the lessons or more was so small in this study that the practice was deleted from further analysis. Although 42% of students’ teachers reported access to computers for mathematics lessons in 2007 (Mullis, et al., 2008), 91.9% of U.S. middle school students reported computer use in fewer than half of the lessons. These results
indicate that issues other than access may influence the use of computers for mathematics lessons.

In addition, the deletion of USECOMP from analysis, other practices, such as NOCALC, EXPLAIN, and BEGINHW did not significantly contribute to the regression equation predicting student achievement. NOCALC, or practicing computations without a calculator, is strongly related to traditional instruction, while EXPLAIN may relate to Standards-based instruction, and BEGINHW is not strongly related to either traditional or Standards-based instruction. Black and Hispanic students reported the use of NOCALC significantly more frequently than White students. Again, these results indicate that Black and Hispanic students experience more computation-focused mathematics lessons than White students. However, the absence of NOCALC in the equation indicates a lack of relationship to student achievement. Instead, USECALC entered into the equation as positively and significantly related to achievement, which White students reported at greater frequencies than Black or Hispanic students. Using the clarifying statements of the practices, the results indicate that the use of a calculator for half of the lessons or more is related to higher student achievement, while practicing computations without the calculator demonstrates no relationship to student achievement.

NCTM (2000) also supports the use of student explanations in the classroom, yet the use of student explanations has demonstrated varying relationships to student achievement in the literature. For example, the quality of student explanations is an important indicator of student achievement and students must be instructed in providing high quality explanations.
(Webb, 1994). There is not enough information in the TIMSS data to determine whether students received any of this instruction. In the current study, EXPLAIN did not significantly contribute to the model predicting student achievement, indicating no relationship to student achievement.

Finally, although a high homework emphasis is related to higher student achievement in the literature, studies generally investigate the frequency at which teachers assign homework and the amount of time spent on homework assignments to develop emphasis levels (e.g., Martin et al., 2008); beginning homework in class is not included in these levels. The results of the current study indicate that while reviewing homework in class is positively related to student achievement, beginning homework in class does not offer any achievement benefits for students.

**Limitations**

The current study is limited by the available items in the TIMSS 2007 student questionnaire and the data analysis methods employed. As such, the questionnaire items did not address the instructional practices with enough specificity to draw firm conclusions about the nature of many of the practices and how those practices were implemented into the classrooms. Also, no firm conclusions can be made about the effectiveness of specific practices, due to the absence of pretest and posttest data. Finally, the use of one-level data analysis methods did not allow for the comparison of teacher reports to student reports of instructional practices, which may lead to an incomplete picture of classroom practice by
relying wholly on student reports. This section discusses the major limitations to the study and the consequences of the limitations on the interpretations of the findings.

First, although the TIMSS 2007 student questionnaire explored important student contextual considerations when conducting educational studies, the general nature of some of the questions limited the specificity of the data that was available. For example, the statements for many of the classroom instructional practices did not provide enough information to determine whether the practices were entirely consistent or inconsistent with the Standards. Specifically, “We work on fractions and decimals,” “We solve problems about geometric shapes, lines, and angles,” “We interpret data in tables, charts, or graphs” and, “We explain our answers,” can be interpreted and implemented using very different methods in the classroom. For instance, working with fractions and decimals may include performing computations without context, solving contextual problems, generating and using models, or exploring the relationships between fractions and decimals. The same ambiguity holds true for many of the remaining statements of classroom practice. With more specificity in the statements, students may be able to report uses of practices more accurately, and more meaningful results could be gleaned from the analysis of the data.

Also, TIMSS measures achievement at one point in time. No information is available about the growth in achievement since the last testing cycle or within the single testing year. A four year testing cycle is much too long to attempt a longitudinal study to follow students from the 4th grade to the 12th grade. First, the content is too different across grade levels to track patterns and trends, except in the broadest areas of content domains. Secondly, although
the samples generalize to the entire population, each cycle samples different students in different schools, and their achievement may reflect more on local efforts in any one year rather than national trends, making it impractical to compare the results to students who test in the next cycle, four years later, in different locations around the country. Such longitudinal studies would provide additional information about the use of instructional practices and their effects on achievement, however. For instance, do students who use calculators in half of their lessons or more show greater growth in mathematics achievement than students who use them less frequently? If the use of calculators positively affects student learning, we would expect to see greater gains in learning from students who use them more often. It is difficult to make conclusions about the effectiveness of classroom instructional strategies without information about previous achievement from items such as pretests or the previous year’s test for the specific group of students.

Although TIMSS researchers attempt to address some of these concerns by including trend items in the assessments, further steps could be taken to measure student learning. For example, administering a pretest at the beginning of a testing year would help to solve this problem. Randomly sampled schools would administer one version of the test in the fall, along with an improved and more specific background questionnaire. Ideally, a second, parallel version would be administered in the spring to the same sample of schools, along with the same background questionnaire. A second option is to include a two-year testing cycle, with one version of the test administered near the end of the seventh grade year, and the second version near the end of the eighth grade year. This option would allow time for
the analysis of the pretest data in preparation for comparison to the posttest data. In either case, more detailed learning and achievement information would be gathered using two tests, and the effects of classroom instructional practices would be more easily and accurately represented in the data.

Finally, the current study relates student reports of instructional practices to student achievement in one-level analyses. Comparing student reports to teacher reports in a two-level analysis of student achievement may yield more information about differing perceptions of the frequencies of classroom instructional practices and the links to student achievement. Similarly, a three-level analysis would allow for comparisons of classroom instructional practices and student achievement levels between schools. As such, the current study relies wholly on student-reported data, and all findings should be interpreted as reflective of the student perspective of instructional practices and the relationships of those practices to student achievement.

**Potential Study Implications**

The study findings offer valuable information for policy and practice. First, if one of the goals of grouping is to equalize girls’ opportunities to achieve in mathematics, the need for gender-specific classrooms and schools for middle grades is now questionable, considering the finding that gender is no longer a strong predictive factor of student mathematics achievement in the middle school. This finding is supported by current literature on gender differences in achievement (Hyde et al., 2008; Kane & Mertz, 2012; Lindbergh et al, 2010). Policy makers should carefully consider whether any perceived
academic benefits of single-sex education on mathematics achievement are actually due to factors related to student characteristics other than gender, curriculum, or instructional practices. Although perceived social benefits of single-sex education may justify its continued use, current literature and the current study do not support the use of single-sex education to impact student achievement in middle grades mathematics.

Secondly, particular attention should be paid to student background characteristics, especially the mother’s highest level of education. This data can be collected as a part of routine registration information and updated yearly as with other demographic information. Although policymakers cannot directly influence how much education a mother receives, the information will assist in identifying students who may potentially need additional support as they progress through school in order to achieve at their highest levels. Caution should be taken, however, not to “label” students whose mothers do not attain more than a high school education as somehow deficient or needy. Instead, the information should be used to simply identify students and families who may benefit from extra support services available in the school and community as a proactive, rather than reactive, action to increase achievement before learning problems occur. For example, although teachers do not necessarily need this information for daily instruction, school social workers could inform families of available adult educational opportunities and resources; guidance counselors could support the learning of the students by meeting with groups to address specific social needs; and school administrators could identify mentors for the students to encourage them and to check on monitor their progress on a regular basis. These sorts of interactions currently happen in
schools; however, the identification of the mother’s highest level of education would simplify the recognition of students who may most benefit from this type of support.

As for teacher practice, particular classroom instructional strategies that predict student mathematics achievement may need to be implemented more frequently. Specifically, the strongest associations occurred between achievement and the practices of REPRESENT, WORKONOWN, MEMORIZE, USECALC, and REVIEWHW. The more frequent use of these practices, according to student reports, is positively related to student achievement as measured by the highest international mathematics benchmark reached. Although only one of the practices, USECALC, can be confidently linked to elements of Standards-based instruction, REVIEWHW can be linked to an emphasis on homework, resulting in greater achievement, in the literature (e.g., Mullis et al., 2000). Consequently, WORKONOWN and MEMORIZE, which are generally considered elements of traditional instruction that persist despite efforts at reform, are also positively related to mathematics achievement in this study. More specific information is needed, however, for REPRESENT to determine the manner in which it is implemented before conclusions about its relationships to the Standards can be made.

However, special care should be made not to discount the remaining practices due to the results of one study. The TIMSS data does not provide enough information for teachers to effectively implement new approaches without training. For example, although working in groups is related to higher student achievement in the literature (Johnson et al., 2000; Slavin et al., 2009), the results of this study showed no predictive relationship between group
work and student achievement. These conflicting results may demonstrate a lack of professional development for teachers on effective cooperative learning strategies. Due to the strong research base on cooperative learning, it seems that a special effort should be made for staff development leaders to train teachers in its benefits and uses, and for teachers to implement more frequent uses of cooperative learning in the classroom.

In all, although the current study offers few new findings regarding classroom instructional strategies and student achievement in U.S. eighth grade mathematics classrooms, the major findings align with much of the existing literature. First, gender is no longer an important predictor of achievement in middle grades classrooms. This finding supports recent research regarding the closing of the gender achievement gap for mathematics (Hyde et al., 2008; Kane & Mertz, 2012; Lindbergh et al., 2010). Also, SES is an important determining factor in student achievement, even greater than 15 of the specific instructional practices in the study. Finally, race is more strongly related to student achievement than gender, SES, or instructional practices. These results confirm the significance of student characteristics in relation to achievement as in Goldhaber and Brewer (1999). Several of the secondary findings suggest a need for further research, however, in order to fully investigate the details behind the results.

**Recommendations for Future Research**

The current study provided three important findings about U.S. eighth grade mathematics students and the effects of background and classroom instructional practices on achievement. Although the study adds to the literature investigating these relationships, some
findings were contrary to previous literature or are worthy of further study. Specifically, it is recommended that future research focus on collecting additional data and investigating related research topics.

**Data Collection**

The data collected by the TIMMS researchers is meant to survey students on a broad range of topics related to mathematics and science. Additional data needs to be collected to more specifically describe the classroom instructional practices that students experience and the effects of those practices on student achievement. First, clear, precise statements of instructional practices, perhaps with examples or explanations, would assist students in providing accurate accounts of experiences. These statements would replace the current, more ambiguous statements in the questionnaire. The resulting statements would offer more information on the exact practices used in the classroom. For example, the statement, “We explain our answer” could be replaced with, “We write explanations of our problem-solving strategies and processes,” “We verbally share our problem-solving strategies and processes with the whole class,” and “We verbally share our problem-solving strategies and processes with a partner or a small group.” These statements would provide the student with much more information on the intentions of the item, as well as provide the researcher with more specific information about the actual implementation of practices in the classroom.

Also, as previously discussed, additional data about student learning over time would more completely illustrate the effects of instructional practices on achievement. Data collected through pretests would be compared to posttests to determine the amount of
learning between the tests. This information, along with reports of instructional practices, would provide more solid evidence for or against the increased frequency of specific practices that seem to positively relate to learning.

Research Topics

Five additional research topics are also evident from the results of the study. First, the study found that students reported different reports of frequencies of classroom strategies by background characteristics. A study investigating the underlying reasons for this result is warranted. Do certain groups of students actually experience instructional strategies differently? Differences in the results could relate to the racial/ethnic classifications of the students, their socioeconomic statuses, and/or the schools’ reflections of the racial/ethnic compositions or socioeconomic statuses of their communities. A comparison of the student reports of instructional practices in different schools, grouped by mean mothers’ highest level of education and race/ethnicity, would provide the first steps towards answering this question.

A second, related study, would involve the relationships between those student reports and student mathematics achievement. Once any groups have been established by the mother’s highest level of education and race/ethnicity, comparing the achievement of those groups would provide more evidence of the relationships between classroom instructional practices and student achievement. For example, if students in less affluent schools, as measured by mean mother’s highest educational level, experience a classroom strategy more
often and also achieve at higher levels than students in more affluent areas, those results would provide strong evidence of the links between the specific strategy and achievement.

Third, TIMSS provides student achievement information on the specific content domains included in the exam. It is possible that particular classroom instructional practices affect achievement in particular content domains. For example, it is expected that students who spend more time solving problems involving geometric shapes, lines, and angles would achieve at higher levels in the geometry domain. Such a study may illuminate more specific relationships between classroom instructional strategies and student achievement in specific content domains, as well as describe how those relationships apply to overall mathematics achievement.

Also, the results of the current study indicated that gender had very little effect on student mathematics achievement. This finding was contrary to previous research that stated a greater importance for gender. Many of those studies were conducted on data older than the TIMMS 2007 dataset, however. More recent data reflects a closing of the gender gap in middle grades mathematics (Hyde et al., 2008; Kane & Mertz, 2012; Lindbergh et al., 2010). Additional, large-scale studies of current data could be used to investigate this finding further.

Finally, the study provided significant, yet very small effect sizes. These results indicate that there are additional variables that affect student achievement that were not included in the study. In addition to more information about the student’s family and home, the TIMSS 2007 eighth grade student background questionnaire requests additional
information, how far the student expects to go in school, students’ opinions about school, safety concerns, the frequency and amount of homework assigned, and how students spend their time after school. These items provide more information about the context in which the student learns. Previous studies have investigated many of the areas, but more information is needed about how all of these factors work together to affect student achievement, and if any one area is most important to student learning.

**Conclusion**

The current study sought to add to existing literature about the links between classroom instructional practices and student mathematics achievement. Previous literature regarding this topic generally consisted of small, program-specific studies or reports from large-scale test administrations. This study provided empirical evidence of the relationships between gender, mother’s highest level of education, student race/ethnicity, classroom instructional strategies, and student mathematics achievement in a recent, national student population. The results of the study demonstrated differences in achievement by these factors, and identified instructional practices that may be important to implement more frequently in order to improve student achievement. The study confirmed many of the previous findings in the literature, including a narrowing of the gender achievement gap and the strong relationships of student SES and race/ethnicity to achievement. Regrettably, no specific conclusions regarding Standards-based instruction can be made due to the inability to classify practices on the survey with certainty. Instead, implications and suggestions for further research raised from study determine the need for more complete data concerning
students’ prior knowledge and teachers’ methods of implementation of specific classroom instructional strategies. Importantly, the current study serves as a starting point for incorporating more specific factors in the investigations of the relationships between classroom instructional practices and student achievement in U.S. middle school mathematics classrooms.
References


from the Third International Mathematics and Science Study. (NCES Report 97-198).
Washington, D.C.: NCES.


Research Companion to Principles and Standards for School Mathematics (pp. 353 – 392). Reston, VA: NCTM.


APPENDICES
**Appendix A**

**Tables**

*Table 1*

**TIMSS 2007 Weighting Variables**

<table>
<thead>
<tr>
<th>Variable Labels</th>
<th>Variable Names</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTWGT</td>
<td>Total Student Weight</td>
<td>Sums to the national population</td>
</tr>
<tr>
<td>SENWGT</td>
<td>Student Senate Weight</td>
<td>Sums to 500 in each country</td>
</tr>
<tr>
<td>HOUWGT</td>
<td>Student House Weight</td>
<td>Sums to the student sample size in each country</td>
</tr>
<tr>
<td>TCHWGT</td>
<td>Overall Teacher Weight</td>
<td></td>
</tr>
<tr>
<td>MATWGT</td>
<td>Mathematics Teacher Weight</td>
<td></td>
</tr>
<tr>
<td>SCIWGT</td>
<td>Science Teacher Weight</td>
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</tr>
</tbody>
</table>

Table 2

Mathematics International Benchmark Reached

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Code in TIMSS</th>
<th>Statement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Basic</td>
<td>1</td>
<td>Below 400</td>
<td>Students do not have basic mathematical knowledge.</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>At or above 400 but</td>
<td>Students have some knowledge of whole numbers and decimals, operations, and basic graphs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>below 475</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>3</td>
<td>At or above 475 but</td>
<td>Students can apply basic mathematical knowledge in straightforward situations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>below 550</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>4</td>
<td>At or above 550 but</td>
<td>Students can apply their knowledge and understanding in a variety of relatively complex situations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>below 625</td>
<td></td>
</tr>
<tr>
<td>Advanced</td>
<td>5</td>
<td>At or above 625</td>
<td>Students can organize and draw conclusions from information, make generalization, and solve non-routine problems.</td>
</tr>
</tbody>
</table>


Note. Benchmark label “Below Basic” and description added by researcher. TIMSS codes and statements adapted from data file bsgusam4.sav in TIMSS 2007 public-use database.
Table 3

Correlations for Mathematics International Benchmark Reached

<table>
<thead>
<tr>
<th>Mathematics International Benchmark Reached with</th>
<th>1st PV</th>
<th>2nd PV</th>
<th>3rd PV</th>
<th>4th PV</th>
<th>5th PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>.855**</td>
<td>.850**</td>
<td>.854**</td>
<td>.852**</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Mathematics International Benchmark Reached with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.855**</td>
<td>1</td>
<td>.854**</td>
<td>.855**</td>
<td>.853**</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Mathematics International Benchmark Reached with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.850**</td>
<td>.854**</td>
<td>1</td>
<td>.853**</td>
<td>.847**</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Mathematics International Benchmark Reached with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.854**</td>
<td>.855**</td>
<td>.853**</td>
<td>1</td>
<td>.850**</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Mathematics International Benchmark Reached with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.852**</td>
<td>.853**</td>
<td>.847**</td>
<td>.850**</td>
<td>1</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note. *TOTWGT* student weights applied. **= correlation significant at the 0.01 level (2-tailed). n = 7282.
### Table 4

**TIMSS 2007 Parental Education Levels**

<table>
<thead>
<tr>
<th>Level</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Finished elementary or did not go to school</td>
</tr>
<tr>
<td>2</td>
<td>Finished junior high/middle school</td>
</tr>
<tr>
<td>3</td>
<td>Finished some high school</td>
</tr>
<tr>
<td>4</td>
<td>Finished high school</td>
</tr>
<tr>
<td>5</td>
<td>Finished vocational certificate after high school</td>
</tr>
<tr>
<td>6</td>
<td>Finished AA in a vocational program</td>
</tr>
<tr>
<td>7</td>
<td>Finished college or bachelor’s degree</td>
</tr>
<tr>
<td>8</td>
<td>Finished master’s degree or higher</td>
</tr>
<tr>
<td>9</td>
<td>I do not know</td>
</tr>
</tbody>
</table>

Table 5

Descriptive Statistics for Mother’s Highest Level of Education

<table>
<thead>
<tr>
<th>Level</th>
<th>Education Description</th>
<th>Percent</th>
<th>Percent s.e.</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Finished elementary or did not go to school</td>
<td>3.0</td>
<td>(.28)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Finished junior high/middle school</td>
<td>3.1</td>
<td>(.24)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Finished some high school</td>
<td>6.4</td>
<td>(.39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Finished high school</td>
<td>22.3</td>
<td>(.63)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Finished vocational certificate after high school</td>
<td>3.5</td>
<td>(.22)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Finished AA in a vocational program</td>
<td>2.3</td>
<td>(.21)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Finished college or bachelor’s degree</td>
<td>23.0</td>
<td>(.75)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Finished master’s degree or higher</td>
<td>12.3</td>
<td>(.58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I do not know</td>
<td>22.8</td>
<td>(.58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>.59</td>
<td>(.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not Administered</td>
<td>.71</td>
<td>(.11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0</td>
<td>10.725</td>
<td>7.966</td>
<td>64.886</td>
<td>(.001)</td>
</tr>
</tbody>
</table>

Note. n = 7377. TOTWGT student weights applied. Standard errors reported within parentheses.
Table 6

Descriptive Statistics for Mother’s Highest Educational Level (SES)

<table>
<thead>
<tr>
<th>Level</th>
<th>Indicator</th>
<th>Percent</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>I don’t know/missing</td>
<td>23.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>High school or less</td>
<td>35.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Beyond high school</td>
<td>40.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0</td>
<td>.784</td>
<td>-.292</td>
<td>-1.319</td>
</tr>
</tbody>
</table>

(.025) (.051)

Note. n = 7282. TOTWGT student weights applied. Standard errors are reported within parentheses.
Table 7

Classroom Instructional Practices with Variable Labels

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Code in TIMSS</th>
<th>Statement</th>
<th>Variable Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>BS4MHASM</td>
<td>We practice adding, subtracting, multiplying, and dividing without using a calculator</td>
<td>NOCALC</td>
</tr>
<tr>
<td>P2</td>
<td>BS4MHWFED</td>
<td>We work on fractions and decimals</td>
<td>FRACDEC</td>
</tr>
<tr>
<td>P3</td>
<td>BS4MHGSA</td>
<td>We solve problems about geometric shapes, lines, and angles</td>
<td>GEO</td>
</tr>
<tr>
<td>P4</td>
<td>BS4MHGCT</td>
<td>We interpret data in tables, charts, or graphs</td>
<td>INTERPRET</td>
</tr>
<tr>
<td>P5</td>
<td>BS4MHEFRI</td>
<td>We write equations and functions to represent relationships</td>
<td>REPRESENT</td>
</tr>
<tr>
<td>P6</td>
<td>BS4MHFRR</td>
<td>We memorize formulas and procedures</td>
<td>MEMORIZE</td>
</tr>
<tr>
<td>P7</td>
<td>BS4MHEXP</td>
<td>We explain our answers</td>
<td>EXPLAIN</td>
</tr>
<tr>
<td>P8</td>
<td>BS4MHMDL</td>
<td>We relate what we are learning in mathematics to our daily lives</td>
<td>RELATE</td>
</tr>
<tr>
<td>P9</td>
<td>BS4MHSCP</td>
<td>We decide on our own procedures for solving problems</td>
<td>DECIDE</td>
</tr>
<tr>
<td>P10</td>
<td>BS4MHROH</td>
<td>We review our homework</td>
<td>REVIEWHW</td>
</tr>
<tr>
<td>P11</td>
<td>BS4MHLSPI</td>
<td>We listen to the teacher give a lecture-style presentation</td>
<td>LECTURE</td>
</tr>
<tr>
<td>P12</td>
<td>BS4MHWP0</td>
<td>We work problems on our own</td>
<td>WORKONOWN</td>
</tr>
<tr>
<td>P13</td>
<td>BS4MHWSPG</td>
<td>We work together in small groups</td>
<td>WORKGROUPS</td>
</tr>
<tr>
<td>P14</td>
<td>BS4MHBC</td>
<td>We begin our homework in class</td>
<td>BEGINHW</td>
</tr>
<tr>
<td>P15</td>
<td>BS4MHHQST</td>
<td>We have a quiz or test</td>
<td>QUIZTEST</td>
</tr>
<tr>
<td>P16</td>
<td>BS4MHCAL</td>
<td>We use calculators</td>
<td>USECALC</td>
</tr>
<tr>
<td>P17</td>
<td>BS4MHCOM</td>
<td>We use computers</td>
<td>USECOMP</td>
</tr>
</tbody>
</table>


Note. Variable labels added by researcher.
Table 8

Descriptive Statistics for Gender – Original Data

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Percent</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girl</td>
<td>3697</td>
<td>50.3</td>
<td>(.76)</td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>3622</td>
<td>49.1</td>
<td>(.74)</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>58</td>
<td>.6</td>
<td>(.25)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0</td>
<td></td>
<td>2.025</td>
</tr>
</tbody>
</table>

Note. n = 7377. TOTWGT student weights applied. Standard errors are reported within parentheses.
Table 9

Descriptive Statistics for Race – Original Data

<table>
<thead>
<tr>
<th>Description</th>
<th>N</th>
<th>Percent</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 White, not Hispanic</td>
<td>3873</td>
<td>53.2</td>
<td>(1.54)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Black, not Hispanic</td>
<td>949</td>
<td>13.0</td>
<td>(.89)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Hispanic</td>
<td>1787</td>
<td>24.5</td>
<td>(1.55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Asian</td>
<td>243</td>
<td>2.97</td>
<td>(.36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Native American</td>
<td>90</td>
<td>1.22</td>
<td>(.25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Pacific Islander</td>
<td>58</td>
<td>.88</td>
<td>(.21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 2 or More Races</td>
<td>282</td>
<td>3.91</td>
<td>(.28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>95</td>
<td>1.07</td>
<td>(.25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7377</td>
<td>100.0</td>
<td>1.066</td>
<td>.660 (.025)</td>
<td>-1.058(.051)</td>
</tr>
</tbody>
</table>

Note. TOTWGT student weights applied. Standard errors are reported within parentheses.
Table 10

*Descriptive Statistics for GENDER*

<table>
<thead>
<tr>
<th></th>
<th>Percent</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>50.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl</td>
<td>49.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>.500</td>
<td>.024</td>
<td>-2.00</td>
</tr>
</tbody>
</table>

Note. \( n = 7282 \). *TOTWGT* student weights applied. Standard errors reported within parentheses.
Table 11

Descriptive Statistics for RACE, Recoded

<table>
<thead>
<tr>
<th>Description</th>
<th>N</th>
<th>Percent</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 White, not</td>
<td>3873</td>
<td>55.15</td>
<td>1.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Black, not</td>
<td>949</td>
<td>12.41</td>
<td>.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Hispanic</td>
<td>1787</td>
<td>23.38</td>
<td>1.56</td>
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</tr>
<tr>
<td>4 Other</td>
<td>673</td>
<td>9.06</td>
<td>.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7282</td>
<td>100.0</td>
<td>1.066</td>
<td>.660</td>
<td>-1.058</td>
</tr>
</tbody>
</table>

Note. n = 7282. TOTWGT student weights applied. Standard errors are reported within parentheses.
**Table 12**  
*Descriptive Statistics for Instructional Practices – Original Data*

<table>
<thead>
<tr>
<th>Practice</th>
<th>Median</th>
<th>SD</th>
<th>Skewness s.e. (.029)</th>
<th>Kurtosis s.e. (.057)</th>
<th>Percent Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 NOCALC</td>
<td>2.0</td>
<td>1.275</td>
<td>1.691</td>
<td>5.763</td>
<td>1.3</td>
</tr>
<tr>
<td>P2 FRACDEC</td>
<td>2.0</td>
<td>1.160</td>
<td>2.350</td>
<td>11.181</td>
<td>1.5</td>
</tr>
<tr>
<td>P3 GEO</td>
<td>3.0</td>
<td>1.151</td>
<td>2.082</td>
<td>10.239</td>
<td>1.6</td>
</tr>
<tr>
<td>P4 INTERPRET</td>
<td>2.0</td>
<td>1.189</td>
<td>2.407</td>
<td>11.392</td>
<td>1.8</td>
</tr>
<tr>
<td>P5 REPRESENT</td>
<td>2.0</td>
<td>1.221</td>
<td>2.661</td>
<td>11.679</td>
<td>1.7</td>
</tr>
<tr>
<td>P6 MEMORIZE</td>
<td>2.0</td>
<td>1.258</td>
<td>2.484</td>
<td>10.183</td>
<td>1.7</td>
</tr>
<tr>
<td>P7 EXPLAIN</td>
<td>1.0</td>
<td>1.259</td>
<td>2.927</td>
<td>12.449</td>
<td>1.8</td>
</tr>
<tr>
<td>8P8 RELATE</td>
<td>3.0</td>
<td>1.271</td>
<td>1.500</td>
<td>5.882</td>
<td>1.6</td>
</tr>
<tr>
<td>P9 DECIDE</td>
<td>3.0</td>
<td>1.308</td>
<td>1.801</td>
<td>7.024</td>
<td>2.1</td>
</tr>
<tr>
<td>P10 REVIEWHW</td>
<td>1.0</td>
<td>1.287</td>
<td>3.023</td>
<td>12.274</td>
<td>1.8</td>
</tr>
<tr>
<td>P11 LECTURE</td>
<td>2.0</td>
<td>1.350</td>
<td>2.182</td>
<td>7.839</td>
<td>1.9</td>
</tr>
<tr>
<td>P12 WORKONOWN</td>
<td>1.0</td>
<td>1.232</td>
<td>3.244</td>
<td>14.910</td>
<td>1.9</td>
</tr>
<tr>
<td>P13 WORKGROUPS</td>
<td>3.0</td>
<td>1.289</td>
<td>1.636</td>
<td>6.508</td>
<td>1.9</td>
</tr>
<tr>
<td>P14 BEGINHW</td>
<td>2.0</td>
<td>1.343</td>
<td>2.099</td>
<td>7.662</td>
<td>1.9</td>
</tr>
<tr>
<td>P15 QUIZTEST</td>
<td>2.0</td>
<td>1.198</td>
<td>2.949</td>
<td>13.707</td>
<td>1.7</td>
</tr>
<tr>
<td>P16 USECALC</td>
<td>2.0</td>
<td>1.371</td>
<td>1.861</td>
<td>6.338</td>
<td>1.9</td>
</tr>
<tr>
<td>P17 USECOMP</td>
<td>4.0</td>
<td>.982</td>
<td>.798</td>
<td>9.435</td>
<td>1.6</td>
</tr>
</tbody>
</table>

*Note. n = 7377. TOTWGT student weights applied. Responses ranged from 1 (Almost every lesson) to 4 (Never). Cronbach’s alpha = .918*
### Table 13

**Descriptive Statistics for Instructional Practices—No Missing Cases**

<table>
<thead>
<tr>
<th>Practice</th>
<th>Median</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>2</td>
<td>1.052</td>
<td>.414</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>2</td>
<td>.861</td>
<td>.062</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>3</td>
<td>.861</td>
<td>-.229</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>2</td>
<td>.846</td>
<td>-.117</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>2</td>
<td>.881</td>
<td>.564</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>2</td>
<td>.928</td>
<td>.610</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>1</td>
<td>.885</td>
<td>.989</td>
</tr>
<tr>
<td>8P8</td>
<td>RELATE</td>
<td>3</td>
<td>1.019</td>
<td>-.099</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>3</td>
<td>.984</td>
<td>-.116</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>1</td>
<td>.908</td>
<td>1.384</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>2</td>
<td>1.012</td>
<td>.558</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>1</td>
<td>.810</td>
<td>.903</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>3</td>
<td>.998</td>
<td>-.169</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>2</td>
<td>1.013</td>
<td>.421</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>2</td>
<td>.833</td>
<td>.595</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>2</td>
<td>1.061</td>
<td>.350</td>
</tr>
<tr>
<td>P17</td>
<td>USECOMP</td>
<td>4</td>
<td>.773</td>
<td>-1.995</td>
</tr>
</tbody>
</table>

*Note.* n = 7282. *TOTWGT* student weights applied. Responses ranged from 1 (Almost every lesson) to 4 (Never).
Table 14

Descriptive Statistics for Recoded Instructional Practices

<table>
<thead>
<tr>
<th>Practice</th>
<th>Code 1</th>
<th>Percent</th>
<th>Code 2</th>
<th>Percent</th>
<th>Skewnes s.e.</th>
<th>Kurtosis s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>2272</td>
<td>38.1</td>
<td>4510</td>
<td>61.9</td>
<td>-.492</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>2674</td>
<td>36.7</td>
<td>4608</td>
<td>63.3</td>
<td>-.551</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>3788</td>
<td>52.0</td>
<td>3494</td>
<td>48.0</td>
<td>.081</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>3088</td>
<td>42.4</td>
<td>4194</td>
<td>57.6</td>
<td>-.307</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>1912</td>
<td>26.3</td>
<td>5370</td>
<td>73.7</td>
<td>-1.079</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>2033</td>
<td>27.9</td>
<td>5249</td>
<td>72.1</td>
<td>-.985</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>1519</td>
<td>20.9</td>
<td>5763</td>
<td>79.1</td>
<td>-1.435</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>3890</td>
<td>53.4</td>
<td>3392</td>
<td>46.6</td>
<td>.137</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>3920</td>
<td>53.8</td>
<td>3362</td>
<td>46.2</td>
<td>.154</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>1333</td>
<td>18.3</td>
<td>5949</td>
<td>81.7</td>
<td>-1.640</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>2328</td>
<td>32.0</td>
<td>4954</td>
<td>68.0</td>
<td>-1.773</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>1276</td>
<td>17.5</td>
<td>6006</td>
<td>82.5</td>
<td>-1.709</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>4072</td>
<td>55.9</td>
<td>3210</td>
<td>44.1</td>
<td>.238</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>2642</td>
<td>36.3</td>
<td>4640</td>
<td>63.7</td>
<td>-.571</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>1692</td>
<td>23.2</td>
<td>5590</td>
<td>76.8</td>
<td>-1.268</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>2863</td>
<td>39.3</td>
<td>4419</td>
<td>60.7</td>
<td>-.438</td>
</tr>
<tr>
<td>P17</td>
<td>USECOMP</td>
<td>6635</td>
<td>91.1</td>
<td>647</td>
<td>8.9</td>
<td>2.891</td>
</tr>
</tbody>
</table>

Note. N = 7282. Code 1 = half of the lessons or fewer, Code 2 = more than half of the lessons. Cronbach’s alpha = 0.754.
Table 15

*Measures of Effect Size*

<table>
<thead>
<tr>
<th>Effect size</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.2</td>
<td>Small</td>
</tr>
<tr>
<td>≈ 0.5</td>
<td>Medium</td>
</tr>
<tr>
<td>≥ 0.8</td>
<td>Large</td>
</tr>
</tbody>
</table>

Table 16

**Descriptive Statistics for International Benchmark Reached (SCORES)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Percent</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Below Basic</td>
<td>Below 400</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Low</td>
<td>At or above 400</td>
<td>26.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>but below 475</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Intermediate</td>
<td>At or above 475</td>
<td>36.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>but below 550</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 High</td>
<td>At or above 550</td>
<td>25.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>but below 625</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Advanced</td>
<td>At or above 625</td>
<td>5.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>2.970</td>
<td>1.005</td>
<td>-.010</td>
<td>-.560</td>
</tr>
</tbody>
</table>

*Note. n = 7282. TOTWGT student weight applied. Standard errors are reported within parentheses.*
Table 17

Correlation Statistics for Instructional Practices and GENDER

<table>
<thead>
<tr>
<th>Practice</th>
<th>Correlation Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>.020</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>-.012</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>-.015</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>-.021</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>.038**</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>.034**</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>-.033**</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>-.026*</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>-.055**</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>.013</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>-.041**</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>.015</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>.006</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>.010</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>.069**</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>.017</td>
</tr>
</tbody>
</table>

Note. TOTWGT student weights applied. * denotes significance at p < .05, ** denotes significance at p < .01.
Table 18

Correlation Statistics for Instructional Practice and Gender - IDB Analyzer

<table>
<thead>
<tr>
<th>Practice</th>
<th>Correlation Statistic (s.e. .01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
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<td>P13</td>
<td>WORKGROUPS</td>
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<td></td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
</tr>
</tbody>
</table>

Note. n = 2782. TOTWGT student weights applied.
Table 19

Correlations Statistics for Instructional Practices and SES

<table>
<thead>
<tr>
<th>Practice</th>
<th>SES Level 0 Correlation Statistic</th>
<th>p</th>
<th>SES Level 1 Correlation Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>-.017</td>
<td>.155</td>
<td>.028*</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>-.036**</td>
<td>.002</td>
<td>-.022</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>-.027**</td>
<td>.022</td>
<td>.009</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>-.037**</td>
<td>.002</td>
<td>-.008</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>-.061**</td>
<td>.000</td>
<td>-.027*</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>-.040**</td>
<td>.001</td>
<td>-.028*</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>-.014</td>
<td>.245</td>
<td>.001</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>-.029*</td>
<td>.015</td>
<td>.018</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>-.027*</td>
<td>.023</td>
<td>.011</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>-.036**</td>
<td>.002</td>
<td>-.053**</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>-.014</td>
<td>.228</td>
<td>-.003</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>-.041**</td>
<td>.000</td>
<td>-.051</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>-.025*</td>
<td>.032</td>
<td>-.023</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>-.042**</td>
<td>.000</td>
<td>-.015</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>.001</td>
<td>.937</td>
<td>.022</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>-.046**</td>
<td>.000</td>
<td>-.042**</td>
</tr>
</tbody>
</table>

Note. n = 7282. TOTWGT student weights applied. * denotes significance at p < .05, **denotes significance at p < .01.
Table 20

Correlation Statistics for Instructional Practices and SES - IDB Analyzer

<table>
<thead>
<tr>
<th>Practice</th>
<th>SES Level 0 Correlation Statistic (s.e. .01)</th>
<th>SES Level 1 Correlation Statistic (s.e. .01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>-.01</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>-.04</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>-.03</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>.03</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>-.06</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>-.04</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>-.01</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>-.03</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>-.03</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>-.05</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>-.01</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>-.04</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>-.02</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>-.04</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>.01</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>-.04</td>
</tr>
</tbody>
</table>

Note. n = 7282. TOTWGT student weights applied. * denotes significance at p < .05, **denotes significance at p < .01.
Table 21

Correlation Statistics for Instructional Practices and RACE

<table>
<thead>
<tr>
<th>Practice</th>
<th>Black Correlation Statistic &amp; p</th>
<th>Hispanic Correlation Statistic &amp; p</th>
<th>Other Correlation Statistic &amp; p</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>.035** &amp; .002</td>
<td>.051** &amp; .000</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>-.022 &amp; .065</td>
<td>.028* &amp; .017</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>.018 &amp; .131</td>
<td>.041** &amp; .000</td>
</tr>
<tr>
<td>P4</td>
<td>INTERPRET</td>
<td>.016 &amp; .171</td>
<td>.008 &amp; .481</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
<td>.007 &amp; .570</td>
<td>-.043** &amp; .008</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>.000 &amp; .996</td>
<td>-.031** &amp; .009</td>
</tr>
<tr>
<td>P7</td>
<td>EXPLAIN</td>
<td>.030* &amp; .010</td>
<td>-.025* &amp; .036</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>.024* &amp; .043</td>
<td>.028* &amp; .017</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>.024* &amp; .037</td>
<td>.015 &amp; .210</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>-.076** &amp; .000</td>
<td>-.118** &amp; .000</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>-.004 &amp; .731</td>
<td>.021 &amp; .077</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>-.019 &amp; .105</td>
<td>-.055** &amp; .000</td>
</tr>
<tr>
<td>P13</td>
<td>WORKGROUPS</td>
<td>-.001 &amp; .926</td>
<td>-.010 &amp; .388</td>
</tr>
<tr>
<td>P14</td>
<td>BEGINHW</td>
<td>-.056** &amp; .000</td>
<td>-.109** &amp; .000</td>
</tr>
<tr>
<td>P15</td>
<td>QUIZTEST</td>
<td>.037** &amp; .002</td>
<td>-.008 &amp; .487</td>
</tr>
<tr>
<td>P16</td>
<td>USECALC</td>
<td>-.008 &amp; .481</td>
<td>-.182** &amp; .000</td>
</tr>
</tbody>
</table>

Note: n = 7282. TOTWGT student weights applied. * denotes significance at p < .05, **denotes significance at p < .01.
Table 22

Correlation Statistics for Instructional Practices to RACE - IDB Analyzer

<table>
<thead>
<tr>
<th>Practice</th>
<th>Black</th>
<th>Hispanic</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation Statistic</td>
<td>Correlation Statistic</td>
<td>Correlation Statistic</td>
</tr>
<tr>
<td>P1</td>
<td>NOCALC</td>
<td>.04 (.01)</td>
<td>.06 (.02)</td>
</tr>
<tr>
<td>P2</td>
<td>FRACDEC</td>
<td>-.03 (.02)</td>
<td>.04 (.01)</td>
</tr>
<tr>
<td>P3</td>
<td>GEO</td>
<td>.01 (.01)</td>
<td>.04 (.01)</td>
</tr>
<tr>
<td>P4</td>
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<td>.02 (.01)</td>
<td>.00 (.02)</td>
</tr>
<tr>
<td>P5</td>
<td>REPRESENT</td>
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<td>-.04 (.01)</td>
</tr>
<tr>
<td>P6</td>
<td>MEMORIZE</td>
<td>.00 (.01)</td>
<td>.03 (.02)</td>
</tr>
<tr>
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<td>EXPLAIN</td>
<td>.03 (.01)</td>
<td>-.02 (.02)</td>
</tr>
<tr>
<td>P8</td>
<td>RELATE</td>
<td>.02 (.01)</td>
<td>.02 (.01)</td>
</tr>
<tr>
<td>P9</td>
<td>DECIDE</td>
<td>.03 (.01)</td>
<td>.01 (.01)</td>
</tr>
<tr>
<td>P10</td>
<td>REVIEWHW</td>
<td>-.07 (.02)</td>
<td>-.11 (.02)</td>
</tr>
<tr>
<td>P11</td>
<td>LECTURE</td>
<td>.00 (.01)</td>
<td>.02 (.01)</td>
</tr>
<tr>
<td>P12</td>
<td>WORKONOWN</td>
<td>-.02 (.01)</td>
<td>-.05 (.01)</td>
</tr>
<tr>
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<td>WORKGROUPS</td>
<td>-.01 (.02)</td>
<td>-.01 (.01)</td>
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<td>BEGINHW</td>
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<td>-.11 (.02)</td>
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<tr>
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<td>QUIZTEST</td>
<td>.04 (.01)</td>
<td>-.01 (.02)</td>
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<tr>
<td>P16</td>
<td>USECALC</td>
<td>-.02 (.02)</td>
<td>-.17 (.02)</td>
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Note. n = 7282. TOTWGT student weights applied. Standard errors are reported within parentheses.
Table 23

Model Summary for Hypothesis 2.1

<table>
<thead>
<tr>
<th>Step</th>
<th>R</th>
<th>$R^2$</th>
<th>$R^2_{adj}$</th>
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<th>$F_{chg}$</th>
<th>p</th>
<th>df1</th>
<th>df2</th>
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<td>.023</td>
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<td>7280</td>
</tr>
<tr>
<td>2. RELATE</td>
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<td>.041</td>
<td>.041</td>
<td>.018</td>
<td>136.56</td>
<td>&lt; .001</td>
<td>1</td>
<td>7279</td>
</tr>
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<td>3. REVIEWHW</td>
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<td>.060</td>
<td>.019</td>
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<td>1</td>
<td>7278</td>
</tr>
<tr>
<td>4. WORKONOWN</td>
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<td>.072</td>
<td>.072</td>
<td>.012</td>
<td>91.62</td>
<td>&lt; .001</td>
<td>1</td>
<td>7277</td>
</tr>
<tr>
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<td>.082</td>
<td>.011</td>
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<td>1</td>
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</tr>
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<td>.094</td>
<td>.094</td>
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<td>.103</td>
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<td>.111</td>
<td>.110</td>
<td>.007</td>
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<tr>
<td>9. INTERPRET</td>
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<td>.114</td>
<td>.113</td>
<td>.003</td>
<td>22.70</td>
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<td>1</td>
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<td>.115</td>
<td>.002</td>
<td>18.21</td>
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</tr>
<tr>
<td>11. DECIDE</td>
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<td>.118</td>
<td>.116</td>
<td>.001</td>
<td>11.58</td>
<td>.001</td>
<td>1</td>
<td>7270</td>
</tr>
<tr>
<td>12. NOCALC</td>
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<td>.119</td>
<td>.117</td>
<td>.001</td>
<td>7.77</td>
<td>.005</td>
<td>1</td>
<td>7269</td>
</tr>
<tr>
<td>13. EXPLAIN</td>
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<td>.118</td>
<td>.001</td>
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<td>.019</td>
<td>1</td>
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<td>.118</td>
<td>.000</td>
<td>4.85</td>
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<td>1</td>
<td>7267</td>
</tr>
</tbody>
</table>

*Note.* Dependent Variable: SCORES. *TOTWGT* student weights applied. One classroom instructional practice was added at each step, with the final model incorporating each of the fourteen practices shown.
Table 24

Coefficients for Final Model for Hypothesis 2.1

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>Bivariate r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. REPRESENT</td>
<td>.337</td>
<td>.165</td>
<td>12.984*</td>
<td>.153</td>
<td>.151</td>
</tr>
<tr>
<td>2. RELATE</td>
<td>-.244</td>
<td>-.121</td>
<td>-10.008*</td>
<td>-.108</td>
<td>-.117</td>
</tr>
<tr>
<td>3. REVIEWHW</td>
<td>.310</td>
<td>.118</td>
<td>10.083*</td>
<td>.143</td>
<td>.117</td>
</tr>
<tr>
<td>4. WORKONOWN</td>
<td>.319</td>
<td>.120</td>
<td>10.262*</td>
<td>.139</td>
<td>.120</td>
</tr>
<tr>
<td>5. GEO</td>
<td>-.185</td>
<td>-.092</td>
<td>-7.320*</td>
<td>-.080</td>
<td>-.086</td>
</tr>
<tr>
<td>6. USECALC</td>
<td>.224</td>
<td>.108</td>
<td>9.304*</td>
<td>.130</td>
<td>.109</td>
</tr>
<tr>
<td>7. QUIZTEST</td>
<td>-.240</td>
<td>-.101</td>
<td>-8.830*</td>
<td>-.066</td>
<td>-.103</td>
</tr>
<tr>
<td>8. MEMORIZE</td>
<td>.238</td>
<td>.106</td>
<td>8.726*</td>
<td>.126</td>
<td>.102</td>
</tr>
<tr>
<td>9. INTERPRET</td>
<td>-.108</td>
<td>-.053</td>
<td>-4.052*</td>
<td>-.020</td>
<td>-.047</td>
</tr>
<tr>
<td>10. LECTURE</td>
<td>-.098</td>
<td>-.045</td>
<td>-3.910*</td>
<td>-.020</td>
<td>-.036</td>
</tr>
<tr>
<td>11. DECIDE</td>
<td>-.076</td>
<td>-.038</td>
<td>-3.061</td>
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<td>-.032</td>
</tr>
<tr>
<td>12. NOCALC</td>
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<td>-.032</td>
<td>-2.722</td>
<td>-.041</td>
<td>-.032</td>
</tr>
<tr>
<td>13. EXPLAIN</td>
<td>-.067</td>
<td>-.027</td>
<td>-2.295</td>
<td>.001</td>
<td>-.027</td>
</tr>
<tr>
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<td>.053</td>
<td>.023</td>
<td>2.203</td>
<td>.061</td>
<td>.026</td>
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</table>

Note. B = Unstandardized Coefficients; β = Standardized Coefficients. * Indicates significance at p < .001. TOTWGT student weights applied.
Table 25

Model Summary for Hypothesis 2.2

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>R</th>
<th>R²</th>
<th>R²adj</th>
<th>Δ R²</th>
<th>Fchg</th>
<th>p</th>
<th>df₁</th>
<th>df₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hispanic</td>
<td>.267</td>
<td>.071</td>
<td>.071</td>
<td>.071</td>
<td>559.47</td>
<td>&lt; .000</td>
<td>1</td>
<td>7280</td>
</tr>
<tr>
<td>2.</td>
<td>Black</td>
<td>.414</td>
<td>.172</td>
<td>.171</td>
<td>.100</td>
<td>881.20</td>
<td>&lt; .000</td>
<td>1</td>
<td>7279</td>
</tr>
<tr>
<td>3.</td>
<td>SES 1</td>
<td>.430</td>
<td>.185</td>
<td>.184</td>
<td>.013</td>
<td>117.50</td>
<td>&lt; .000</td>
<td>1</td>
<td>7278</td>
</tr>
<tr>
<td>4.</td>
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<td>.198</td>
<td>.198</td>
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<td>&lt; .000</td>
<td>1</td>
<td>7277</td>
</tr>
<tr>
<td>5.</td>
<td>Other</td>
<td>.449</td>
<td>.202</td>
<td>.201</td>
<td>.003</td>
<td>28.35</td>
<td>&lt; .000</td>
<td>1</td>
<td>7276</td>
</tr>
</tbody>
</table>

Note. Dependent Variable: SCORES. TOTWGT student weights applied. One student background characteristic was added at each step, with the final model incorporating each of the fourteen practices shown.
Table 26

Coefficients for Final Model for Hypothesis 2.2

<table>
<thead>
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<th>$B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>Bivariate $r$</th>
<th>Partial $r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hispanic</td>
<td>-.744</td>
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<td>-28.09*</td>
<td>-.267</td>
<td>-.313</td>
</tr>
<tr>
<td>2. Black</td>
<td>-.992</td>
<td>-.326</td>
<td>-29.97*</td>
<td>-.254</td>
<td>-.331</td>
</tr>
<tr>
<td>3. SES 1</td>
<td>-.357</td>
<td>-.170</td>
<td>-14.51*</td>
<td>-.165</td>
<td>-.168</td>
</tr>
<tr>
<td>4. SES 0</td>
<td>-.297</td>
<td>-.126</td>
<td>-10.84*</td>
<td>-.073</td>
<td>-.126</td>
</tr>
<tr>
<td>5. Other</td>
<td>-.201</td>
<td>-.057</td>
<td>-5.32*</td>
<td>.037</td>
<td>-.062</td>
</tr>
</tbody>
</table>

Note. $B$ = Unstandardized Coefficients; $\beta$ = Standardized Coefficients. * denotes significance at $p < .001$. TOTWGT student weights applied.
### Table 27

**Model Summary for Hypothesis 2.3**

<table>
<thead>
<tr>
<th>Step</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$R^2_{adj}$</th>
<th>$\Delta R^2$</th>
<th>$F_{chg}$</th>
<th>$p$</th>
<th>$df_1$</th>
<th>$df_2$</th>
</tr>
</thead>
<tbody>
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<td>.071</td>
<td>.071</td>
<td>.071</td>
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<td>1</td>
<td>7280</td>
</tr>
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<td>.414</td>
<td>.172</td>
<td>.171</td>
<td>.100</td>
<td>881.20</td>
<td>&lt; .001</td>
<td>1</td>
<td>7279</td>
</tr>
<tr>
<td>3.</td>
<td>.438</td>
<td>.192</td>
<td>.191</td>
<td>.020</td>
<td>180.03</td>
<td>&lt; .001</td>
<td>1</td>
<td>7278</td>
</tr>
<tr>
<td>4.</td>
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<td>.206</td>
<td>.205</td>
<td>.014</td>
<td>129.10</td>
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<td>1</td>
<td>7277</td>
</tr>
<tr>
<td>5.</td>
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<td>.217</td>
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<td>1</td>
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</tr>
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<td>.229</td>
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</tr>
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<td>.246</td>
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<tr>
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<td>.253</td>
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<td>&lt; .001</td>
<td>1</td>
<td>7272</td>
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<td>.261</td>
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<td>7270</td>
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<td>.265</td>
<td>.264</td>
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<td>7269</td>
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<td>.270</td>
<td>.001</td>
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<td>.007</td>
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</tbody>
</table>

*Note.* Dependent Variable: SCORES. TOTWGT student weights applied. One variable was added at each step, with the final model incorporating each of the seventeen variables shown.
Table 28

Coefficients for Final Model for Hypothesis 2.3

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>Bivariate r</th>
<th>Partial r</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hispanic</td>
<td>-.656</td>
<td>-.277</td>
<td>-25.272*</td>
<td>-.267</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
<td>-.924</td>
<td>-.303</td>
<td>-28.915*</td>
<td>-.254</td>
</tr>
<tr>
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<td>.336</td>
<td>.147</td>
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<tr>
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<td>-.110</td>
<td>-10.071*</td>
<td>-.108</td>
</tr>
<tr>
<td>5</td>
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<td>-.303</td>
<td>-.144</td>
<td>-12.815*</td>
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</tr>
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<td>-.105</td>
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<td>.098</td>
<td>9.294*</td>
<td>.139</td>
</tr>
<tr>
<td>8</td>
<td>GEO</td>
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<td>-.080</td>
<td>-6.998*</td>
<td>-.080</td>
</tr>
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<td>9</td>
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<td>.224</td>
<td>.100</td>
<td>9.099*</td>
<td>.126</td>
</tr>
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<td>-.074</td>
<td>-7.148*</td>
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<td>-.049</td>
<td>-4.681*</td>
<td>.037</td>
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<tr>
<td>13</td>
<td>REVIEWHW</td>
<td>.153</td>
<td>.058</td>
<td>5.467*</td>
<td>.143</td>
</tr>
<tr>
<td>14</td>
<td>INTERPRET</td>
<td>-.101</td>
<td>-.050</td>
<td>-4.180*</td>
<td>-.020</td>
</tr>
<tr>
<td>15</td>
<td>LECTURE</td>
<td>-.072</td>
<td>-.034</td>
<td>-3.180</td>
<td>-.020</td>
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<tr>
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<td>-.032</td>
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</tr>
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<td>DECIDE</td>
<td>-.061</td>
<td>-.030</td>
<td>-2.707</td>
<td>-.047</td>
</tr>
</tbody>
</table>

*Note. B = Unstandardized Coefficients; β = Standardized Coefficients. * Indicates significance at p < .001. TOTWGT student weights applied.
Figure A–1. Conceptual Framework
Figure A - 2. Univariate Outliers for SES
Figure A – 3. Univariate Outliers for RACE
Figure A – 4. *Univariate Outliers for GENDER*
Figure A - 5. Scatterplot of Standardized Predicted Values by Standardized Residuals
* Script created using the IEA IDB Analyzer (Version 2.0.0.51).

* Created on 11/25/2012 at 12:07 PM.

* Press Ctrl+A followed by Ctrl+R to submit this analysis.

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include file = "C:\Program Files\IEA\IDBAnalyzer\data\templates\JB_Gen.ieasps".

JB_gen  infile="E:\July 13 Grouped Data\USA Student Background Original Set.sav"
   cvar=IDCNTRY /
   xvar=BS4MHLSBP BS4MHWPO BS4MHWSG BS4MHBHC BS4MHHQT BS4MHCAL BS4MHCOM /
   wgt=TOTWGT/
   nrwgt=75 /
   jkz=JKZONE/
   jkr=JKREP/
   method=JRR/
   viewcod=N/
   ndec=2/
   nomiss=Y/
   outdir="E:\November 2012\NOVEMBER21"/
   outfile="IDBoriginalsetb"..
```

Figure A – 6. *Sample IDB Analyzer Syntax*
Appendix C

TIMSS 2007 International Student Questionnaire
Student Questionnaire

<Grade 8>

<TIMSS National Research Center Name>
<Address>

International Association for the Evaluation of Educational Achievement
© Copyright IEA, 2007
General Directions

In this questionnaire, you will find questions about yourself. Some questions ask for facts while other questions ask for your opinions.

Read each question carefully and answer as accurately as possible. You may ask for help if you do not understand something or are not sure how to respond.

Each question is followed by a number of answers. Shade in the circle next to the answer of your choice as shown in Examples 1, 2, and 3.

Example 1

Do you go to school?

Yes ___________________________ ☐
No ___________________________ ☐

Example 2

How often do you do these things?

Fill in one circle for each line

Every day At least once a week Once or twice a month A few times a year Never

a) I listen to music ___________________________ 3 4 5
b) I talk with my friends ___________________________ 2 3 4 5
 c) I play sports ___________________________ 1 3 4 5
Example 3

Indicate how much you agree with each of these statements.

Fill in one circle for each line

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a) Watching movies is fun
b) I like eating ice cream

Read each question carefully, and pick the answer you think is best. Fill in the circle next to or below your answer. If you decide to change an answer to a question, put an “x” over your first choice, and then fill in the circle for your new choice. Ask for help if you do not understand something or are not sure how to answer.

Thank you for your time, effort, and thought in completing this questionnaire.
## About You

### 1. When were you born?

A. **Fill in the circle next to the year you were born**

- **Year**
  - 1989 - O
  - 1990 - O
  - 1991 - O
  - 1992 - O
  - 1993 - O
  - 1994 - O
  - 1995 - O
  - 1996 - O
  - **Other** - O

B. **Fill in the circle next to the month you were born**

- **Month**
  - January - O
  - February - O
  - March - O
  - April - O
  - May - O
  - June - O
  - July - O
  - August - O
  - September - O
  - October - O
  - November - O
  - December - O

### 2. Are you a girl or a boy?

**Fill in one circle only**

- **Girl**
  - ----------------------------------- ①

- **Boy**
  - ----------------------------------- ②
3

How often do you speak <language of test> at home?

Fill in one circle only

Always - ------------------------ ③
Almost always - ------------------ ②
Sometimes - ----------------------- ①
Never - -------------------------- ③

4

About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)

Fill in one circle only

None or very few
(0-10 books) - ---------------------- ①

 Enough to fill one shelf
(11-25 books) - ---------------------- ②

 Enough to fill one bookcase
(26-100 books) - --------------------- ③

 Enough to fill two bookcases
(101-200 books) - ------------------- ③

 Enough to fill three or more bookcases
(more than 200 books) - ------------ ③
About You (Continued)

Do you have any of these things at your home?

Fill in one circle for each line

Yes No

a) Calculator -  

b) Computer (do not include PlayStation®, GameCube®, XBox®, or other TV/video game computers) -  

c) Study desk/table for your use  

d) Dictionary  

e) Internet connection  

f) <country-specific>  

g) <country-specific>  

h) <country-specific>  

i) <country-specific>  

<Grade 8> Student Questionnaire
A. What is the highest level of education completed by your mother (or stepmother or female guardian)?

Fill in one circle only

Some <ISCED Level 1 or 2> or did not go to school ①
<ISCED 2> ②
<ISCED 3> ③
<ISCED 4> ④
<ISCED 5B> ⑤
<ISCED 5A, first degree> ⑥
Beyond <ISCED 5A, first degree> ⑦
I don't know ⑧

B. What is the highest level of education completed by your father (or stepfather or male guardian)?

Fill in one circle only

Some <ISCED Level 1 or 2> or did not go to school ①
<ISCED 2> ②
<ISCED 3> ③
<ISCED 4> ④
<ISCED 5B> ⑤
<ISCED 5A, first degree> ⑥
Beyond <ISCED 5A, first degree> ⑦
I don't know ⑧
About You (Continued)

7

How far in school do you expect to go?

Fill in one circle only

Finish <ISCED 3>  
Finish <ISCED 4>  
Finish <ISCED 5B>  
Finish <ISCED 5A, first degree>  
Beyond <ISCED 5A, first degree>  
I don't know  

① ② ③ ④ ⑤ ⑥
## Mathematics in School

How much do you agree with these statements about learning mathematics?

*Fill in one circle for each line*

<table>
<thead>
<tr>
<th></th>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>c</td>
<td>Mathematics is more difficult for me than for many of my classmates</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d</td>
<td>I enjoy learning mathematics</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>e</td>
<td>Mathematics is not one of my strengths</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>f</td>
<td>I learn things quickly in mathematics</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>g</td>
<td>Mathematics is boring</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>h</td>
<td>I like mathematics</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Mathematics in School (Continued)

How much do you agree with these statements about mathematics?

*Fill in one circle for each line*

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
</table>

a) I think learning mathematics will help me in my daily life
   [ ] [ ] [ ] [ ]

b) I need mathematics to learn other school subjects
   [ ] [ ] [ ] [ ]

c) I need to do well in mathematics to get into the university of my choice
   [ ] [ ] [ ] [ ]

d) I need to do well in mathematics to get the job I want
   [ ] [ ] [ ] [ ]
### How often do you do these things in your mathematics lessons?

*Fill in one circle for each line*

<table>
<thead>
<tr>
<th></th>
<th>Every or almost every lesson</th>
<th>About half the lessons</th>
<th>Some lessons</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) We practice adding, subtracting, multiplying, and dividing without using a calculator</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b) We work on fractions and decimals</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c) We solve problems about geometric shapes, lines and angles</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d) We interpret data in tables, charts, or graphs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e) We write equations and functions to represent relationships</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f) We memorize formulas and procedures</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g) We explain our answers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h) We relate what we are learning in mathematics to our daily lives</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i) We decide on our own procedures for solving complex problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j) We review our homework</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k) We listen to the teacher give a lecture-style presentation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l) We work problems on our own</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>m) We work together in small groups</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>n) We begin our homework in class</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>o) We have a quiz or test</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>p) We use calculators</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>q) We use computers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Science in School

How much do you agree with these statements about learning science?

Fill in one circle for each line

Agree a lot Agree a little Disagree a little Disagree a lot

a) I usually do well in science
b) I would like to take more science in school
c) Science is more difficult for me than for many of my classmates
d) I enjoy learning science
e) Science is not one of my strengths
f) I learn things quickly in science
g) Science is boring
h) I like science
12

How much do you agree with these statements about science?

**Fill in one circle for each line**

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a) I think learning science will help me in my daily life  
   1  2  3  4  5

b) I need science to learn other school subjects  
   1  2  3  4  5

c) I need to do well in science to get into the <university> of my choice  
   1  2  3  4  5

d) I need to do well in science to get the job I want  
   1  2  3  4  5
### Science in School (Continued)

**How often do you do these things in your science lessons?**

*Fill in one circle for each line*

<table>
<thead>
<tr>
<th></th>
<th>Every or almost every lesson</th>
<th>About half the lessons</th>
<th>Some lessons</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) We make observations and describe what we see</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b) We watch the teacher demonstrate an experiment or investigation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c) We design or plan an experiment or investigation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d) We conduct an experiment or investigation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e) We work in small groups on an experiment or investigation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f) We read our science textbooks and other resource materials</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g) We memorize science facts and principles</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h) We use scientific formulas and laws to solve problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i) We give explanations about what we are studying</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j) We relate what we are learning in science to our daily lives</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k) We review our homework</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l) We listen to the teacher give a lecture-style presentation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>m) We work problems on our own</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>n) We begin our homework in class</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>o) We have a quiz or test</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>p) We use computers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Computers

14

A. Do you ever use a computer? (Do not include PlayStation®, GameCube®, XBox®, or other TV/video game computers.)

   Yes  No

Fill in one circle only ------------- ① --- ②

If No, please go to question 15

B. Where do you use a computer?

   Fill in one circle for each line

   Yes  No

   a) At home --------------- ① --- ②
   b) At school-------------- ① --- ②
   c) Elsewhere (e.g., public library, friend's home, Internet café)-------- ① --- ②

C. How often do you use a computer for your schoolwork (in and out of school)?

   Fill in one circle for each line

   Every day  At least once a week  Once or twice a month  A few times a year  Never

   a) In mathematics --------------- ① --- ② --- ③ --- ④ --- ⑤
   b) In science --------------------- ① --- ② --- ③ --- ④ --- ⑤
Your School

15

How much do you agree with these statements about your school?

Fill in one circle for each line

Agree a lot           Agree a little           Disagree a little           Disagree a lot

a) I like being in school
b) I think that students in my school try to do their best
c) I think that teachers in my school want students to do their best

16

In school, did any of these things happen during the last month?

Fill in one circle for each line

Yes           No

a) Something of mine was stolen
b) I was hit or hurt by other student(s) (e.g., showing, hitting, kicking)
c) I was made to do things I didn't want to do by other students
d) I was made fun of or called names
e) I was left out of activities by other students
## Things You Do Outside of School

On a normal school day, how much time do you spend before or after school doing each of these things?

*Fill in one circle for each line*

<table>
<thead>
<tr>
<th>Activity</th>
<th>No Time</th>
<th>Less than 1 hour</th>
<th>1-2 hours</th>
<th>More than 2 but less than 4 hours</th>
<th>4 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I watch television and videos</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) I play computer games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) I play or talk with friends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) I do jobs at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) I work at a paid job</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) I play sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) I read a book for enjoyment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h) I use the Internet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) I do homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Homework**

18

A. How often does your teacher give you homework in mathematics?

*Fill in one circle only*

- Every day - ------------------------- ③
- 3 or 4 times a week - -------------- ②
- 1 or 2 times a week- --------------- ③
- Less than once a week --------------- ③
- Never ----------------------------- ③

*If Never, please go to question 19*

B. When your teacher gives you mathematics homework, about how many minutes do you usually spend on your homework?

*Fill in one circle only*

- Zero minutes ---------------------- ③
- 1 - 15 minutes ---------------------- ③
- 16 - 30 minutes --------------------- ③
- 31 - 60 minutes --------------------- ③
- 61 - 90 minutes --------------------- ③
- More than 90 minutes ---------------- ③
19

A. How often does your teacher give you homework in science?

*Fill in one circle only*

Every day - ------------------------ ③
3 or 4 times a week - -------------- ③
1 or 2 times a week - -------------- ③
Less than once a week - ------------ ④
Never - --------------------------- ⑤

If Never, please go to question 20

B. When your teacher gives you science homework, about how many minutes do you usually spend on your homework?

*Fill in one circle only*

Zero minutes - --------------------- ①
1 - 15 minutes - ------------------- ③
16 - 30 minutes - ------------------ ③
31 - 60 minutes - ------------------ ③
61 - 90 minutes - ------------------ ③
More than 90 minutes - ------------- ⑥
More About You

20

A. Was your mother (or stepmother or female guardian) born in <country>?

Yes  No

Fill in one circle only  ①  ----  ②

B. Was your father (or stepfather or male guardian) born in <country>?

Yes  No

Fill in one circle only  ①  ----  ②

21

A. Were you born in <country>?

Yes  No

Fill in one circle only  ①  ----  ②

If Yes, you have completed the questionnaire

B. If you were not born in <country>, how old were you when you came to <country>?

Fill in one circle only

Older than 10 years old  ③
5 to 10 years old  ②
Younger than 5 years old  ③
Thank You
for completing
this questionnaire
Student Questionnaire

<Grade 8>
Appendix D

TIMSS 2007 U.S. Student Questionnaire
STOP

PLEASE DO NOT TURN THE PAGE UNTIL INSTRUCTED TO DO SO.

Trends in International Mathematics and Science Study

TIMSS 2007

Student Questionnaire

Grade 8

National Center for Education Statistics
Institute of Education Sciences
U.S. Department of Education
1900 K St., N.W.
Washington, D.C. 20006-5650
General Directions

In this questionnaire, you will find questions about yourself. Some questions ask for facts while other questions ask for your opinions.

Read each question carefully and answer as accurately as possible. You may ask for help if you do not understand something or are not sure how to respond.

Each question is followed by a number of answers. Fill in the oval next to the answer of your choice as shown in Examples 1, 2, and 3.

Example 1

Do you go to school?

Fill in one oval only

Yes ○
No ○

Example 2

How often do you do these things?

Fill in one oval for each line

Every day ○
At least once a week ○
Once or twice a month ○
A few times a year ○
Never ○

a) I listen to music ○
b) I talk with my friends ○
c) I play sports ○
Example 3

How much do you agree with each of these statements?

_a) Watching movies is fun_ 

_b) I like eating ice cream_

*Fill in one oval for each line*

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Read each question carefully, and pick the answer you think is best. Fill in the oval next to or below your answer. If you decide to change an answer to a question, completely erase your first choice, and then fill in the oval for your new choice. Ask for help if you do not understand something or are not sure how to answer.

Thank you for your time, effort, and thought in completing this questionnaire.
### About You

**When were you born?**

**A. Fill in the oval next to the year you were born**

<table>
<thead>
<tr>
<th>Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

**B. Fill in the oval next to the month you were born**

<table>
<thead>
<tr>
<th>Month</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td></td>
</tr>
<tr>
<td>April</td>
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<tr>
<td>May</td>
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<tr>
<td>June</td>
<td></td>
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<td>July</td>
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<td>August</td>
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<td>September</td>
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<td>October</td>
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</tr>
<tr>
<td>November</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td></td>
</tr>
</tbody>
</table>

Grade 8 Student Questionnaire
2

A. Are you a girl or a boy?

Fill in one oval only

Girl

Boy

B. Are you Hispanic or Latino?

Fill in one oval only

Yes, I am Hispanic or Latino.

No, I am not Hispanic or Latino.

C. Which of the following best describes you?

Fill in one or more ovals

White

Black or African American

Asian

American Indian or Alaska Native

Native Hawaiian or other Pacific Islander
About You (Continued)

3
A. How often do you speak English at home?

Fill in one oval only

Always ........................... ○
Almost always ................... ○
Sometimes ......................... ○
Never .............................. ○

If Always, please go to question 4

If Almost always, Sometimes, Never, please go to question 3B

B. What language do you speak at home (other than English)?

Fill in one oval only

Spanish ............................. ○
Other ................................. ○
(Please specify) ________________

4

About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)

Fill in one oval only

None or very few
(0-10 books) ................................ ○

Enough to fill one shelf
(11-25 books) ............................ ○

Enough to fill one bookcase
(26-100 books) ............................. ○

Enough to fill two bookcases
(101-200 books) ............................ ○

Enough to fill three or more bookcases
(more than 200 books) ..................... ○
Do you have any of these things at your home?

Fill in one oval for each line.

a) Calculator  

b) Computer (do not include PlayStation®, GameCube®, XBox®, or other TV/video game systems)

c) Study desk/table for your use

d) Dictionary

e) Internet connection

f) Encyclopedia (as a book or CD)

g) PlayStation®, GameCube®, XBox®, or other TV/video game systems

h) VCR or DVD player

i) Three or more cars, small trucks, or sport utility vehicles
A. What is the highest level of education completed by your mother (or stepmother or female guardian)?

Some elementary or junior high/middle school or did not go to school
Completed junior high/middle school
Some high school
Completed high school
Completed a vocational/technical certificate after high school
Completed an Associate's degree (AA) in a vocational/technical program
Completed a 2-year or 4-year college or university degree (i.e., Associate's or Bachelor's degree)
Completed a Master's degree, teaching certificate program, or professional degree (e.g., law, medicine, dentistry) or higher
I don't know

B. What is the highest level of education completed by your father (or stepfather or male guardian)?

Some elementary or junior high/middle school or did not go to school
Completed junior high/middle school
Some high school
Completed high school
Completed a vocational/technical certificate after high school
Completed an Associate's degree (AA) in a vocational/technical program
Completed a 2-year or 4-year college or university degree (i.e., Associate's or Bachelor's degree)
Completed a Master's degree, teaching certificate program, or professional degree (e.g., law, medicine, dentistry) or higher
I don't know
7

How far in school do you expect to go?

Finish high school .......................... ☐
Finish vocational/technical education
after high school ............................ ☐
Finish community or junior college ......... ☐
Complete a bachelor’s degree at a
college or university ........................ ☐
Beyond a bachelor’s degree .................. ☐
I don’t know ................................. ☐

8

Have you ever repeated a grade?

Fill in only one oval for each line

No  Yes

a) In elementary school ........................ ☐  ☐
b) In middle or junior high school ........... ☐  ☐
How much do you agree with these statements about learning mathematics?

Fill in one oval for each line

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I usually do well in mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) I would like to take more mathematics in school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Mathematics is more difficult for me than for many of my classmates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) I enjoy learning mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Mathematics is not one of my strengths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) I learn things quickly in mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) Mathematics is boring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h) I like mathematics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How much do you agree with these statements about mathematics?

Fill in one oval for each line

<table>
<thead>
<tr>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) I think learning mathematics will help me in my daily life</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) I need mathematics to learn other school subjects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) I need to do well in mathematics to get into the university or college of my choice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) I need to do well in mathematics to get the job I want</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mathematics in School (Continued)

How often do you do these things in your mathematics lessons?

**Fill in one oval for each line**

Every or almost every lesson | About half the lessons | Some lessons | Never

a) We practice adding, subtracting, multiplying, and dividing without using a calculator

b) We work on fractions and decimals

c) We solve problems about geometric shapes, lines and angles

d) We interpret data in tables, charts, or graphs

e) We write equations and functions to represent relationships

f) We memorize formulas and procedures

g) We explain our answers

h) We relate what we are learning in mathematics to our daily lives

i) We decide on our own procedures for solving complex problems

j) We review our homework

k) We listen to the teacher give a lecture-style presentation

l) We work problems on our own

m) We work together in small groups

n) We begin our homework in class

o) We have a quiz or test

p) We use calculators

q) We use computers
### Science in School

How much do you agree with these statements about learning science?

<table>
<thead>
<tr>
<th></th>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I usually do well in science</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>b) I would like to take more science in school</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>c) Science is more difficult for me than for many of my classmates</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>d) I enjoy learning science</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>e) Science is not one of my strengths</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>f) I learn things quickly in science</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>g) Science is boring</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
<tr>
<td>h) I like science</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
<td>✤</td>
</tr>
</tbody>
</table>
Science in School (Continued)

How much do you agree with these statements about science?

Fill in one oval for each line

<table>
<thead>
<tr>
<th></th>
<th>Agree a lot</th>
<th>Agree a little</th>
<th>Disagree a little</th>
<th>Disagree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### How often do you do these things in your science lessons?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Every or almost every lesson</th>
<th>About half the lessons</th>
<th>Some lessons</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) We make observations and describe what we see</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b) We watch the teacher demonstrate an experiment or investigation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c) We design or plan an experiment or investigation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d) We conduct an experiment or investigation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e) We work in small groups on an experiment or investigation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>f) We read our science textbooks and other resource materials</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>g) We memorize science facts and principles</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>h) We use scientific formulas and laws to solve problems</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>i) We give explanations about what we are studying</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>j) We relate what we are learning in science to our daily lives</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>k) We review our homework</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>l) We listen to the teacher give a lecture-style presentation</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>m) We work problems on our own</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>n) We begin our homework in class</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>o) We have a quiz or test</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>p) We use computers</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Computers

15

A. Do you ever use a computer? (Do not include PlayStation\textsuperscript{a}, GameCube\textsuperscript{a}, XBox\textsuperscript{a}, or other TV/video game systems.)

Yes  No

Fill in one oval only

If No, please go to question 16

B. Where do you use a computer?

Fill in one oval for each line

Yes  No

a) At home
b) At school

c) Elsewhere (e.g., public library, friend's home, Internet cafe)

C. How often do you use a computer for your schoolwork (in and out of school)?

Fill in one oval for each line

Every day  At least once a week  Once or twice a month  A few times a year  Never

a) In mathematics
b) In science
Your School

16

How much do you agree with these statements about your school?

Fill in one oval for each line

- Agree a lot
- Agree a little
- Disagree a little
- Disagree a lot

a) I like being in school

b) I think that most students in my school try to do their best

c) I think that most teachers in my school want students to do their best
Things You Do Outside of School

On a normal school day, how much time do you spend before or after school doing each of these things?

Fill in one oval for each line

<table>
<thead>
<tr>
<th></th>
<th>No time</th>
<th>Less than 1 hour</th>
<th>1-2 hours</th>
<th>More than 2 but less than 4 hours</th>
<th>4 or more hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) I watch television and videos</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>b) I play computer games</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>c) I play or talk with friends</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>d) I do jobs or chores at home</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>e) I work at a paid job</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>f) I play sports</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>g) I read a book for enjoyment</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>h) I use the Internet</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>i) I do homework</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>
Homework

18

A. How often does your teacher give you homework in mathematics?

Fill in one oval only

Every day -
3 or 4 times a week -
1 or 2 times a week -
Less than once a week -
Never -

If Never, please go to question 19

B. When your teacher gives you mathematics homework, about how long does it take you to complete this homework?

Fill in one oval only

Zero minutes -
1 - 15 minutes -
16 - 30 minutes -
31 - 60 minutes -
61 - 90 minutes -
More than 90 minutes -
Homework (Continued)

19

A. How often does your teacher give you homework in science?

*Fill in one oval only*

Every day
3 or 4 times a week
1 or 2 times a week
Less than once a week
Never

*If Never, please go to question 20*

B. When your teacher gives you science homework, about how long does it take you to complete this homework?

*Fill in one oval only*

Zero minutes
1 - 15 minutes
16 - 30 minutes
31 - 60 minutes
61 - 90 minutes
More than 90 minutes
More About You

20

A. Was your mother (or stepmother or female guardian) born in the United States*?

Yes No

Fill in one oval only ————  ————

B. Was your father (or stepfather or male guardian) born in the United States*?

Yes No

Fill in one oval only ————  ————

21

A. Were you born in the United States*?

Yes No

Fill in one oval only ————  ————

If Yes, you have completed the questionnaire

B. If you were not born in the United States*, how old were you when you came to the United States*?

Fill in one oval only

Older than 10 years old ————
5 to 10 years old ————
Younger than 5 years old ————

* "United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad.
Thank You
for completing
this questionnaire