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AN ANALYSIS OF THE RELATIONSHIPS BETWEEN HOMEWORK FREQUENCY
AND HOMEWORK GRADING PRACTICES OF ALGEBRA 1 TEACHERS ON STUDENT
OUTCOMES AS MEASURED ON THE ALGEBRA 1 END-OF-COURSE EXAMINATION

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Education
in the Department of Educational Leadership and Higher Education
in the College of Community Innovation and Education
at the University of Central Florida
Orlando, Florida

Summer Term
2019

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ABSTRACT

The purpose of this study was to analyze the relationship, if any, between homework practices of Algebra 1 teachers and student outcomes as measured by the state of Florida's Algebra 1 End of Course assessment (EOC). Algebra 1 EOC scores were collected from the study district's central office. Data on teacher homework practices was collected through a researcher-created survey. Cross-tabulation tables were used to identify variations in homework assignment, homework frequency, homework type, and homework grading practice associated with school (middle or high) and teacher (educational attainment and experience teaching Algebra 1) characteristics. A two-way ANOVA was used to analyze the relationship between homework frequency and student achievement and to investigate the influence of teacher characteristics as moderators. The main effect of homework frequency as well as the interaction effects of the teacher's educational attainment and the teacher's educational experience were statistically significant. Results showed that students who were given more homework did better on the Algebra 1 EOC than their peers who received less homework. A second two-way ANOVA was used to analyze the relationship between the way homework is graded and student achievement and to investigate the influence of teacher characteristics as moderators. The main effect of homework grading practice as well as the interaction effect of the teacher's educational experience was statistically significant. Results showed that students had the highest Algebra 1 EOC score when their homework was graded for accuracy. While making decisions on how homework should be graded in an Algebra 1 classroom, teachers and administrators will be informed through these findings as to what type of grading practice has the potential to positively impact student achievement.

ACKNOWLEDGMENTS

I would like to thank my wife, kids and mother-in-law for supporting me through this journey. Without their help and support the time required for this journey would not have been possible.

I would like to thank my committee chair Dr. Jerry Johnson for his guidance and support through this process. The time he spent going through and strengthening my research is greatly appreciated. My committee members: Dr. Juli Dixon, Dr. Walter Doherty, and Dr. Michelle Pisani; thank you for your helpful comments and support during my research project.

I would like to thank my amazing cohort-seven members. We spent many hours these past three years together. Thank you all for the memories and insight you have given me during this process.

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CHAPTER 1 INTRODUCTION

Background of the Study

Algebra 1 is a course taken by students in the sixth through ninth grades. Historically, Algebra 1 has “been offered to ninth graders but was frequently taken by eighth graders” (Snipes & Finklestein, 2015, p. 2). Students in Algebra 1 are presented with mathematical problems involving variables, multiple steps, working with polynomials, and working with functions (CPALMS, 2018). Commonly in educational coursework, students practice algebraic concepts to show mastery and competency of skills they are working on. Practicing for improvement has been used for centuries and is applicable to many disciplines. With regards to education, practice is used intentionally by students and teachers. Nuthall (2002) reported that multiple exposures to content are necessary for the content to be learned. According to the National Center for Education Statistics (2007-2008), the average student spends 6.7 hours a day in school; in the state of Florida the average student spends 6.43 hours a day in school. To help extend the time students have to practice material, teachers often assign homework.

Homework is a common instructional practice across all levels of education as well as a variety of academic disciplines, including Algebra 1. Homework is given for several different purposes. Cooper (1989b), in a synthesis of research on homework, defined homework as “tasks assigned to students by school teachers that are meant to be carried out during non-school hours” (p. 85). Homework allows students to practice material and content at a location other than their school. One of the aims of homework is for students to gain additional practice time in a given subject area. Teachers often assign homework with the expectation that the student will complete the problems with fidelity to the intent that it was assigned. Though well intentioned,

teachers also often assign homework, without concern for its effect, based on custom or the expectation that students are supposed to do homework. (Hinchey, 1996, p. 244)

Hattie (2009), in discussing learning, gave homework an average effect size of $d = 0.29$ (p.8). This would be considered of low practical importance, according to Frankel, Wallen, & Hyun (2015). However, the effectiveness of homework is dependent on the schooling level of the student: $d = .15$ for elementary students and $d = 0.64$ for high school students (Hattie, 2009, p. 235). The intent of homework is often to provide feedback to either the instructor or the student. According to Sadler (1989), feedback is intended to provide information related to the task. The way that homework is graded or not graded would direct the feedback to either the student, the instructor, or both. Homework grading practices among teachers of Algebra 1 vary. Some of the variation is based on factors such as teachers' educational experience and professional attainment. This study was conducted to investigate the relationship between homework grading practices of teachers of Algebra 1 and student outcomes as measured by the Algebra 1 end-of-course examination. It was also intended to (a) add to the body of knowledge in which teacher homework grading practice shows a relationship to student performance on end-of-course examinations, specifically in Algebra 1 courses and (b) provide additional information on the effectiveness of homework grading practices for teachers of Algebra 1.

Problem Statement

Algebra 1 is a mathematics course taught in the state of Florida in the sixth through ninth grades. According to the Florida's guide to public high school graduation (Florida Department of Education [FDOE], 2018), the state of Florida requires students to pass the Algebra 1 end-of-course examination in order to earn a high school diploma. Students in Grades 6-8 taking Algebra 1 generally have taken more advanced mathematics classes or have been accelerated in

their mathematics coursework more often than their ninth-grade Algebra 1 counterparts. In a large suburban school district in central Florida, there has historically been a disparity between first-time Algebra 1 students' scores on their end-of-course examinations. Students taking Algebra 1 in a middle school setting, Grades 6-8, have historically scored higher on the Algebra 1 end-of-course assessment than Algebra 1 students in a high school setting (Florida Standards Assessment, 2018). The literature reviewed did not adequately support conclusions on whether or how the method the teacher grades homework impacts or correlates with student outcomes. To contribute to filling the gap in the literature on homework grading practices, this investigation was conducted to describe the relationship between (a) the way that teachers grade Algebra 1 homework, and (b) those teachers' student outcomes as measured by the Algebra 1 end-of-course examination.

Purpose Statement

This study was conducted to investigate the relationship between teachers' homework grading practices and student achievement as measured on the Algebra 1 end-of-course (EOC) examination. The intention of homework is to either reinforce concepts and skills taught in some type of educational setting or to extend the learning outside the classroom so that students might more fully understand a concept or skill. To date, there have been numerous studies on the effect size of homework and its ability to help students learn (Cooper 1989b, 2011; Cooper & Valentine, 2001). Homework is distinct from practice completed in the classroom setting in that homework is practice beyond the limits of the institution and its faculty. The grading practices employed by teachers vary based on factors including preference, time available, research used, and convenience.

Research Questions

In this study, the research questions were intended to generate information on the homework assignment and grading practices of teachers of Algebra 1 and to disclose any relationships that existed between homework practices and student performance. The research questions that guided this study are as follows:

1. In what ways and to what extent do homework practices vary by school and teacher characteristics?
 - a. In what ways and to what extent do teacher practices vary with regard to the assignment of homework in Algebra 1?
 - b. In what ways and to what extent do teacher practices vary with regard to the frequency of assigning homework for Algebra 1?
 - c. In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?
 - d. In what ways and to what extent do teacher practices vary regarding the grading of Algebra 1 homework?
2. In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?
3. In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

Research Question 1 sought to identify and characterize the variations in homework by teacher characteristics including: homework assignment, homework frequency, homework composition type, and how homework is graded. Results were compared across middle schools

(i.e., Grades 6-8) and high schools (i.e., Grades 9-12) to determine whether practices differed by school level. This descriptive information supported the study district in understanding teacher practices in this specific area and added to the body of knowledge on homework grading practices.

Research Question 2 supported the school district being studied in understanding the relationships between teacher decisions about homework frequency and performance on state-mandated assessments, and added to the body of knowledge on homework practices of Algebra 1 teachers and their relationship to student achievement. The use of a two-way ANOVA allowed for the investigation of both main effects (i.e., variation in average Algebra 1 EOC scores across categories of the frequency with which homework is assigned) and interaction effects (i.e., whether the relationship between homework frequency and EOC scores was moderated by years of teaching experience, and the level of educational attainment).

Research Question 3 generated information that directly supported the school district being studied in understanding the relationships between teacher decisions about homework grading practices and performance on state-mandated assessments, adding to the body of knowledge on homework practices of Algebra 1 teachers and their relationship to student achievement. The use of a two-way ANOVA allowed the researcher to investigate both main effects (i.e., variation in average Algebra 1 EOC scores across categories how homework is graded) and interaction effects (i.e., whether the relationship between how homework is graded and EOC scores was moderated by the years of teaching experience, and teachers' level of educational attainment)

Operational Definitions

The following terms and definitions are presented to clarify their meaning in the present study:

Homework. Homework is defined as practice completed outside the construct of a school, typically at home (Cooper, 1989b).

Completion. Completion refers to the homework grading practice of an instructor looking at a student's homework to see that the problems have an answer. "Studies conducted in several countries (e.g., Germany, Hong Kong, Singapore) reported homework control (i.e., checking whether students have completed their homework) as the homework follow-up practice teachers use in class most often in elementary and middle school levels" (Rosario et al., 2015, p. 2).

Accuracy. Accuracy refers to "a measure of how little an approximation deviates from the true value" (Mathematics Dictionary, n.d., para.18). When teachers are grading homework for accuracy they are looking for the true value of the problem assigned on the student's work.

Student performance. Student performance was measured by the Florida Department of Education's (FDOE) Algebra 1 end-of-course examination.

Algebra 1 end-of-course examination. According to the FDOE, the Algebra 1 end-of-course examination (EOC) is a, "computer-based, criterion-references assessment that measures the Florida Standards. . ." (End-of-course (EOC) Assessments, n.d.).

Educational attainment Educational attainment refers to the type and level of professional degree held by an instructor. Sparks (2004) stated that, teachers who teach in a content area in which they are certified are, generally, more effective than those who are not certified in the content area in which they are teaching.

Educational experience. Educational experience refers to the time that an instructor has been teaching a particular subject. Harris and Sass (2011) reported that studies on teacher experience which “include middle school consistently find positive effects of teacher experience on math achievement. . .” (p. 799).

Conceptual Framework & Literature Review

Practice, specifically spaced practice, and feedback are the theories that framed the inquiry in this study. Practice is a skill that students and teachers use to learn and reinforce skills and concepts. The concept of practicing for learning is vital for student’s eventual mastery and fluency of content. Practice is important regardless of content area and student grade; and practice as an instructional strategy is intended to be thoughtful and deliberate. Campitelli & Gobet (2011) stated that deliberate practice (DP) “occurs when an individual intentionally repeats an activity in order to improve performance” (p. 282). Generally the more individuals engage in practice, the more competent they become in what they are practicing. Homework can be classified as a type of practice in which students regularly take part (Foyle & Bailey, 1986). Homework is generally assigned for students to complete outside of the school (Cooper, 1989b).

There are two generally accepted types of practice in educational settings: massed and distributed practice. “When the spacing gap between two or more presentations of the same item is zero, the presentations are said to be massed together.” (Carpenter, Cepeda, Rohrer, Kang, & Pashler, 2012, p. 370). Donovan & Radosevich (1999) stated in their review of the practice effect, that “Massed practice conditions are those in which individuals practice a task continuously without rest. . .” (p. 795). Massed practice is generally the default practice strategy employed by students and teachers. Cramming for an examination the night before the test is an example of massed practice.

Teachers facilitate learning through various kinds of practice. The concept of practicing for learning is vital for students' eventual mastery and fluency of content. Practice as an instructional strategy, is intended to be thoughtful and deliberate. Teachers often assign homework so that students can practice skills and content learned in the school setting.

“When the gap between presentations is greater than zero, then the presentations are said to be spaced or distributed because they are separated by a nonzero time interval.” (Carpenter et al., 2012, p. 370). Distributed practice involves the spacing of short study or practice sessions over a defined period of time. The spacing effect of distributed practice is “one of the oldest and most reliable findings in research on human learning” (Carpenter, et al., 2012, p. 370). Homework would fall into the distributed practice category because the spacing is separated over a defined period of time, a school year, semester, unit, etc. An example of distributed practice would be if a group of students were studying various formulae and their application to specific problems (Rohrer, 2009). The conceptual framework articulates a relationship between homework, grading practices, the frequency of assignment, and student outcomes; measured in this study by student scores on the Florida Department of Education's Algebra 1 end-of-course assessment. The investigation was conducted to explore the dynamics within that relationship through the use of a two-way ANOVA.

The literature review for this study has been organized into three sections: (a) an overview of homework, (b) Algebra 1, and (c) homework grading practices. The following paragraphs present a representative review of content aligned with the literature review.

Homework attitudes have been in flux for several decades and, in the case of the United States, often coincide with significant cultural happenings during that time period. “Early in the twentieth century, educational theories suggested that homework could be an important means

for disciplining children's minds" (Cooper & Valentine, 2001, p. 145). During World War II homework was not seen as important in the education of students. This attitude continued until the 1950s with the Soviet Union's launch of Sputnik (Cooper, 1989). After Sputnik, "educators became concerned that a lack of rigor in the educational system was leaving children unprepared to face a complex technological future and to compete against our ideological adversaries" (Cooper & Valentine, 2001, p. 145). During the 1960s, once again, homework was not seen as important. With the Vietnam War going on and the civil rights movement, great social change was happening, and homework was shifted to a secondary task in education. The swing back to homework as being a method of educational improvement happened again in the 1980s with the publication of *A Nation at Risk* by Ronald Reagan's National Commission on Excellence in Education (Cooper, 1989b). According to Cooper and Valentine, "In the wake of declining achievement-test scores and increased concern about America's ability to compete in a global marketplace, homework underwent its third renaissance in the past 50 years" (p. 146).

Cooper (1989b, 2011) and Cooper and Valentine (2001) have studied homework and its effectiveness in meeting educational outcomes for several decades. Cooper (1989b) synthesized research on homework, setting out to catalog the various studies conducted on homework and their implications for student learning. Homework, how it is assigned, how much is assigned, how it is graded, and how it is used (if at all) to influence instruction are important questions in regard to K-12 instructional practices. Hattie (2009) stated that homework "is a hotly contested area, and my experience is that many parents judge the effectiveness of schools by the presence or amount of homework. . ." (p. 234). Hattie analyzed several research studies to find out the effect size that homework had on student achievement. He found that homework was more correlated for students in high school than in an elementary setting (p. 234). In his book, *Visible*

Learning, he did not mention specific grading practices, only the use of the instructional practice of assigning homework.

Cooper (1994), in his review of the literature on homework policy, classified six factors that influence the effect of homework: (a) exogenous factors; (b) assignment characteristics; (c) initial classroom factors; (d) home-community factors; (e) classroom follow-up; and outcomes or effects. Exogenous factors include student characteristics, subject matter, and grade level. Homework's effectiveness as an instructional tool is variable depending on the complexity of the assignment as well as students' grade levels. The physical factors of the environment in which students complete their homework also has an impact on the homework's effectiveness. The classroom is a structured and generally controlled environment for the purpose of knowledge acquisition and retention. The home environment, or an environment outside the school setting where homework is being completed, could interfere with students' concentration and impact the effectiveness of homework.

The characteristics of the assignment also have an impact on the effectiveness of homework. The amount of thought, time, and questions or problem complexity can have an impact on the effectiveness of the homework as well. "Homework involving higher level conceptual thinking and project based was the least effective" (Hattie, 2009, p. 235).

Homework's effectiveness as an instructional tool can be affected by the material with which it is trying to have students practice, whether procedural or conceptual in nature.

Homework is generally completed once or multiple times per week depending on the academic discipline and the instructor of the class. Homework is often created with the hope that it can, "provide practice, prepare for upcoming lessons, extend students' thinking about a

subject, and draw on students' creative work in making connections among mathematical concepts and other subjects" (Gilliand, 2002, p. 36).

Algebra is an underlying mathematical discipline for other more advanced mathematical disciplines. Without an understanding of Algebraic principles students are ill-equipped to deal with and work with higher level mathematics. (Wilder, 2013). In addition to being a gatekeeper for higher level mathematics, Algebra is also an economic gatekeeper for students. (Moses, 1993). Learning and being able to apply Algebraic concepts allows an individual to gain employment in STEM fields (DARPA, 2010).

Yalcin and Kaw (2011) explored the effect of homework grading practices of college professors on the learning of engineering students. They considered the way homework was assigned for grading and its impact on semester examinations. Research at the college level on homework grading practices and their impact on student performance was extensive (Henderson, Heller, Heller, Kuo, and Yerushalmi, 2002; Palazzo, Lee, Warnakulasooriya, & Pritchard, 2010; Trussel & Dietz, 2003; Wankat, 2001). Although Yalcin and Kaw contributed to the body of knowledge on homework grading practices, the population being studied was not the population of focus for this research. The literature has substantial gaps on the effect of teacher homework grading practices, specifically on students in mathematics courses in K-12 settings.

Methodology

Research Design

This study used a causal-comparative design (Steinberg, 2011). Descriptive statistics, cross-tabulation tables, and a two-way ANOVA were used to investigate homework practices among Algebra 1 teachers and explore their potential influence on Algebra 1 student achievement. The two-way ANOVA model considered two moderator variables: (a) number of

years of teaching Algebra 1 or educational experience, and (b) the degree(s) held by the instructor or educational attainment. Two separate two-way ANOVA models were used to measure the direct effect between homework practices (frequency of homework for one model and homework grading practices for the other) and student achievement in Algebra 1 while accounting for the influence of teaching experience, and educational attainment among teachers, allowing for identifying and describing interaction effects.

Figure 1 represents the fundamental research model for Research Questions 2 and 3.

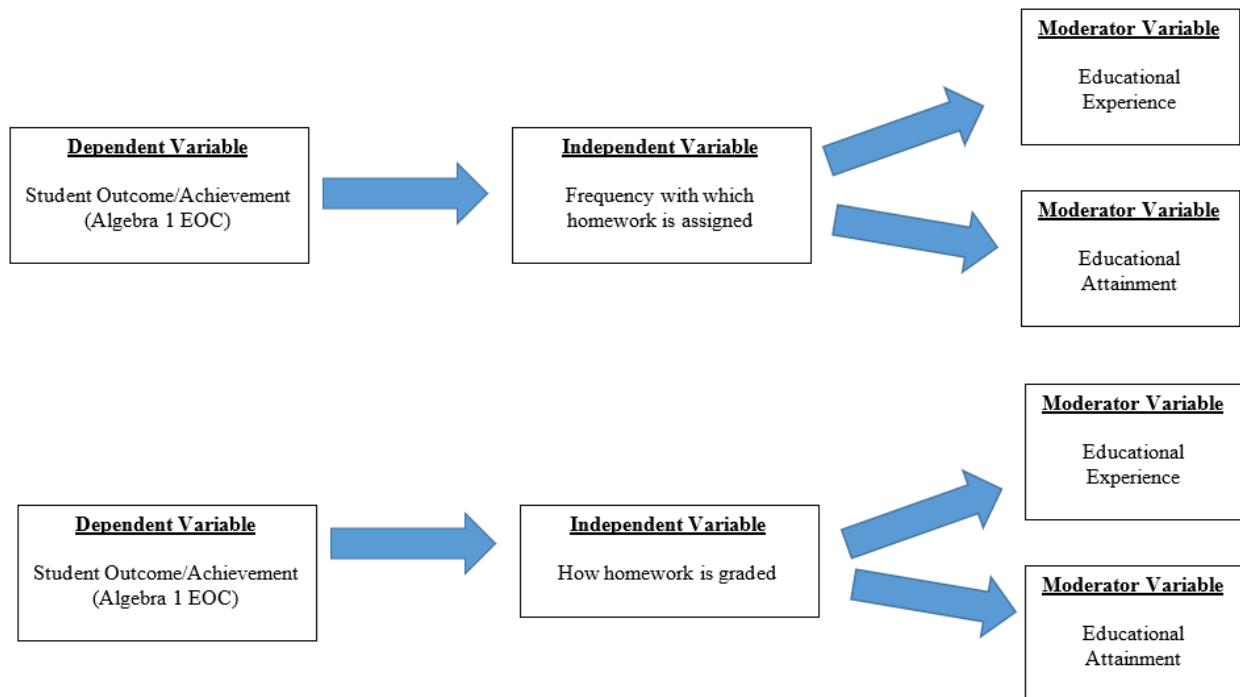


Figure 1. Overview of variables and their role in the two-way ANOVAs.

Participants

The participants in the study were teachers of Algebra 1 and their corresponding students in the study district. The teachers of Algebra 1 worked at and their respective students attended the selected schools during the 2017–2018 school year. The sample for the study was a convenience sample. Teachers and students from middle schools (defined as Grades 6-8) and

teachers and students from high schools (defined as Grades 9-12) were included in the study. Middle schools and high schools were selected because they are secondary schools, and Algebra 1 is taught at the secondary level in middle and high school. Surveys were sent out to all Algebra 1 teachers in the study district. Participants were asked to reflect on their practice during the 2017–2018 school year for the study district.

Instrumentation and Data Collection

The Algebra 1 teachers in the study district were invited to participate in the study. Participants were asked to take a researcher created survey (Appendix A) containing eleven questions to obtain the following data: (a) homework grading practices of participants, (b) participants' earned college degrees, and (c) total years participants had taught Algebra 1 and (d) specific homework practices participants employed. In addition to the researcher created survey, Algebra 1 end-of-course examination scores (EOC) were also used to investigate student outcomes based on the homework grading practices of the instructor. The Algebra 1 end-of-course assessments were obtained through the study district. Algebra 1 end-of-course examination data was obtained from the study district's central office. The researcher created unique identifiers and secured materials to ensure confidentiality of the student assessment data.

For Research Question 1 and all sub-questions, the dependent variable for the study was Algebra 1 homework practice. The independent variable for Research Question 1 was the Algebra 1 teacher.

For Research Question 2, the dependent variable was student-level Algebra 1 end-of-course examination scores. The independent (factor) variable was the frequency with which homework was assigned; the independent (moderator) variables were the educational attainment and educational experience of the teacher.

For Research Question 3, the dependent variable was student-level Algebra 1 end-of-course examination scores. The independent (factor) variable was the way in which homework was graded; the independent (moderator) variables were the educational attainment and educational experience of the teacher. The research questions, the variables, and the sources of data are presented in Table 1

Table 1

Research Questions, Variables, and Sources of Data

Research Questions	Variables		Sources of Data	
	Dependent	Independent	Dependent	Independent
1. In what ways and to what extent do homework practices vary by school and teacher characteristics in Algebra 1?	Algebra 1 homework practices	Algebra 1 teacher	Teacher survey	Teacher survey
2. In what ways and to what extent is student achievement in Algebra I associated with the frequency with which homework is assigned?	Algebra 1 EOC	The frequency with which Algebra 1 homework is assigned	Suburban school district	Teacher survey
3. In what ways and to what extent is student achievement in Algebra I associated with the way in which homework is graded?	Algebra 1 EOC	The way in which Algebra 1 homework is graded	Suburban school district	Teacher survey

Measurement of Variables

The study investigated the homework grading practices of Algebra 1 teachers and those grading practices relationships to student outcomes as measured by the Algebra 1 end-of-course examination. According to the FDOE (2018), the Algebra 1 end-of-course examination is a norm-referenced, criterion-based assessment that measures student’s proficiency with the Florida Standards. The dependent variable (Algebra 1 end-of-course examination scores) was measured using Algebra 1 end-of-course examination results. The independent variables (homework grading practices, and the frequency with which homework is assigned) were measured through the use of a researcher-created survey. The moderator variables (years of teaching experience

and the type of degree held by the instructor) were measured through the use of the researcher-created survey.

Analysis

Research Question 1 was answered using descriptive statistics and cross-tabulation tables. Descriptive statistics of mean, median, and standard deviation were calculated and presented to capture and present the data as represented in the population of interest (secondary Algebra 1 teachers). Cross-tabulation tables were used to describe homework practice (frequency and how homework was graded by Algebra 1 teachers), disaggregated by the variables of teacher's educational experience, and educational attainment. Cross-tabulation tables were used to describe homework practices of Algebra 1 teachers, disaggregated by school level (i.e., high school or middle school), professional experience (less than five years teaching Algebra 1, six to twenty years teaching Algebra 1, more than twenty years teaching Algebra 1), and the Algebra 1 teacher's educational attainment (Bachelor's degree, Master's degree, Specialist degree).

For Research Question 2, a two-way ANOVA was used to investigate whether and how student outcomes (as measured by Algebra 1 EOC examinations) varied based on the frequency with which homework was assigned. The two-way ANOVA considered moderator variables (educational experience, educational attainment). The results indicated whether or not the relationship between student outcomes as measured by the Algebra 1 end-of-course examination and the frequency with which homework was assigned (main effect) was statistically significant. The results also indicated whether the interaction effects of moderator variables (educational experience, and educational attainment) were statistically significant.

In Research Question 3, a two-way ANOVA was used to investigate whether and how student outcomes (as measured by Algebra 1 EOC examinations) varied according to the way in which homework was graded. The two-way ANOVA took into account moderator variables (educational experience, and educational attainment). The results indicated whether or not the relationship between student outcomes, as measured by the Algebra 1 EOC examinations and the way in which homework was graded (main effect), were statistically significant. The results also indicated whether the interaction effects of moderator variables (educational experience, and educational attainment) were statistically significant.

Delimitations

The study was delimited to middle schools and high schools in the study district. Student performance data was used only for the 2017–2018 school year in the study district. The study was delimited to Algebra 1 classes only because of a large pass rate difference between middle school Algebra 1 students and high school Algebra 1 students. The study was delimited to teachers who taught during the 2017-2018 school year at the schools in the study district.

Limitations

As a result of delimiting the study to a single school district, the results were not readily generalizable to other schools and school districts. The schools at the middle and high school levels were selected because this researcher was an employee of the study district. Because a single school district was studied, the results of the study were not immediately generalizable to other districts in the state as well as in other states; cautious generalizations may be warranted from the results. Using only Algebra 1 teachers and their students limited the relationship to grading practices as a whole in regard to the relationship to student outcomes. The exclusion of other academic disciplines within K-12 schools limited the generalizability of the relationship of

homework grading practices to student outcomes. In regards to participants completing the researcher-created survey it was assumed participants reported accurately on their survey and the results show that the number of students in their classes received or had the practice used with them. In reporting results this assumption will allow for making direct statements (e.g., if a teacher reports they assigned homework five times a week the students were given homework five times in a week).

Using a non-experimental, causal-comparative design does not support causal inferences. A causal-comparative design does not allow for measurement of causation; instead a causal-comparative design permits the researcher to understand the relationships among the variables (Fraenkel et al., 2015). Using self-reported survey data limits the study because of respondents not responding truthfully (Lefever, Dal, & Matthiasdottir, 2007, p. 576). Teachers were asked to reflect on their practice several months after the instruction was given; recollection of specific procedures, therefore, may have been murky and impacted their responses on the survey. In addition, teachers could move schools, retire, administratively or self-select to teach a course other than Algebra 1, or have their teaching contract non-renewed by the school district. The movement of teachers away from the school or from teaching Algebra 1 could limit the study in that participants could not be found who taught students in the study district during the school years being studied. A limitation of the study was through the use of the two-way ANOVA. School and district policies regarding homework are also a limitation in this study. Homework policies can dictate to the teacher how often and how much homework to assign, this may have an impact on the teacher's use of homework with their students. The schedule of the school is also a limitation in this study. School schedules are often put in place by school and or district

administrators. The number of class meetings the teacher has with students, for example if they were on block schedule, could dictate how often the teacher assigns homework to their students.

Summary

Homework is an instructional practice used by many educators across disciplines and schooling levels. It is used as a feedback and practice tool for instructors and students. The purpose of this study was to identify which homework grading practice had a quantifiably higher relationship, if any, to student outcomes. The results of this study were intended to add to the body of knowledge on homework, specifically if homework grading practices show a relationship to student outcomes.

CHAPTER 2 REVIEW OF LITERATURE

Introduction

This literature review was constructed using the ERIC and EBSCO databases. The terms used in the search were: homework, accuracy, completion, feedback, and Algebra 1. In addition to the ERIC and EBSCO searches, the reference pages for articles within the searches were used to identify texts that could help frame the research project. This chapter is structured into three sections. Homework is discussed in general terms in the first section, focusing on the evolving definition of homework, society's fluctuating view of homework, homework construction, the benefits of homework, the weaknesses of homework, summaries of major studies and meta-analyses completed on homework to provide the reader with an overview of homework as an instructional practice, and homework as a means of feedback. The rationale for the selection of Algebra 1 as the subject of this research is presented in the second section of the literature review. The third and final section of this review contains a review of literature directly related to the area of focus within homework for this research project, the grading practices teachers use in the instructional practice of homework.

Homework

Cooper (1989b) defined homework as any activity that is assigned by a teacher that is intended to be carried out during non-school hours. Although the intent is present for students to carry out homework during non-school hours, in practice many students choose to complete homework assigned by a teacher at school during the school day (Trautwein, 2003). Specifically, "Secondary students often work on homework assignments during the school day" (Bembenutty, 2011, p. 340).

The importance and impact of homework on student achievement has been researched frequently over the past several decades (Cooper, 1989b; Cooper, Robinson, & Patall, 2006; Cooper & Valentine, 2001; Trautwein, Ludtke, Kastens, & Koller, 2006; Walberg & Paik 2000). However, the importance of homework as deemed by educational institutions, parents, teachers, and society at large has fluctuated during that same time-period (Paschal, Weinstein, & Walberg, 1984). Paschal, Weinstein, & Walberg (1984) asserted that homework's emphasis in schools has shifted in regards to social movements prevalent during the time-period in question. During the time of Sputnik a re-emphasis on homework was found to maintain American dominance in the sciences. This feeling then waned during the Vietnam War during the civil rights movement in the 1970s. Homework's emphasis again re-emerged and has stayed at the forefront of academic conversations since the publication of *A Nation at Risk* (Cooper, 1989b; Cooper et al., 2006; Paschal et al., 1984). "However, as the century turned, and against the backdrop of continued parental support for homework, a predictable backlash set in, led by beleaguered parents concerned about the stresses on their children" (Cooper et al., 2006, p. 4). The cyclical nature of society valuing homework has spurred new discussions about the importance of homework and how it can be used most effectively to increase student achievement. (Bas, Senturk, & Cigerci, 2017; Bembenutty, 2011; Cooper et al., 2006; Rosario et al., 2015; Xu, 2007)

Lee and Pruitt (1979) classified homework into four distinct types: (a) practice, (b) preparation, (c) extension, and (d) creative. Each type of homework assignment has a distinct purpose for the student and the instructor assigning the homework. Each type is discussed in the following paragraphs to provide further clarification in understanding homework's purpose and intent.

Practice homework assignments “help student’s master specific skills” (Lee & Pruitt, 1979, p. 32). These are the most common types of homework assignments. In class, students learn a skill or concept and are given problems to practice outside of instructional time to further master the skill or concept. Practice homework assignments “should be limited to material presented in class” (Lee & Pruitt, 1979, p. 32). There are inherent problems with this type of homework assignment. Because the homework is routine practice, it can easily be copied by other students (Lee & Pruitt, 1979). One method to alleviate this is to assign a follow-up assessment to be taken in class the day the homework is due or shortly thereafter. “Since practice assignments are given to insure the mastery of either skills or content, a short quiz will be the most valid indicator of mastery” (Lee & Pruitt, 1979, p. 33).

The second type of homework assignment is a preparation homework assignment. “The goal of the preparation assignment is to prepare students to profit from the next class meeting” (Lee & Pruitt, 1979, p. 34). An instructor could use preparation assignments as a pre-test to see what the students know about content before they teach it. “Preparation assignments must always be followed up in class” (Lee & Pruitt, 1979, p. 34). Without follow-up, students will not be able to see the connection and importance of the assignment.

A third type of homework assignment can be classified as an extension assignment. In extension assignments, the teacher, “asks the students to extend the concept or skill learned in class to new situations” (Lee & Pruitt, 1979, p. 34). This type of homework assignment could be considered to be one requiring higher-order thinking skills. These types of assignments differ from preparation or practice homework assignments, in that they ask, “the student to go beyond simple familiarization to apply ideas or skills to new situations” (Lee & Pruitt, 1979, p. 34).

The final type of homework assignment is classified as a creative assignment. As the name implies, creative assignments “require students to integrate many skills and concepts in the process of producing a response” (Lee & Pruitt, 1979, p. 33). Creative assignments often take longer to complete and are different in almost every way from the previously mentioned types of homework assignments.

Thought must be given to the construction of the homework assignment to get the maximum benefit from it. Lee and Pruitt (1979) posited that “to obtain maximum benefit from any assignment, it is necessary to determine the purpose behind making the assignment and then allow that purpose to determine the homework policy” (p. 32). Without a purpose for the homework, students may not see the importance and not complete the assignment. This could negate the original purpose of assigning homework. Kitsantas, Cheema, and Ware (2011) commented on the achievement aspect of homework, stating, “Cooper (1989) found that the most potent factor affecting achievement was the amount of homework the student actually completed as opposed to the amount of homework that was assigned” (p. 312).

In addition to the actual construction of homework assignments, thought must be given to the assignment characteristics of purpose, efficiency, ownership, competence, and aesthetic appeal (Vatterott, 2010). Vatterott believed that the best kind of homework “deepens student understanding and builds essential skills” (p. 10).

Lee & Pruitt (1979) discuss how, when discussing homework, purpose refers to the reasons why students complete homework. “Ideally, homework should provide feedback to teachers about student understanding, enabling teachers to adjust instruction and, when necessary, reteach concepts before assigning practice” (Vatterott, 2010, p. 11). The teacher assigning the homework needs to have a clear understanding of what the students are to get out

of the homework and this should be communicated to the students. Having students understand the “why” of something is one method that instructors use to ensure that stakeholders are clear on the purpose of an assignment or skill they are practicing.

The characteristic of efficiency refers to the assignment’s ability to “efficiently demonstrate student learning” (Vatterott, 2010, p. 10). For a task to be considered efficient, there must be evidence of learning on the assignment. That is, students, having completed the homework assignments, should be able to show what they have learned through their work or discussion of the assignment. “Homework assignments must be cognitively challenging but not overtaxing” (Kunter & Baymert, 2010, p. 468). Vatterott (2010) defined inefficient homework utilizing actions such as “cutting, gluing, or drawing” (p.11) without corresponding academic criteria.

The third homework characteristic of ownership refers to students’ having some type of choice in the assignment so that they take ownership of the learning. “Moreover, teachers should design engaging and interesting homework activities to boost students’ self-efficacy and responsibility for learning; otherwise, students may not be motivated to complete them” (Ramdass & Zimmerman, 2011, p. 213). “The goal of ownership is to create a personal relationship between the student and the content” (Vatterott, 2010, p. 12). When students have a sense of ownership on assignments, they are more likely to complete the assignment as they have a stake in the assignment because it is specifically for them. (Bempechant, Li, Neier, Gillis, & Holloway, 2011; Van Voorhis, 2011)

Homework should be within the ability of the student(s) to complete, and students should feel competent that they can complete the homework. “To ensure homework is doable, teachers must differentiate assignments so they are at the appropriate level of difficulty for the individual

students” (Vatterott, 2011, p. 12). Classes are rarely populated with students who have the same deficiencies and needs. Likewise, homework cannot be considered effective if every student is completing the same homework assignment in the same way. Van Voorhis (2011) listed five ways to increase student completion that complement Vatterott’s (2010) characteristic of competence in that they bolster student confidence and help to ensure that the construction of the homework assignment is right for students. Van Voorhis suggested that (a) the directions of the assignment should be clear to students, (b) the skill and the required student work and interactions should be linked to the real world as often as possible, (c) teachers should be careful not to lose sight of the objective, completing the assignment themselves to make sure that it is doable, (d) teachers should vary the types of interactions that are required across assignments. (Van Voorhis, 2010, p. 245)

Homework should endeavor to be enjoyable for the student. “Teachers should try to engage students through homework assignments that are interesting and innovative” (Bempchant et al., 2011, p. 255). The way homework is constructed and looks is important and can sway a student from either completing the assignment or not completing the assignment. Teachers have learned that “students at all levels are more motivated to complete assignments that are visually uncluttered” (Vatterott, 2010, p. 14). When homework looks appealing, students are more likely to complete the work and get the practice or learning that the homework assignment was designed to provide them. In addition to the characteristics of homework, students must also be able to discuss the homework with the assigning teacher for clarification and direction. For homework to be truly effective, “students must be able to freely communicate with teachers when they struggle with the homework, knowing they can admit that they don’t understand a task--and can do so without penalty” (Vatterott, 2010, p. 15). Students who do not feel

embarrassed by their lack of understanding are more likely to be able to clarify the assignment and get the direction they need to be able to complete the homework assignment, thereby benefiting from the assignment (Vatterott, 2010).

Lee and Pruitt (1979) presented four types of homework types. Vatterott (2010) discussed characteristics that homework should have to be successfully completed. Kunter and Baumert (2010) separated homework's success into two categories: the selection of the homework and the challenge the homework presented, both being necessary to adequately provide students with the best possible learning opportunity that the homework could provide.

Kunter and Baumert (2010) addressed the balance between “cognitively activating instruction (i.e., challenging homework assignments) and instruction that caters for the low-achieving students in the class” (p. 478). Striking the right balance of the actual homework task and its complexity is difficult and is often disregarded for a “one-size fits all” model of homework. Walberg and Paik (2000) presented the finding that the “quality of homework is as important as the amount” (p. 10). With quality being an important part of homework assignments, the careful selection by the assigning teacher is paramount for the students to receive the practice and learning intended from the assignment. Kunter and Baumert (2010) provided questions that teachers need to answer regarding homework selection and homework challenge. Regarding homework selection, Kunter and Baumert (2010) suggested that teachers ask themselves, “Do the tasks selected by teachers enhance students’ understanding? Are they interesting? Is homework well integrated into lessons?” (p. 469). Regarding the homework challenge of problems, Kunter and Baumert suggested that teachers ask themselves, “Are they easy to solve or do they require mental effort?” (p. 469). Having a clear answer for each of these questions for homework selection and homework challenge, as well as adhering to the

characteristics that Van Voorhis (2010) and Lee and Pruitt (1979) presented, can help to ensure that homework assignments that students complete are helping them meet the assigning teacher's intent.

Hattie (2009) found homework's overall effects to be positive with some moderators (p. 234). He labeled homework's effect size at $d = 0.29$, which he described as under the "zone of desired effects" or instructional practice that has a quantifiable impact on student achievement (p. 234). However, he expressed the belief that "There are marked differences in effect sizes between elementary ($d = 0.15$) and high school students ($d = 0.64$) . . ." (Hattie, 2009, p. 235). Nevertheless, homework is a common practice in schools around the world, assigned with several aims, one of which has been to increase student achievement.

Homework has many different characteristics that make-up its effectiveness and as a result impact student achievement. Figure 2, reproduced with permission from Kunter and Baumert (2010) in the *Journal of Educational Psychology*, shows graphically the ideal way that the factors of homework can impact achievement.

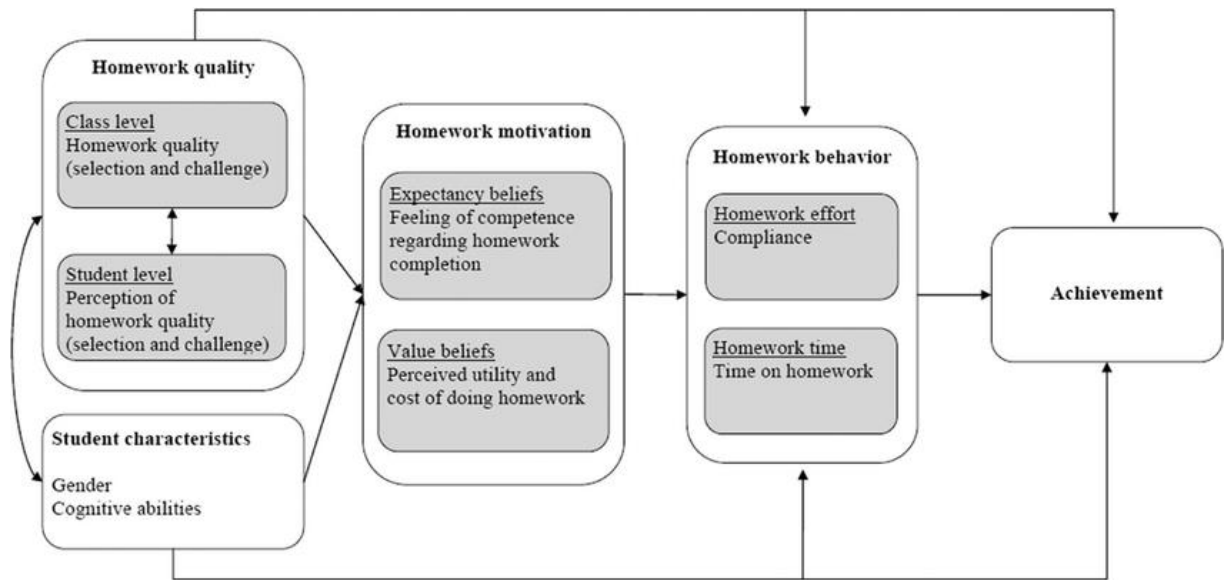


Figure 2. Homework factors impacting achievement

Reproduced with permission from "Homework works if homework quality is high: Using Multilevel Modeling to Predict the Development of Achievement in Mathematics," by M. Kunter and J. Baumert, 102(2) *Journal of Educational Psychology*, p. 478. Copyright, 2010 by *Journal of Educational Psychology*.

Homework has many detractors and has been cited in numerous studies as having negative outcomes on student achievement. (Bempechat et al., 2011; Cooper, 1989b, Cooper et al., 2006; Kunter & Baumert, 2010) Kunter and Baumert (2010) commented on the use of multilevel modeling to predict the development of achievement in mathematics:

Major criticisms include the lack of control for other important predictors of achievement, failure to adequately model the multilevel structure inherent in homework studies, the reliance on cross-sectional data, uncertainty about the theoretical model of homework measures used, and the absence of a theoretical model for homework assignment and behavior. (p. 468)

The main recurring themes for homework detractors are that homework takes time away from student's lives where they could be doing other things and that teachers often assign homework without proper forethought about the construction of the assignment and how the

students are to apply what they have learned in class on their homework. (Bempechant et al., 2011; Lee & Pruitt, 1979). In addition, according to Bempechat et al (2011), motivation and relevance play a part of homework's effectiveness in improving student achievement. They observed that high achievers were bored by non-cognitively complex assignments, and low achievers were bored by homework perceived as either uninteresting or having to do too much homework.

Although homework does impinge on a student's time beyond the school day, there are many more positive than negative benefits to homework. The most commonly cited benefit of homework is an increase in time on task for students. "Homework contributes substantially to time on task in core subjects and this provides additional opportunities to learn" (Kunter & Baumert, 2010, p. 468). With additional opportunities to practice, students can become more adept at skills and reproduce them with minimal effort. "Through homework assignments, teachers have a valuable opportunity to harness some of students out-of-school time to cultivate school engagement" (Bempechat et al., 2011, p. 253). Again, by extending the time on task students receive through homework, teachers can give students more opportunities to practice, review, and expand upon material learned in class.

Graue, Weinstein, and Walberg (1983) focused their writing on homework and the family structure's connection. Through homework being assigned for completion during non-instructional hours (Bembenutty, 2011), the completion of homework could happen at the residence of the student. Graue et al. (1983) wrote, "Educators have become increasingly aware of the powerful effects of programs to give parents, particularly those in financial or social need, the materials and procedures that seem likely to promote the affective, behavioral, and cognitive growth of their children" (p. 351). Using the home as place for learning could extend the

opportunities for students to practice material and provides an opportunity to extend the learning time apart from their normal school day. Graue et al. (1983) noted that homework's effect on student achievement varied by student's school-grade level, and that because of this one would think that home effects on achievement would also be grade-level dependent; however, "stimulating homes benefit older children as much as they benefit younger children" (p. 355).

The home has a large impact on student's academic achievement (Bloom, 1984; Cooper 1989b; Zimmerman & Kitsantas, 2005). "Through homework assignments, teachers have a valuable opportunity to harness some of students' out-of-school time to cultivate student engagement" (Bempechant et al., 2011, p. 253). Through completion of homework, students can gather additional practice for their studies, making the possibility of higher achievement more likely. However, there is more to homework practice by students at home than completing the assignment. "Students must manage homework assignments by engaging in various self-regulation processes such as planning, managing time, finding a suitable place to work, and motivating themselves" (Ramdass & Zimmerman, 2011, p. 197). Carrying out these practices is important for students so that they can get as much out of the assignment as the teacher who assigned it intended.

Finding time to complete homework can be challenging for some students. "Homework brings learning to students' daily lives, where it coexists with multiple competing activities" (Xu, 2010, p. 1938). According to the National Center for Educational Statistics [NCES] (2013), the average school day in the United States of America is 6.7 hours. Because most of their time is spent outside the school building or under the supervision of educators, students often participate in other activities that take a portion of their time they could devote to homework.

In addition to finding time to work on homework, students must also be able to motivate themselves to complete it. Student's self-efficacy is part of their motivation to complete their homework. "Self-efficacy refers to beliefs about one's capability to learn or perform effectively, and self-efficacy for learning refers to beliefs about using self-regulation processes, such as goal setting, self-monitoring, strategy use, self-evaluation, and self-reactions to learn" (Zimmerman & Kitsantas, 2005, p. 398). Hattie (2009) rated a student's self-efficacy as a high effect on student learning. Zimmerman and Kitsantas (2005) found that students self-efficacy beliefs were predictive of their grades (p. 399). They further stated that "Homework activities are also expected to enhance students' perceived responsibility for academic achievement" (p. 400).

Paschal et al. (1984) conducted one of the earliest comprehensive meta-analyses of homework one of the most often cited pieces of research on the subject. They noted that most of the research on homework up to the late 20th century had been shoddy and ill-researched (p. 104). In their synthesis of the effects of homework in learning, they reported that "measures of home stimulation account for as much as 50% of the variance in school achievement" (p. 97). Their findings formed the basis for further research on homework (Cooper, 1989; Cooper et al., 2006; Cooper & Valentine, 2001; Kunter & Baumert, 2010; Trautwein et al., 2006; Walberg & Paik, 2000). Up until this point most of the research on homework was to identify the "homework/no homework" link to student achievement (Paschal et al., 1984). Though Paschal et al. (1984) did report on studies that focused on other aspects of homework, the majority were concerned with the presence or non-presence of homework and its relationship to student achievement. Important observations of Paschal et al. (1984) were:

Larger effects on achievement were found for homework that bears teachers' comments and grades. Assigned homework produced more learning than no homework; and

traditional homework was superior to non-traditional. Another characteristic approaching significance (probability less than .06) is the effect of homework quantity per week; the highest effect size indicated the superiority of daily homework assignments. (p. 103)

In his book (Cooper, 1989a) and his corresponding journal article (Cooper (1989b) on homework, Cooper chronologically and categorically combined findings from the previous 70 years of research on homework. He presented his ideas for implementing homework policy at the classroom, school, and school district levels.

Cooper (1989b) categorized homework based on its purpose, noting there is rarely a single purpose; the different classifications of homework are the “amount, purpose, skill area utilized, degree of individualization, degree of choice permitted the student, completion deadline, and social context” (p. 7). Homework is generally found to have a positive impact on student achievement (Bas et al., 2017; Cooper 1989b; Rosario et al, 2015; Walberg & Paik, 2000; Yalcin & Kaw, 2011). Cooper (1989b) grouped the positive effects of homework into four categories (a) immediate effects, one of which is an increase of learning time, (b) long-term effects, one of which is to establish practices that facilitate lifelong learning, (c) nonacademic effects, two of which are discipline and self-direction, and (e) parental involvement, one of which is to involve parents in the homework or learning process. The positive and negative effects of homework can be presented in Table 2

Table 2

Positive and Negative Effects of Homework

Positive Effects	Negative Effects
Immediate achievement and learning Better retention of factual knowledge Increased understanding Better critical thinking, concept formation, information-processing Curriculum enrichment	Satiation Loss of interest in academic material Physical and emotional fatigue
Long-term academic Encourage learning during leisure time Improved attitude toward school Better study habits and skills	Parental interference Pressure to complete assignments and perform well Confusion of instructional techniques
Nonacademic Greater self-direction Greater self-discipline Better time organization More inquisitiveness More independent problem-solving	Cheating Copying from other students Help beyond tutoring
Greater parental appreciation of and involvement in schooling	Increased differences between high and low achievers

Note. Adapted from “Homework” (Table 1.2) by H. M. Cooper, 1989.

As mentioned in Table 2, there have been linkages of homework to negative student outcomes in some research studies (Bempechat et al., 2011; Cooper, 1989b; Kunter & Baumert, 2010; Yalcin and Kaw, 2011 ;). However, most of the research has shown a positive effect of homework on student achievement (Cooper, 1989a, 1989b; Hong, Wan, & Peng, 2011; Kitsantas et al., 2011; Rosario et al, 2015).

Because the effectiveness of homework is contingent upon several factors, Cooper (1989b) also delineated factors that influence homework (Table 3). These factors that influence homework allow a teacher to thoughtfully consider the homework assignment and to have a clearly defined purpose for the homework they want to assign.

Table 3

A Process Model of Factors Influencing the Effectiveness of Homework

Exogenous Factors	Assignment Characteristics	Initial Classroom Factors	Home-Community Factors	Classroom Follow-Up	Outcomes or Effects
Student <i>Characteristics</i> Ability Motivation Study habits Subject matter Grade level	Amount Purpose Skill area utilized Degree of individualization Degree of student choice Completion deadlines Social context	Provision of materials Facilitators Suggested approaches Links to curriculum Other rationales	Competitors for student time Home environment Space Light Quiet Materials Others involvement Parents Siblings Other students	Feedback Written comments Grading Incentives Testing of related content Use in class discussion	Assignment completion Assignment performance Positive effects Immediate academic Long-term academic Nonacademic Parental Negative effects Satiation Denial of leisure time Parental interference Cheating Increased student differences

Source. Reproduced from "Homework," by H. M. Cooper, 1989, p. 14, Longman.

Cooper (1989b) identified a gap in the literature, stating, “No study has examined whether instructional feedback, evaluative comments, or grading has a positive impact on the effectiveness of homework when compared with the absence of these strategies” (p. 171). This gap in the research is explored further in this chapter in the section concerning grading practices of teachers.

Cooper et al. (2006) published an updated synthesis of research from 1987-2003, reiterating from their previous research that “the most common instructional purpose of homework is to provide the student with an opportunity to practice or review material that has already been presented in class” (p. 1). This conclusion was consistent with the findings of Austin and Austin (1974) and Lee and Pruitt (1979). Cooper et al. (2006) reaffirmed many of the qualities of homework including how choice afforded to students regarding homework assignment yields greater completion rates than those assignments without choice.

Homework has an important role in students’ lives at many levels. “More recent surveys support the extensive use of homework, although the amount of homework that students report varies from study to study” (Cooper et al., 2006, p. 2). Given the variations of teachers assigning homework and students completing it, the effects on student achievement have also varied. Cooper et al. (2006) also discussed the friction caused by homework between students, school, and parents regarding frequency, time involved, and effect on the student’s grades or achievement. (Bembenutty, 2011; Paschal et al., 1984; Voorhis, 2011).

Cooper et al. (2006) found that the effect size of homework varied from 0.97 to -0.27. This variation across a multitude of studies underlies the continued “fight” for and against homework. With such variation and studies purporting the advantages and disadvantages of homework, it has been difficult to formulate research-based policy regarding frequency, quantity,

and cognitive complexity of homework assignments that would help teachers and students.

Cooper et al. (2006) did put forth several guidelines on homework for teachers, schools, and school districts to abide by. A summary of the characteristics of Cooper et al.’s (2006) studies correlating time on homework and academic achievement in mathematics is presented in Table 4.

Table 4

Characteristics of Studies Correlating Time on Homework and Academic Achievement in Mathematics

Study	Positive and Negative Effects
Homework and no-homework conditions.	Generally, a positive effect across all grade levels and subjects regarding the assignment of homework and student achievement.
Characteristics of studies correlating time on homework and academic achievement in multiple subjects.	Generally positive with a more significant correlation in grades six through twelve.
Characteristics of studies correlating time on homework and academic achievement in mathematics.	Generally positive with a more significant correlation in grades eighth through twelve.
Characteristics of studies correlating time on homework and academic achievement in foreign language.	Positive effects across all grade levels on student achievement.
Characteristics of studies correlating time on homework and academic achievement in language arts.	General negative effects for primary grades one through five.

Source. Cooper et al. (2006).

Feedback provides students and teachers information on how students are progressing on a given skill set. Homework is a type of feedback in that it can provide the teacher and student with guidance on how they are performing regarding the content that is being used for the basis of the homework. Hattie (2009) noted: “Feedback needs to provide information specifically

relating to the task or process of learning that fills a gap between what is understood and what is aimed to be understood. . .” (p. 174). Homework can provide feedback to the student if the instructor makes comments or notes to the student and can provide feedback to the instructor through the work turned in on the homework itself. Hattie said that “feedback was most powerful when it is from the student to the teacher. . .” (p. 173). Homework can provide feedback to instructors to help them target instruction to students to remedy their misconceptions and provide information about the task at hand. The question of how to provide feedback can be in the form of written comments on the feedback, general discussion in a classroom setting about trends the instructor saw, or a plethora of other means in providing insight to students on what they did and the instructor adjusting their instruction based on the student’s work.

Feedback differs accordingly to intentionality—that is, whether the feedback was designed to inform the performer about the appropriateness (quality, correctness, etc.) of relatively specific aspects with the social and physical environment. Intentional feedback typifies instructional settings (especially direct or expository instruction), although informal feedback processes can have important educational effects. . . . (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991, p. 215)

Bangert-Drowns et al. (1991), in discussing feedback, observed that the most common feedback “is used to signal whether the student has correctly retrieved specific information or has correctly applied recently studied concepts or procedures to familiar or novel tasks (p. 215). Research findings have been firm on the statement that feedback helps to maximize homework’s potential positive impact. (Bangert-Drowns et al., 1991, Cooper, 1989b; Rosario et al., 2015; Walberg & Paik, 2000).

Feedback has potential for great power in informing teachers of their students' progress in learning. "The role of the teacher in providing feedback—in reinforcing what has been done correctly and re-teaching what has not—is the key to maximizing the positive impact of homework" (Walberg & Paik, 2000, p. 10). Feedback can also be used by instructors to change their instruction based on student work. Through carefully constructed homework, teachers could see what their students are learning and adapt their methods to meet students' needs by altering content delivery, pace, and assessments.

Providing feedback to students can take many different forms, the most common of which are (a) signaling that the student has submitted the homework assignment and (b) scoring the assignment. Both types of feedback provide students with some type of information. However, certain types of feedback provide more useful information to students than others. "Feedback's most important instructional effect would be to correct erroneous responses, not to strengthen correct responses" (Bangert-Drowns et al., 1991, p. 216). Seeing their mistakes enables students to see where they are not understanding the material and can help them alter their actions until they internalize processes. Also, according to Rosario et al. (2015), "Feedback is an important source of information for checking answers" (p. 1). Students who receive information regarding the correctness of their answers are more likely to show achievement gains. (Fuentes & Moreira, 2015; Paschal et al., 1984).

In summary, this section provided a general overview of homework; its definitions, construction, benefits, weaknesses, and summaries of several key studies on homework. Homework's importance has been in flux for decades but has recently taken on a prominent status in affecting student achievement through increasing students' time on task. The following

section, Algebra 1, contains a review of the literature and research focused on the importance of Algebra 1 and its selection as the course of focus for this study.

Algebra 1

In the state of Florida, Algebra 1 has generally been offered in Grades 7-9, with the expectation that all students will have taken Algebra 1 by the end of their ninth-grade year. Florida Statute states that students must earn one credit in Algebra 1 and pass the “statewide, standardized Algebra 1 EOC assessment or earn a comparative score in order to earn a standard high school diploma” (Florida Statute 1003.4282). Algebra 1 functions as a gatekeeper for students to graduate with a standard diploma in the state of Florida.

In addition to serving as a gatekeeper for graduating from high school in Florida, Algebra has also functioned as a gateway to higher mathematics and is important in a student’s mathematical progression. “Mathematics, or more specifically, algebra is a gateway to the study of any STEM discipline that students may wish to embark on while in college” (Wilder, 2013, p. 49). Algebra is vital for students as they progress to higher mathematics and other STEM fields. “Furthermore, because access to algebra in eighth grade positions students to enroll in a high school course-taking sequence ending in calculus by twelfth grade, the point at which students gain access to algebra is also deemed critical” (Stein, Kaufman, Sherman, Hillen, 2011, p. 454). The school year in which students take Algebra places them in position for an educational and eventual career path that can set them apart from their peers.

Lastly, Algebra has served as a gatekeeper to economic and social mobility in the United States of America. Moses (1993), quoted in an interview about equity in mathematics, said, “There’s no question that algebra is necessary.” (The algebra initiative colloquium, p. 57). With the continued move of the economy from the industrial to the knowledge economy, people with

mathematical skills are increasingly in need. Computers introduced the need for students with quantitative literacy, and educators and policy makers put quantitative literacy in Algebra. (Richardson, 2009).

The United States Department of Defense has also cited a need for students with STEM (Science Technology Engineering and Mathematics) backgrounds, and algebra is a large part of many STEM fields. The Defense Advanced Research Projects Agency (DARPA) stated in a 2010 study that there is a decline in individuals going into STEM fields (Computer Science-Science, Technology, Engineering, and Mathematics (CS-STEM) Education Research Announcement (DARPA-RA-10 – 03). There have been recent pushes to include more women in STEM fields but “the gender gap in STEM fields persists” (Shein, 2018, p. 21). With the high availability of jobs in STEM fields, it is important to get students exposed to these types of fields.

Homework Grading Practices

This section contains an overview of homework grading practices of teachers at various levels for completion and accuracy. The literature reviewing the positives and negatives for each practice and its subsequent relationship to student achievement is discussed.

Grading homework for accuracy, as opposed to completion, has the potential to provide students with more feedback as the instructor is checking students’ work and answers for correctness. If students are given opportunities to have their homework reviewed for quality, more opportunities for growth may be present. Instructors will be more likely to have a clearer understanding of students’ learning progress and in turn provide students with a clearer picture of where they made mistakes. In discussing the value of grading for accuracy, cost must be considered. “Instructors spend time grading the assignments and providing adequate feedback...

As for students, they may need to forgo other, more productive learning processes and methods to make the time to work on graded assignments” (Latif & Miles, 2011, p. 1).

Tuckman (1992) conducted a two-part study on assignments, considering length of assignments and how the assignments were graded for junior and senior teaching education majors in two sections of a required educational psychology course. The course sections were offered at the same time but on different days. Part 1 of the study involved 126 participants, the majority of which were female, with a median age of 21. The second part of the study involved 63 students taking the same course at the same time and the same day.

In the study, participants were given an assignment of writing test questions, open ended/completion, and multiple choice. “Items were loosely screened for acceptability and, where needed, were returned for correction” (Tuckman, 1992, p. 192). Each week students were asked about “the number of test items they felt capable of writing that week, and how confident they were in that estimate on a 9-point scale” (Tuckman, 1992, p. 192). For Part 1 of the study, a correlation of .80 was found between the self-competence scores. Students were graded using a norm-referenced grading system that was constant across all participants in the study. They were given bonuses to their grades based on how many questions they wrote. They were graded using three groups with the highest third of students receiving double grade bonuses and the lower their receiving no grade bonuses, the middle third received a single grade bonus. To keep the groups across both parts of the study the same, “each class was of approximately equal size, met at the same time of day, and was taught the same material in the same way by the same instructor” (Tuckman, 1992, p. 193).

In Part 2 of the study, “Any number of students could obtain each bonus” (Tuckman, 1992, p. 194). Part 2 of the study used a criterion-referenced evaluation, in that students were

given a point value (or amount of assignments they had to complete) to attain each bonus; with a double bonus at 450 points and a single bonus at 300 points. When compared to the participants in Part 1 of the study, no difference was found in the students' self-competence ratings.

Regarding grading:

While students in the two groups produced about the same amount, regardless of grading criterion, a differential effect of grading criterion (which approached significance) was obtained for the different self-competence groups. The two types of grading criteria had exactly the opposite effects on the medium and low self-competence groups (while having no effect on the high self-competence group)." (Tuckman, 1992, p. 195)

Tuckman (1992) concluded that grading criteria did not make a substantial difference in the amount of work that students completed. However, his study did reveal a correlation in the way students perceived themselves and their work output; the relationship was positive in that the more self-competent students viewed themselves the more question-writing they completed. Tuckman said that "In courses where students are likely to have less self-competence (perhaps mathematics), grading homework assignments should be absolute (e.g., based on number of problems completed correctly), while for courses where grade expectations are higher, relative grading would be used" (Tuckman, 1992, p. 198). Although this study was conducted with students at the collegiate level, implications for K-12 students do exist, and an argument for grading for accuracy is implied for certain courses in the study.

Latif & Miles (2011) in their study of the impact of assignments on academic performance, found a positive correlation between graded homework and student achievement. The study was conducted at a small college in Canada with a sample of 387 economics students. To control for bias, Latif and Miles said that they "included as many

relevant independent variables as possible, and second, we used the Propensity Score Matching approach as a robustness check” (p. 10). These researchers found that the courses that included graded assignments had a “significant impact on grade” (Latif & Miles, 2011, p. 10). A positive correlation was found across all the subgroups in the study but was most pronounced in males and international students.

Grading homework for completion as opposed to accuracy provides students with minimal feedback as the instructor is simply checking that the homework has been completed. Grading for completion could also be classified as a compliance grade, in that the student is receiving a grade for completing a task.

Cooper (1989b) expressed the belief that “grading should be kept to a minimum” (p. 91). Several years later, he took the position that “. . . most homework assignments should not be graded” (Cooper, 1994, p. 8). Cooper’s 1994 synthesis was a continuation of his previous work on homework and its effect on student achievement. In it, he emphasized that using grades as a punishment can harm the intrinsic motivation of students. Cooper (1994) suggested that teachers should, “collect homework, check it for completeness, and give intermittent instructional feedback” (p. 8). Cooper’s emphasis was that homework should be used as a learning tool to promote student growth as well as “to identify individual students’ learning problems” (Cooper, 1994, p. 8).

Mikk (2006) researched homework in relation to the Trends in International Mathematics and Science Study (TIMSS). TIMSS is a mathematics test that generates algebra, measurement, and geometry data. Mikk studied how the various factors associated with homework affected the TIMSS scores of students across 46 countries, with an average per country sample of 4,777 of students whose average age was 14 years old. According to Mikk, “About 40% of the items

were free response format” (p. 2). The average scale score was 467 with a standard deviation of 73, and the reliability of the test was measured as a 0.89. The test was accompanied by a questionnaire for teachers and students. The results of the questionnaire were also published. Mikk (2006) provided one example of the results as follows: “78% of teachers monitor ‘always’ or ‘almost always’ whether the homework was completed, 57% of teacher’s correct assignments and give feedback, etc.” (p. 5).

Mikk (2006) found that “teachers’ high emphasis on mathematics homework had no significant correlation with the TIMSS results” (p. 5). The variance of student scale scores with teachers’ emphasis on homework ranged from students of teachers with high emphasis on homework scoring a 473 on the TIMSS to students of teachers with a low emphasis on homework scoring a 453 on the TIMSS. (p. 6). Most teachers in the study said that they “monitored” that homework was completed (78%), but monitoring had “no statistically significant correlation with TIMSS results ($r = -0.20$).”

It has often been thought that exemplary teachers correct students’ homework and share feedback with them so that they might learn from the assignment. “The percentage of students whose teachers “always” or “almost always” share feedback had a negative correlation with TIMSS results ($r = -0.47$)” (Mikk, 2006, p. 7). The data suggest that this practice of corrective feedback not be used because of its negative correlation to student achievement on the TIMSS.

The time involved in providing each student with feedback and correcting the homework also drains an instructor’s time to prepare lessons and complete other tasks associated with educating students. “Correcting homework in class is a rapid way of giving feedback to students, but it may reduce the TIMSS score by 14%” (Mikk, 2006, p. 7). In theory, providing feedback to students in class on homework sounds good, but it is another drain on instructional

time or time spent in meaningful discussions to promote student learning. Likewise, Mikk found that, “the more there are teachers who use homework to contribute to student’s marks, the lower the TIMSS results ($r = -0.37$)” (p. 7). In addition, “The relationship between school achievement and time spent on homework is significantly higher for math than for reading under fixed-error assumptions” (Hong et al., 2011, p. 284). Although there has been some study of homework grading practices, Trautwein et al. (2006) suggested that more research is necessary and should include investigating strategies such as checking homework for completion and grading homework.

Summary

At the time of the present study, the practice of homework continued to be debated. The literature review emphasized the need to focus on homework grading practices at the secondary level. In this chapter, the practice of homework was examined through the facets of definitions and societal importance of homework, homework construction, the benefits and weaknesses of homework, summaries of major studies on the effectiveness of homework, and homework as an instructional practice. This research examined the role of feedback in homework. Also discussed was the importance of Algebra. Finally, the researcher examined the gap in the homework grading practices literature, noting that minimal research at the secondary level, thereby providing evidence of the need for the present study.

CHAPTER 3 METHODOLOGY

Introduction

This chapter details the methodology used to conduct the study. Included is a restatement of the problem statement, the purpose for the research, research questions, population and sample, instrumentation, data collection and data analysis. This study was intended to evaluate the relationship, if any, between the homework grading practices of Algebra 1 teachers and student achievement as measured by the Florida Algebra 1 end-of-course examination.

Research Problem

In a large suburban school district, students who take Algebra 1 at the middle school level pass the Algebra 1 end-of-course assessment at a higher rate than those students who take Algebra 1 at the high school level (Florida Standards Assessment, 2018). Professional development and professional learning communities have focused on increasing the Algebra 1 end-of-course assessment pass rate but have met with little success. Students who take Algebra 1 in the middle grades (Grades 6-8) have generally had more advanced coursework in mathematics than those who take Algebra 1 in high school (Grades 9-12).

Purpose Statement

The grading practices used by secondary teachers are varied and have often been shaped by educational experience (how long teachers have been teaching a subject) and educational attainment (the highest degree that the teacher holds). The purpose of this research was to evaluate the relationship, if any, between the homework grading practices of Algebra 1 teachers and student achievement as measured by the Florida Algebra 1 end-of-course examination.

Research Questions

The following research questions were used to determine the relationship.

1. In what ways and to what extent do homework practices vary by school and teacher characteristics?
 - a. In what ways and to what extent do teacher practices vary with regard to the assignment of homework in Algebra 1?
 - b. In what ways and to what extent do teacher practices vary with regard to the frequency of assigning homework for Algebra 1?
 - c. In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?
 - d. In what ways and to what extent do teacher practices vary regarding the grading of Algebra 1 homework?
2. In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?
3. In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

Participants

The population for this study is a large suburban school district in Central Florida. The sample for this study consists of secondary school Algebra 1 teachers and their students in the study district. The participants in the study represented seven middle schools and seven high schools in the study district.

The study district's central office provided the de-identified Algebra 1 end-of-course assessment scores for the study. Student scores were aggregated to their respective Algebra 1 teachers. Once surveys and student assessment data were matched, teachers' names and schools were de-identified so that no teacher or student names were identifiable on the data set.

The study district was composed of 76 schools in the study year, of which 12 were public middle schools and 12 were public high schools. (FSA Scores, 2018). The study district served 35,036 students at the secondary level; 18,902 students attended a high school in the district and 15,171 students attended a middle school (FSA Scores, 2018). The average free-and-reduced priced lunch percentage for all middle schools in the study district was 42% of the student body in the high schools and 49% of the student body in the middle schools. (FSA Scores, 2018).

Instrumentation

There were two sources of data used by the researcher for this study. The first source were de-identified student achievement scores on the Algebra 1 end-of-course examination for the 2018 spring administration of the assessment. This data was given to the researcher by the study district. The second source of data was the researcher-developed survey (Appendix A). Items on the survey were developed to ascertain (a) if the participating teachers taught Algebra 1 during the time period in question, (b) how often they assigned homework, (c) the type of feedback they provided if any, (d) the type of homework they assigned as identified by the literature, (d) how the teacher graded the homework during the time period in question, and (e) demographic information regarding their educational experience and educational attainment. The survey was vetted using a cognitive conference with teachers of Algebra 1 in the study district. The questions regarding types of homework and feedback on homework were developed to shed light on current Algebra 1 teacher homework practices. Homework was

classified using four categories as identified by Pruitt and Pruitt (1979). The ways in which homework was graded were developed based on items found in the literature (Bangert-Drowns et al, 1991; Kunter & Baumert, 2010; Walberg & Paik, 2000). The ranges for participants to indicate their educational experience were selected based on ranges used in articles and studies used in the literature review. (Wankat, 2001; Yalcin & Kaw, 2011) The questions regarding the background of the Algebra 1 teachers were developed to identify any relationships between students' achievement scores and (a) teachers' years of experience and (b) completion of advanced degrees.

Data Collection

Collection of data occurred after approval of the study was received from the University of Central Florida's Institutional Review Board (Appendix B) and the school district of interest in the study (Appendix C). The researcher administered the teacher homework survey through Qualtrics. The survey was sent to all teachers of Algebra 1 in the study district. After three weeks 22 surveys were completed. One survey was omitted from the data analysis, as the participant who completed the survey was not the primary teacher. Participants in the study were those who completed the homework grading practice survey.

Upon receipt of the study district's research approval chair, the researcher contacted the study district requesting a list of all student achievement scores for all of the Algebra 1 teachers in the study district. Two days later the researcher was given the information on a USB drive in an Excel spreadsheet. The student achievement scores were given to the researcher in de-identified digital form in an Excel spreadsheet. Upon receipt of the student achievement data, school names were changed to a numerical school identification number. An additional

numerical identification field was added to the data sheet that delineated the student achievement scores as to whether they were for middle or high school students.

The researcher matched the teacher surveys with the student data. After matching the survey data with the student achievement scores, teachers' names were deleted. The matching of teacher surveys to student achievement scores allowed for the inclusion of moderator variables, educational experience and educational attainment. The data from the two sources were created using an Excel spreadsheet. The Excel spreadsheet was then uploaded into the Statistical Package for Social Sciences (SPSS 24) for analysis.

Using the Statistical Package for Social Sciences (SPSS 24), a two-way ANOVA, descriptive statistics, cross-tabulation tables, and frequency tables were used to analyze the data. Descriptive statistics, cross-tabulation tables, and frequency tables were used to present an overall picture of the various types of homework assignments and practices of teachers of Algebra 1 at the secondary level.

A two-way ANOVA is a statistical test that accounts for two independent variables (Steinberg, 2011, p. 236). The two-way ANOVA was used to compare the mean differences between two independent variables; further detail is presented in the data analysis for Research Questions 2 and 3. The two-way ANOVA along with the estimated marginal means enabled the identification of any interaction effects resulting from the two-way ANOVA. (Steinberg, 2011).

Data Analysis

Research Question 1

In what ways and to what extent do homework practices vary by school and teacher characteristics?

Four sub-questions were developed to investigate homework practices. These sub-questions investigate: homework assignment, homework frequency, homework type, and how the homework is graded.

Research Question 1a

In what ways and to what extent do teacher practices vary regarding the assignment of homework in Algebra 1?

Cross-tabulation tables were used to respond to this question, displaying results for teacher practices regarding assignment of homework. The results were disaggregated by school level, educational attainment of the instructor, and educational experience of the instructor.

Research Question 1b

For Research Question 1b (*In what ways and to what extent do teacher practices vary regarding the frequency of assigning homework for Algebra 1?*), cross-tabulation tables were used to display results for the frequency with which teachers of Algebra 1 assigned homework to their students. The frequency with which Algebra 1 homework was assigned was disaggregated by school level, educational attainment of the instructor, and educational experience of the instructor.

Research Question 1c

For Research Question 1c (*In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?*), cross-tabulation tables were used to display the results for the type of Algebra 1 homework that was assigned to students. The type of Algebra 1 homework assigned was disaggregated by school level, educational attainment of the instructor, and educational experience of the instructor.

Research Question 1d

For Research Question 1d (*In what ways and to what extent do teacher practices vary with regard to the way in which homework for Algebra 1 is graded?*), cross-tabulation tables were used to display the results of the analysis of Algebra 1 teachers' practices in grading their students' homework. The way in which students were graded in their Algebra 1 homework was disaggregated by school level, educational attainment of the instructor, and educational experience of the instructor.

Research Question 2

In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?

A two-way ANOVA was used to investigate if and how student outcomes varied based on the frequency with which homework was assigned. The two-way ANOVA was run using the Statistical Package for Social Sciences (SPSS 24) and included the moderator variables of educational experience and educational attainment. The design allowed for investigating whether a statistically significant relationship existed between student achievement and the frequency with which homework was assigned.

The researcher also investigated whether there were any significant interaction effects between (a) homework frequency and educational experience, (b) homework frequency and educational attainment. To accomplish this, estimated marginal means for the different variables were used in the analysis of data. The estimated marginal mean is used to determine the mean value while considering the different variables in the two-way ANOVA. The mean value may be slightly different than the straight mean value because of the additional variables. (Grace-Martin, 2013).

Research Question 3

In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

A two-way ANOVA was used to investigate if and how student outcomes varied according to the way in which homework was graded. The two-way ANOVA to respond to Research Question 3 was run using the Statistical Package for Social Sciences (SPSS 24) and included the moderator variables of educational experience and educational attainment. The design allowed for investigating whether a relationship existed between student achievement and the way in which homework was graded.

The researcher also investigated whether there were any significant interaction effects between (a) homework grading practices and educational experience, (b) homework grading practices and educational attainment. To accomplish this, estimated marginal means for the different variables were used in the analysis of data. The estimated marginal mean is used to determine the mean value while considering the different variables in the two-way ANOVA. The mean value may be slightly different than the straight mean value because of the additional variables. (Grace-Martin, 2013).

Limitations

Because the study was conducted in a single school district, the results were not readily generalizable to other schools and other school districts; however, cautious generalizations may be warranted based on the results. Using only Algebra 1 teachers and their students limited the study of grading practices to those two groups of participants. The exclusion of other academic disciplines within the K-12 schools also limited the generalizability of the relationship between homework grading practices and student outcomes. The study design, causal-comparative, does not support causal inferences. However, the design allowed examination of the relationships

between the variables. Using self-report survey data limits the study in that the participants may not respond truthfully. A final limitation of the study is through the use of the two-way ANOVA.

Summary

The methods and procedures used to conduct the present study on the homework practices of Algebra 1 teachers in a large suburban school district have been presented in this chapter. Included was a description of the two sources of data: a researcher-developed survey and student achievement data used in the research. Data collection strategies were described and the methods used to respond to the three research questions were detailed. The results of the analysis of data are presented in Chapter 4.

CHAPTER 4 RESULTS

Introduction

This study was designed to examine student achievement as measured by the Florida Department of Education's Algebra 1 end-of-course assessment (EOC) through the lens of the homework practices of teachers of Algebra 1 in a large suburban school district in Florida. The researcher also considered the educational attainment and the educational experience of participating Algebra 1 teachers. This chapter has been organized to present (a) descriptive statistics, (b) statistical analysis of the data in response to the research questions which guided the study, and (c) a summary of the chapter's contents. Following are the three research questions and sub-questions which guided the study,

1. In what ways and to what extent do homework practices vary by school and teacher characteristics?
 - a. In what ways and to what extent do teacher practices vary with regard to the assignment of homework in Algebra 1?
 - b. In what ways and to what extent do teacher practices vary with regard to the frequency of assigning homework for Algebra 1?
 - c. In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?
 - d. In what ways and to what extent do teacher practices vary regarding the grading of Algebra 1 homework?
2. In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?

3. In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

Algebra 1 in the Study School District

Table 5 provides an overview of study district’s Algebra 1 end-of-course (EOC) assessment pass rate for each grade level in the middle and high schools for the 2017-2018 school year. The pass rate for Algebra 1 in Grades 6-8 (middle school) was significantly higher than the pass rate for Algebra 1 end-of-course assessments for students in Grades 9-12 (high school). This disparate pass rate was one motivation for the researcher’s investigation of the relationship between homework practices of teachers of Algebra 1 and student achievement as measured by the Algebra 1 end-of-course assessment.

Table 5

2018 End-of-course (EOC) Examination Algebra 1 Student Pass Rates

School District	Grade Level							
	All	6	7	8	9	10	11	12
Pass Rate								
Student count	5,077	1	586	1,895	2,524	61	10	N/A
Percentage	66	N/A	99	91	41	20	60	N/A
Developmental Scale Score								
Mean	506	N/A	538	522	488	468	498	N/A

Source. FDOE (2018).

Descriptive Statistics

The study participants consisted of 1,680 students and 21 teachers at the secondary level. The teacher participants in the study represented 24% of the total teachers of Algebra 1 in the study district. Of the student participants in the study, 40.6% were at the middle school level and 59.4% were at the high school level. The participants in the study taught at seven different high schools and seven different middle schools in the study district. The average free-and-reduced priced lunch percentage of the middle schools that participated in the study was 45% of the

student population. The average free-and-reduced priced lunch percentage of the high schools that participated in the study was 41%. The average free-and-reduced lunch percentage for all middle schools in the study district was 46%. The average free-and-reduced priced lunch percentage for all high schools in the study district was 38.5%. (Students, 2018) The study used homework practices of teachers of Algebra 1 and those teachers’ corresponding student achievement results as indicated by the Algebra 1 End-of-Course assessment (EOC).

The Algebra 1 EOC score is reported as a developmental scale score on a scale of 425 – 575. For students to be considered proficient in Algebra 1, they needed to have a minimum score of 497. Table 6 provides an overview of the student Algebra 1 results by school level and overall for teachers who participated in the study. The middle school Algebra I students ($M = 523.82$, $SD = 20.34$), on average, scored higher than their high school counterparts ($M = 490.05$, $SD = 27.84$).

Table 6

Algebra 1 End-of-course (EOC) Assessment: Developmental Scale Scores (DSS) by School Level

Grade Level	N	DSS Mean	Minimum	Maximum	Std. Deviation
Middle School	682	523.82	429	575	20.338
High School	998	490.05	425	575	27.838
All Levels	1680	503.76	425	575	30.053

Experience levels of teachers were analyzed using data obtained from the researcher-developed survey. Experience levels report the number of years that the teacher had taught Algebra 1. Students of teachers with less than five years of experience (56.1%) teaching Algebra 1 made up the majority of the study compared to 18% for teachers who had taught Algebra 1 for 6 – 20 years, and 25.8% of teachers who had taught Algebra 1 for more than 20 years. Table 7

displays the results for the years of experience in teaching Algebra 1 of the teachers who participated in the study.

Table 7

Algebra 1 Students by Teachers' Years of Experience Teaching Algebra 1

School Level	Teachers' Years of Experience		
	Less than 5 Years	6–20 Years	More than 20 Years
Middle School			
Student count	307	0	375
Percentage	45.0	0	55.0
High School			
Student count	636	303	59
Percentage	63.7	30.4	5.9
All Levels			
Student count	943	303	424
Percentage	56.1	18.0	25.8

Educational attainment of teachers was analyzed using data obtained from the researcher-developed survey. Educational attainment levels report the highest degree Algebra 1 teachers had earned. The majority of students (52.6%) were taught by teachers with a master's degree, followed by 39.1% of students who were taught by teachers with bachelor's degrees, and 8.3% of students who were taught by teachers with a specialist degree. Table 8 displays the results for the educational attainment of the teachers who participated in the study.

Table 8

Algebra 1 Students by Teachers' Educational Attainment

School Level	Teachers' Highest Degree Earned		
	bachelor's (B.A., B.S.)	master's (M.A., M.S., M.Ed., MAT)	Specialist (Ed.S)
Middle School			
Student count	395	148	139
Percentage	57.9	21.7	20.4
High School			
Student count	262	736	0
Percentage	26.3	73.7	0
All Levels			
Student count	657	884	139
Percentage	39.1	52.6	8.3

Teacher homework frequency was analyzed using data obtained from the researcher-developed survey. Survey respondents were asked to report how often they assigned homework to their Algebra 1 students. The majority of students were assigned homework one to two times a week (46.3%) or three to four times a week (31.7%). Of the Algebra 1 students, 14.8% received homework daily, and 7.2% of students received no homework. Table 9 displays the results for the frequency with which homework was assigned by school level.

Table 9

Homework Frequency by School Level

School Level	No homework	Assigned Homework		
		1-2 times Weekly	3-4 times Weekly	5 times Weekly
Middle School				
Student count	0	143	291	248
Percentage	0	21	42.7	36.4
High School				
Student count	121	635	242	0
Percentage	12.1	63.6	24.2	0
All Levels				
Student count	121	778	533	248
Percentage	7.2	46.3	31.7	14.8

Survey respondents were asked to report how they graded the homework that they assigned to their students. Two categories of grading were identified with an additional combination category. The majority of students had their homework graded for completion (52.8%); 42.8% of students had their homework graded through a combination of accuracy and completion; and 1.5% of students had their homework graded for accuracy. Table 10 displays the results for grading practices of teachers by school level.

Table 10

Homework Grading Practices by School Level

School Level	Completion	Grading Practices	
		Accuracy	Completion/ Accuracy
Middle School			
Student count	274	25	383
Percentage	40.2	3.7	56.2
High School			
Student count	274	0	383
Percentage	40.2	0	56.2
All Levels			
Student count	887	25	719
Percentage	52.8	3.7	42.8

Results: Research Question 1

In what ways and to what extent do homework practices vary by school and teacher characteristics?

To answer this question, four sub-questions were developed to examine homework assignment or non-assignment, the frequency with which homework is assigned, the type of homework assigned, and the way in which homework is graded.

Research Question 1a

In what ways and to what extent do teacher practices vary with regard to the assignment of homework in Algebra 1?

To answer this question, a series of cross-tabulation tables were computed to disaggregate teacher practices by school and teacher characteristics. The majority of Algebra 1 students were assigned homework. All middle school students received instruction in an Algebra 1 classroom where homework was assigned. At the high school level, 877 (87.9%) of students

received instruction in an Algebra 1 classroom where homework was assigned. Table 11 displays the results for homework assignment by school level.

Table 11

Homework Assignment by School Level

Homework	Middle School	High School
No		
Student count	0	121
Percentage	0	12.1
Yes		
Student count	682	877
Percentage	100	87.9
Total		
Student count	682	998
Percentage	100	100

Across all three categories of highest degree earned, more than 90% of students were in classes where teachers reported assigning homework. Among students with teachers who held a bachelor’s degree, 92.5% were in classes where homework was assigned. Among students with teachers who held a master’s degree, 91.9% were in classes where homework was assigned. Among students with teachers who held a Specialist degree, 100% were in classes where homework was assigned. Table 12 displays the results for homework assignment by educational attainment of the teacher.

Table 12

Homework Assignment by Teachers' Educational Attainment

Homework Assigned	Teachers' Highest Degree Earned		
	Bachelor's (B.A., B.S.)	Master's (M.A., M.S., M.Ed., MAT)	Specialist (Ed.S)
No homework assigned			
Student count	49	72	0
Percentage	7.5	8.1	0
Homework assigned			
Student count	608	812	139
Percentage	92.5	91.9	100
Total			
Student count	657	884	139
Percentage	100	100	100

Across all three categories of educational experience of the teacher, more than 90% of students were in classes where teachers reported assigning homework. Among students with teachers who had less than five years' experience, 94.8% were in classes where homework was assigned. Among students with teachers who had six to 20 years' experience 76.2% were in classes where homework was assigned. Among students with teachers who had more than 20 years' experience, 100% were in classes where homework was assigned. Table 13 displays the results for homework assignment based on teachers' years of experience teaching Algebra 1.

Table 13

Homework Assignment by Years' Experience Teaching Algebra 1

Homework Assigned	Years' Experience Teaching Algebra		
	Less than 5 Years	6 – 20 Years	More than 20 Years
No homework assigned			
Student count	49	72	0
Percentage	5.2	23.8	0
Homework assigned			
Student count	894	23	434
Percentage	94.8	76.2	100
Total			
Student count	943	95	434
Percentage	100	100	100

Research Question 1b

In what ways and to what extent do teacher practices vary with regard to the frequency of assigning homework for Algebra 1?

To respond to this sub-question, a series of cross-tabulation tables were computed to disaggregate teacher practices by school and teacher characteristics. The frequency with which homework was assigned varied across the middle and high school levels, with middle school students often receiving homework more often than their high school counterparts. The majority of middle school students (79.1%) were assigned homework three to five times a week (specifically, 42.7% had homework 3-4 times per week and 36.4% had homework every day), whereas the majority of high school students (87.8%) were assigned Algebra 1 homework one to four times a week (specifically, 63.6% had homework 1-2 times per week and 24.2% had homework 3-4 days per week). Table 14 displays the results for the frequency with which homework was assigned and the school level of the students.

Table 14

Homework Frequency of Assignment by School Level

Homework Assigned	Middle School	High School
No homework assigned		
Student count	0	121
Percentage	0	12.1
1 – 2 times a week		
Student count	143	635
Percentage	21.0	63.6
3 – 4 times a week		
Student count	291	242
Percentage	42.7	24.2
Daily (at least five days a week)		
Student count	248	0
Percentage	36.4	0
Total		
Student count	682	998
Percentage	100	100

Students who received Algebra 1 instruction by a teacher with a specialist degree received homework at a consistently high rate (100% were assigned homework three to four times a week). Students who received instruction from a teacher with a bachelor's degree received homework with a larger frequency spread (52.9% of students receiving homework three or more times a week) than students who received Algebra 1 instruction from a teacher with a master's degree (58.5% of students receiving homework two or less times per week). Table 15 displays the results for the frequency with which homework was assigned and the educational attainment of the teacher.

Table 15

Homework Frequency of Assignment by Teachers' Educational Attainment

Homework Assigned	Bachelors (B.A., B.S.)	Masters (M.A., M.S., M.Ed., MAT)	Specialist (Ed.S)
No homework assigned			
Student count	49	72	0
Percentage	7.5	8.1	0
1 – 2 times a week			
Student count	261	517	0
Percentage	39.7	58.5	0
3 – 4 times a week			
Student count	204	190	139
Percentage	31.1	21.5	100
Daily (at least five days a week)			
Student count	143	105	0
Percentage	21.8	11.9	0
Total			
Student count	657	884	139
Percentage	100	100	100

Students who received Algebra 1 instruction from a teacher with less than five years of experience received homework less frequently (65.5% of students receiving homework two times or less a week) than those students who received instruction from teachers with six to 20 years of teaching experience (85.8% of students receiving homework three or more times a week) or more than 20 years of teaching experience (86.4% of students receiving homework three or more times in a week). Students who were assigned homework by Algebra 1 instructors with six to 20 years of teaching experience received assignments from zero to four times a week (42.9% of students receiving homework three to four times a week and 42.9% of students receiving homework at least five times in a week). Table 16 displays the results for the

frequency with which homework was assigned based on teachers' years of experience teaching Algebra 1.

Table 16

Homework Frequency of Assignment by Years' Experience Teaching Algebra 1

Homework Assigned	Less than 5 Years	6 – 20 Years	More than 20 Years
No homework assigned			
Student count	49	72	0
Percentage	5.2	23.8	0
1 – 2 times a week			
Student count	618	101	59
Percentage	65.5	33.3	13.6
3 – 4 times a week			
Student count	133	130	270
Percentage	14.1	42.9	62.2
Daily (at least five days a week)			
Student count	133	130	270
Percentage	14.1	42.9	62.2
Total			
Student count	943	303	434
Percentage	100	100	100

Research Question 1c

In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?

This study delineated four categories of homework (practice, extension, creative, and preparation). As discussed in Chapter 2, the extant literature has categorized homework as an assignment completed outside class time. Across middle and high school levels, most students received homework categorized as practice, i.e., students completing homework on skills that

they were taught in class by their instructor. High school students tended to receive a larger variety of homework types than did their middle school counterparts. Creative homework was shown to be the least frequently assigned type of homework for any reporting category. (Lee & Pruitt, 1979)

To respond to this sub-question, a series of cross-tabulation tables were computed to disaggregate teacher practices by school and teacher characteristics. Table 17 displays the results for the type of homework students were assigned by their school level.

Table 17

Type of Homework Assigned by School Level

Homework Types	Middle School	High School
Practice		
Student count	379	635
Percentage	55.6	63.6
Practice & Extension		
Student count	282	0
Percentage	41.3	0
Practice & Preparation		
Student count	0	130
Percentage	0	13
Practice, Extension, & Creative		
Student count	0	17
Percentage	0	1.7
Practice, Extension, Creative, & Preparation		
Student count	21	95
Percentage	3.1	9.5
Total		
Student count	682	877
Percentage	100	100

Students who received instruction from teachers with Master's degrees most often received homework categorized as practice (75.2%); the same is true for students who receive instruction from a teacher with a Bachelor's degree (53.1%). Students who received instruction from teachers with a specialist degree only received Algebra 1 homework that could be categorized by practice and preparation (100%). Table 18 displays the results for the type of homework students were assigned based on the educational attainment of teachers.

Table 18

Type of Homework Assigned by Teachers' Educational Attainment

Homework Types	Bachelors (B.A., B.S.)	Masters (M.A., M.S., M.Ed., MAT)	Specialist (Ed.S)
Practice			
Student count	349	665	0
Percentage	53.1	75.2	0
Practice & Extension			
Student count	143	0	139
Percentage	21.8	0	100
Practice & Preparation			
Student count	0	130	0
Percentage	0	14.7	0
Practice, Extension, & Creative			
Student count	0	17	0
Percentage	0	1.9	0
Practice, Extension, Creative, & Preparation			
Student count	116	0	0
Percentage	17.7	0	0
Total			
Student count	608	812	139
Percentage	100	100	100

Students who received Algebra 1 instruction from instructors with less Algebra 1 teaching experience tended to receive homework involving three or more classification types (practice, extension, creative, preparation). Students receiving Algebra 1 instruction from an instructor with more teaching experience tended to receive homework that reflected one or two of the types (practice, extension, preparation). Table 19 displays the results for the type of homework students were assigned based on the educational experience of their teacher.

Table 19

Type of Homework Assigned by Years Teaching Algebra 1

Homework Types	Less than 5 Years	6 – 20 Years	More than 20 Years
Practice			
Student count	618	101	295
Percentage	65.5	33.3	68
Practice & Extension			
Student count	143	0	139
Percentage	15.2	0	32
Practice & Preparation			
Student count	0	130	0
Percentage	0	42.9	0
Practice, Extension, & Creative			
Student count	17	0	0
Percentage	1.8	0	0
Practice, Extension, Creative, & Preparation			
Student count	116	0	0
Percentage	12.3	0	0
Total			
Student count	894	231	434
Percentage	100	100	100

Research Question 1d

In what ways and to what extent do teacher practices vary regarding the grading of Algebra 1 homework?

A series of cross-tabulation tables were computed to disaggregate teacher practices by school and teacher characteristics. The homework of middle school students tended to be graded by Algebra 1 instructors using a combination of grading for accuracy and completion at a higher rate than did their high school counterparts (56.2% for middle school students and 35.4% for

high school students). Only for middle school students did instructors grade their Algebra 1 homework for accuracy (3.7%). Overall, teachers at both levels placed the most emphasis in grading homework on completion. Table 20 displays the results of the analysis of teachers' grading practices for middle and high school students.

Table 20

Homework Grading Practices by School Level

Grading Practices	Middle School	High School
Accuracy		
Student count	25	0
Percentage	3.7	0
Completion		
Student count	274	613
Percentage	40.2	64.6
Combination (Accuracy and Completion)		
Student count	383	336
Percentage	56.2	35.4
Total		
Student count	682	949
Percentage	100	100

Students who received instruction from a teacher with a bachelor's degree were the only ones who had their Algebra 1 homework graded for accuracy (4.1%). Students most often had their Algebra 1 homework graded for completion if they received instruction from a teacher with a bachelor's (53.6%) or a master's degree (63.5%). All students who received instruction from a teacher with a specialist degree had their homework graded for a combination of completion and accuracy (100%). Table 21 displays the results for the way in which student's homework was graded by the educational attainment of the teacher.

Table 21

Homework Grading Practices by Teachers' Educational Attainment

Grading Practices	Bachelors (B.A., B.S.)	Masters (M.A., M.S., M.Ed., MAT)	Specialist (Ed.S)
Accuracy			
Student count	25	0	0
Percentage	3.7	0	0
Completion			
Student count	326	561	0
Percentage	53.6	63.5	0
Combination (Accuracy and Completion)			
Student count	257	323	139
Percentage	42.3	36.5	100
Total			
Student count	608	884	139
Percentage	100	100	100

Students who received Algebra 1 instruction from a teacher with less than five years' experience were the only students who had their Algebra 1 homework graded for accuracy (2.8%). The majority of students across all instructor educational experience levels had their homework graded for completion, with the highest group of students being those who were taught by teachers with six to 20 years' experience (76/2%). Students who received instruction from teachers with more than 20 years' experience teaching Algebra 1 had the highest percentage of having their homework graded for a combination (56.2%) of completion and accuracy. Table 22 displays the results for the way in which students' homework was graded based on the educational experience of the instructor.

Table 22

Homework Grading Practices by Years of Experience Teaching Algebra 1

Grading Practices	Less than 5 Years	6 – 20 Years	More than 20 Years
Accuracy			
Student count	25	0	0
Percentage	3.7	0	0
Completion			
Student count	466	231	190
Percentage	52.1	76.2	43.8
Combination (Accuracy & Completion)			
Student count	403	72	244
Percentage	45.1	23.8	56.2
Total			
Student count	894	303	434
Percentage	100	100	100

Results: Research Question 2

In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?

To respond to Research Question 2, a two way-ANOVA was used to investigate (a) whether Algebra 1 end of course performance varied according to homework frequency (main effect) and (b) whether the relationship between homework frequency and end of course assessment scores was moderated by teacher characteristics (interaction effects). To assess the practical significance of the results, a partial Eta-squared was calculated as a measure of effect size to determine if the differences were small, moderate, or large. Tabachnick & Fidell (1989) defined partial Eta-squared differences as small if .01-.089; medium as .09 to .249; and large as .25 or more. Steinberg (2011) reported that the effect size us used to determine if the statistically significant difference is a “meaningful difference.” (Steinberg, 2011, p.385) Results obtained

from the two-way ANOVA indicated that all variables and interactions between the variables were statistically significant at $p > .05$.

Students who were assigned homework more frequently tended to have a higher developmental scale score on the Algebra 1 end-of-course assessment (i.e., main effect). The largest increase in Algebra 1 end of course assessment developmental scale score occurred between students who were assigned homework three to four times a week and those who were assigned homework five times a week. Students at the middle school were assigned homework more frequently than their high school counterparts. This assignment could lead to the conclusion that the middle school students scored higher than their high school counterparts on the Algebra 1 end of course assessment. Table 23 displays the estimated marginal means for the Algebra 1 developmental scale score results according to the frequency with which the students were assigned homework.

Table 23

Mean Developmental Scale Score by Homework Frequency

Homework Frequency	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
No homework assigned	481.30	2.233	476.92	485.68
1 – 2 times a week	496.27	1.103	494.10	498.43
3 – 4 times a week	501.52	1.375	498.823	504.22
Daily (at least 5 days a week)	530.18	1.550	527.14	533.22

Students who were assigned daily homework and were taught by a teacher with less than five years' experience teaching Algebra 1 had the highest estimated marginal means of Algebra 1 DSS scores ($M = 592.01$, $SD = 2.017$). In contrast, students who were assigned homework three to four times a week and were taught by an instructor with less than five years' experience ($M = 470.16$, $SD = 3.131$) had the lowest estimated marginal means Algebra 1 developmental

scale score. Table 24 displays the estimated marginal means for the Algebra 1 developmental scale score by the frequency with which students were assigned homework and their instructors' years of experience teaching Algebra 1.

Table 24

Mean Developmental Scale Scores by Homework Frequency and Years' Experience Teaching Algebra 1

Homework Frequency	Educational Experience	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
No homework assigned	Less than 5 years	475.63	3.45	468.88	482.39
	6 – 20 years	486.97	2.842	481.40	492.55
	More than 20 years				
1 – 2 times a week	Less than 5 years	496.81	.982	494.68	498.73
	6 – 20 years	510.41	2.400	505.70	515.11
	More than 20 years	481.05	3.140	474.89	487.21
3 – 4 times a week	Less than 5 years	470.16	3.131	464.02	476.30
	6 – 20 years	503.37	2.115	499.22	507.52
	More than 20 years	521.81	1.644	518.58	525.04
Daily (at least 5 days a week)	Less than 5 years	592.01	2.017	525.05	532.96
	6 – 20 years				
	More than 20 years	531.35	2.353	526.74	535.97

Students who were assigned daily homework and were taught by a teacher with a master's degree had the highest estimated marginal means on the Algebra 1 EOC ($M = 531.35$, $SD = 2.353$). In contrast, students who were assigned no homework and were taught by a teacher with a bachelor's degree had the lowest estimated marginal means on the Algebra 1 EOC ($M = 475.63$, $SD = 3.445$). Table 25 displays the estimated marginal means for the Algebra 1 developmental scale score by the frequency with which students were assigned homework and their instructors' highest degree.

Table 25

Mean Developmental Scale Scores by Homework Frequency and Highest Degree

Homework Frequency	Highest Degree	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
No homework assigned	Bachelor's	475.633	3.445	468.875	482.390
	Master's	486.972	2.842	481.398	492.547
	Specialist				
1 – 2 times a week	Bachelor's	506.571	1.493	503.643	509.499
	Master's	492.834	1.384	490.119	495.549
	Specialist				
3 – 4 times a week	Bachelor's	515.415	1.705	512.071	518.758
	Master's	490.305	2.409	485.581	495.029
	Specialist	507.381	2.045	503.369	511.393
Daily (at least 5 days a week)	Bachelor's	592.007	2.017	525.052	532.962
	Master's	531.352	2.353	526.736	535.968
	Specialist				

Table 26 displays the results for the tests of between-subjects effects to respond to Research Question 2. The two-way ANOVA identified that all variables and interactions between the variables were statistically significant at $p > .05$. The results show that the differences in Algebra 1 scores between homework frequency alone, $F(3, 1666) = 108.91, p > .05$, or the interaction effect between homework frequency and educational experience $F(2, 1666) = 58.604, p > .05$, and the interaction effect between homework frequency and highest degree $F(1, 1666) = 17.111, p > .05$ have a less than five chance in 100 that the results are due to chance and are significant.

The test for effect size, partial Eta-squared, was considered only for the significant results: homework frequency, educational experience, and educational attainment. For homework frequency, partial Eta-squared was .164, a medium effect size; for the interaction of

educational experience, partial Eta-squared was .066, a small effect size; for the interaction of educational attainment, partial Eta-squared was .010, a small effect size.

Table 26

Tests of Between-subject Effects: Homework Frequency by Educational Experience by Highest Degree

Source	Type III Sum of Squares	Df	Mean Squares	F	Sig.	Partial Eta Squared
Corrected Model	547545.05	13	42118.85	72.42	.000	.361
Intercept	183477782.3	1	183477782.3	315489.06	.000	.995
HW Frequency	190014.28	3	63338.1	108.91	.000	.164
Educational Experience	137231.15	2	68615.57	117.98	.000	.124
Highest Degree	111315.48	2	55657.74	95.703	.000	.103
HW Frequency x Educational Experience	68164.05	2	34082.02	58.604	.000	.066
HW Frequency x Highest Degree	9951.092	1	9951.10	17.111	.000	.010
Error	968889.35	1666	581.566			
Total	427853157.0	1680				
Corrected Total	1516434.40	1679				

A plot of the interaction effects of homework frequency and the educational experience of Algebra 1 teachers is depicted in Figure 3. This figure reveals that students who were assigned more homework had higher estimated marginal means on the Algebra 1 end-of-course assessments. The results suggest that teachers with less than five years' experience who do not assign homework have students who score $M = 475.63$, $SD = 3.445$ on the Algebra 1 EOC; teachers who have six to 20 years of experience and do not assign homework have students who score $M = 486.972$, $SD = 2.842$ on the Algebra 1 EOC. Teachers who have less than five years' experience who assign homework one to two times a week have students who score $M = 496.808$, $SD = .982$ on the Algebra 1 EOC; teachers who assign homework one to two times a week who have six to 20 years' experience have students who score $M = 510.406$, $SD = 2.400$ on the Algebra 1 EOC; teachers who assign homework one to two times a week who have more than 20 years' experience have students who score $M = 486.061$, $SD = 3.140$ on the Algebra 1 EOC. Teachers who assign homework three to four times a week and have less than five years' experience have students who score $M = 470.162$, $SD = 3.131$ on the Algebra 1 EOC; teachers who assign homework three to four times a week and have six to 20 years' experience have students who score $M = 503.369$, $SD = 2.115$ on the Algebra 1 EOC; teachers who assign homework three to four times a week and have more than 20 years' experience have students who score $M = 521.811$, $SD = 1.644$ on the Algebra 1 EOC. Teachers who assign homework daily and have less than five years' experience have students who score $M = 529.007$, $SD = 2.017$ on the Algebra 1 EOC; teachers who assign homework daily and have more than 20 years' experience have students who score $M = 531.352$, $SD = 2.353$ on the Algebra 1 EOC.

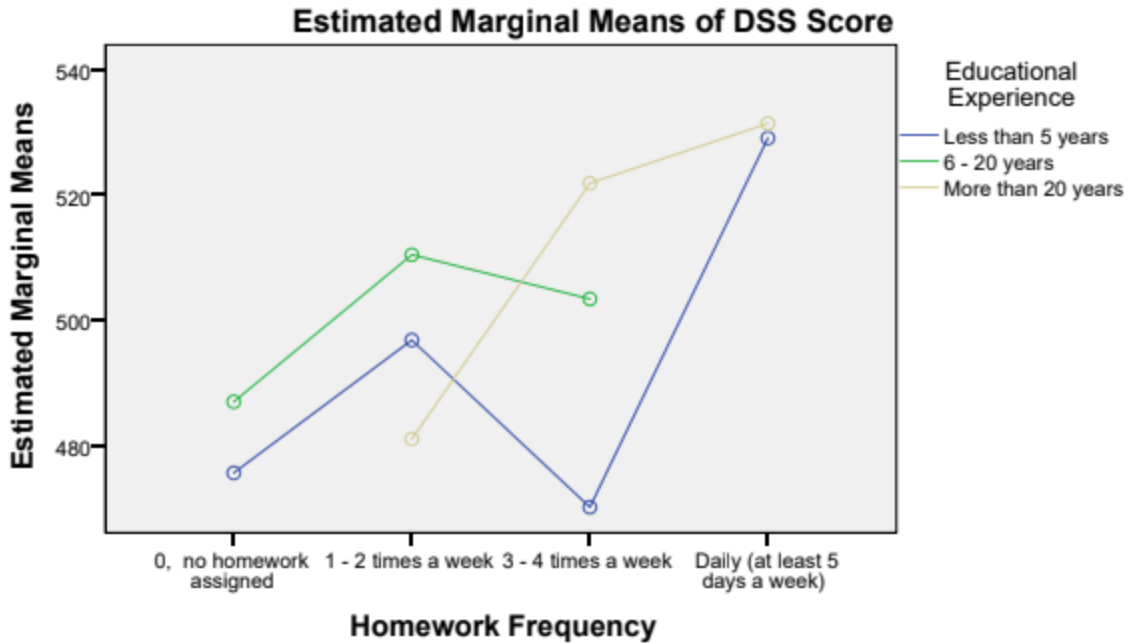


Figure 3. Algebra end-of-course assessment: Interaction effect between homework frequency and the educational experience of the instructor

A plot of the interaction effects of homework frequency and the highest degree the instructor held is shown in Figure 4, showing that students who received homework more frequently, and from a teacher with a bachelor's degree, had higher estimated marginal means on the Algebra 1 end-of-course assessment. Teachers who have a bachelor's degree and do not assign homework have students who score $M = 475.633$, $SD = 3.445$ on the Algebra 1 EOC; teachers who have a master's degree who do not assign homework have students who score $M = 486.972$, $SD = 2.842$ on the Algebra 1 EOC. Teachers who have a bachelor's degree who assign homework one to two times a week have students who score $M = 506.571$, $SD = 1.493$ on the Algebra 1 EOC; teachers who have a master's degree who assign homework one to two times a week have students who score $M = 492.834$, $SD = 1.384$ on the Algebra 1 EOC. Teachers who assign homework three to four times a week who have a bachelor's degree have students who score $M = 515.415$, $SD = 1.705$ on the Algebra 1 EOC; teachers who assign homework three to four times a week and have a master's degree have students who score $M = 490.305$, $SD = 2.409$

on the Algebra II EOC; teachers who assign homework three to four times a week and have a specialist degree have students who score $M = 507.381$, $SD = 2.045$ on the Algebra 1 EOC.

Teachers who assign homework daily and have a bachelor's degree have students who score $M = 529.007$, $SD = 2.017$ on the Algebra 1 EOC; teachers who assign homework daily and have a master's degree have students who score $M = 531.252$, $SD = 2.353$ on the Algebra 1 EOC.

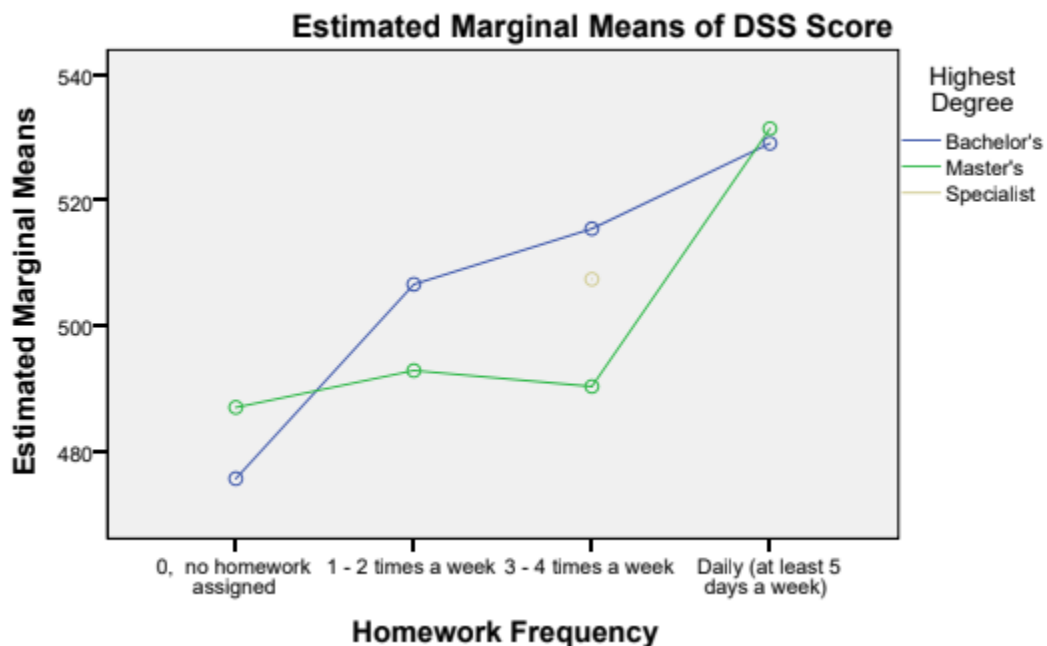


Figure 4. Algebra I end-of-course assessment: Interaction effect between homework frequency and the highest degree held by instructors.

Research Question 3

In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

The two-way ANOVA identified that all variables and interactions between the variables were statistically significant at $p > .05$ except for the interactions between how homework was graded and the degree that the teacher held. Table 27 displays the results for the tests of between-subjects' effects for Research Question 3. The results show that the differences in Algebra 1 scores between homework grading practice alone, $F(2, 1620) = 17.37$, $p > .05$, or the

interaction effect between homework grading and educational experience, $F(2, 1620) = 69.597$, $p > .05$ have a less than five chance in 100 that the results are due to chance and are significant.

The results show that the interaction of homework grading practice and highest degree held, $F(1, 1620) = 5.47$, $p > .19$ was not statistically significant.

The results for effect size, partial Eta-squared, was considered only for the significant results, homework grading practice, educational experience, and highest degree. For homework grading practice, partial Eta-squared was .021, a small effect size; for the interaction of educational experience, partial Eta-squared was .079, a small effect size; for the interaction of educational attainment, partial Eta-squared was .003, a small or non-existent effect size.

Table 27

Tests of Between-subjects Effects: Homework Grading Method by Educational Experience by Highest Degree Held

Source	Type III Sum of Squares	Df	Mean Squares	F	Sig.	Partial Eta Squared
Corrected Model	389293.90	10	38929.39	59.66	.000	.269
Intercept	137024660.2	1	137024660.2	209998.556	.000	.992
HW Grading Method	22668.484	2	11334.24	17.37	.000	.021
Educational Experience	201114.82	2	100557.41	154.11	.000	.160
Highest Degree Held	206899.52	2	103449.76	158.54	.000	.164
HW Grading Method x Educational Experience	90824.819	2	45412.41	69.597	.000	.079
HW Grading Method x Highest Degree	3571.17	1	3571.17	5.47	.019	.003
Error	1057054.65	1620	652.50			
Total	416737901	1631				
Corrected Total	1446348.55	1630				

Students who had their homework graded for accuracy had a higher developmental scale score on the Algebra 1 end-of-course assessment (i.e., main effect). The largest difference in Algebra 1 end of course assessment developmental scale scores occurred between students who had their homework graded for accuracy ($M = 538.92$) and those students who had their homework graded for a combination of accuracy and completion ($M = 502.08$). Survey results indicated that only middle school students had their homework graded for accuracy. Table 28 displays the estimated marginal means for the Algebra 1 developmental scale score results according to the how the student’s homework was graded.

Table 28

Mean Developmental Scale Score by Grading Practice

Homework Frequency	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Accuracy	538.92	5.109	528.90	548.94
Completion	508.31	.943	506.46	510.16
Combination	502.08	1.039	500.04	504.12

Students who had their homework graded for accuracy and were taught by a teacher with less than five years’ experience had the highest Algebra 1 EOC scores ($M = 538.92$, $SD = 5.637$). In contrast, students who had their homework graded for a combination of accuracy and completion and were taught by a teacher with six to 20 years of experience scored the lowest on the Algebra 1 EOC ($M = 486.972$, $SD = 3.322$). Table 29 shows the estimated marginal means for the Algebra 1 DSS scores based on the way homework was graded and instructor’s years of experience teaching Algebra 1.

Table 29

Mean Developmental Scale Scores by Homework Grading Practice and Years' Experience Teaching Algebra 1

Homework Frequency	Educational Experience	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Accuracy	Less than 5 years	538.92	5.637	527.864	549.976
Completion	Less than 5 years	500.221	1.306	497.660	502.782
	6 – 20 years	506.446	1.854	502.809	510.083
	More than 20 years	516.095	2.045	512.084	520.105
Combination	Less than 5 years	496.288	1.404	493.534	499.042
	6 – 20 years	486.972	3.322	480.457	493.487
	More than 20 years	517.697	1.804	514.158	521.236

Students who had their homework graded for accuracy and were taught by a teacher with a bachelor's degree had the highest Algebra 1 EOC scores ($M = 538.920$, $SD = 5.700$). In contrast, students who had their homework graded for a combination of completion and accuracy and were taught by a teacher with a master's degree had the lowest Algebra 1 EOC score ($M = 497.350$, $SD = 1.586$). Table 30 shows the estimated marginal means for the Algebra 1 DSS scores by the way homework was graded and the instructor's highest degree held.

Table 30

Mean Developmental Scale Scores by Homework Frequency and Highest Degree Held

Homework Frequency	Highest Degree	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Accuracy	Bachelor's	538.920	5.700	527.740	550.100
Completion	Bachelor's	517.506	1.578	514.410	520.602

	Master's	498.116	1.203	495.756	500.476
Combination	Bachelor's	506.669	1.778	503.182	510.156
	Master's	497.350	1.586	494.240	500.460
	Specialist	507.381	2.417	502.640	512.123

A plot of the interaction effects of homework grading practice and educational experience of Algebra 1 teachers is depicted in Figure 5 which shows that students who had a teacher that graded homework for accuracy had higher mean scale scores on the Algebra 1 end-of-course assessment. The results suggest that grading homework for accuracy provides the highest score on the Algebra 1 EOC. Students who had their homework graded for accuracy and were taught by a teacher with less than five years' experience scored $M = 538.920$, $SD = 5.637$ on the Algebra 1 EOC. For students who had their homework graded for completion, students that were taught by a teacher with less than five years' experience scored $M = 500.221$, $SD = 1.306$ on the Algebra 1 EOC; students that were taught by a teacher with six to 20 years' experience scored $M = 506.446$, $SD = 1.854$ on the Algebra 1 EOC; students who were taught by a teacher with more than 20 years' experience scored $M = 516.095$, $SD = 2.045$ on the Algebra 1 EOC. For students who had their homework graded for a combination of completion and accuracy; students who were taught by a teacher with less than five years' experience scored $M = 496.288$, $SD = 1.404$ on the Algebra 1 EOC; students who were taught by a teacher with six to 20 years' experience scored $M = 486.972$, $SD = 3.322$ on the Algebra 1 EOC; students who were taught by a teacher with more than 20 years' experience scored $M = 517.697$, $SD = 1.804$ on the Algebra 1 EOC.

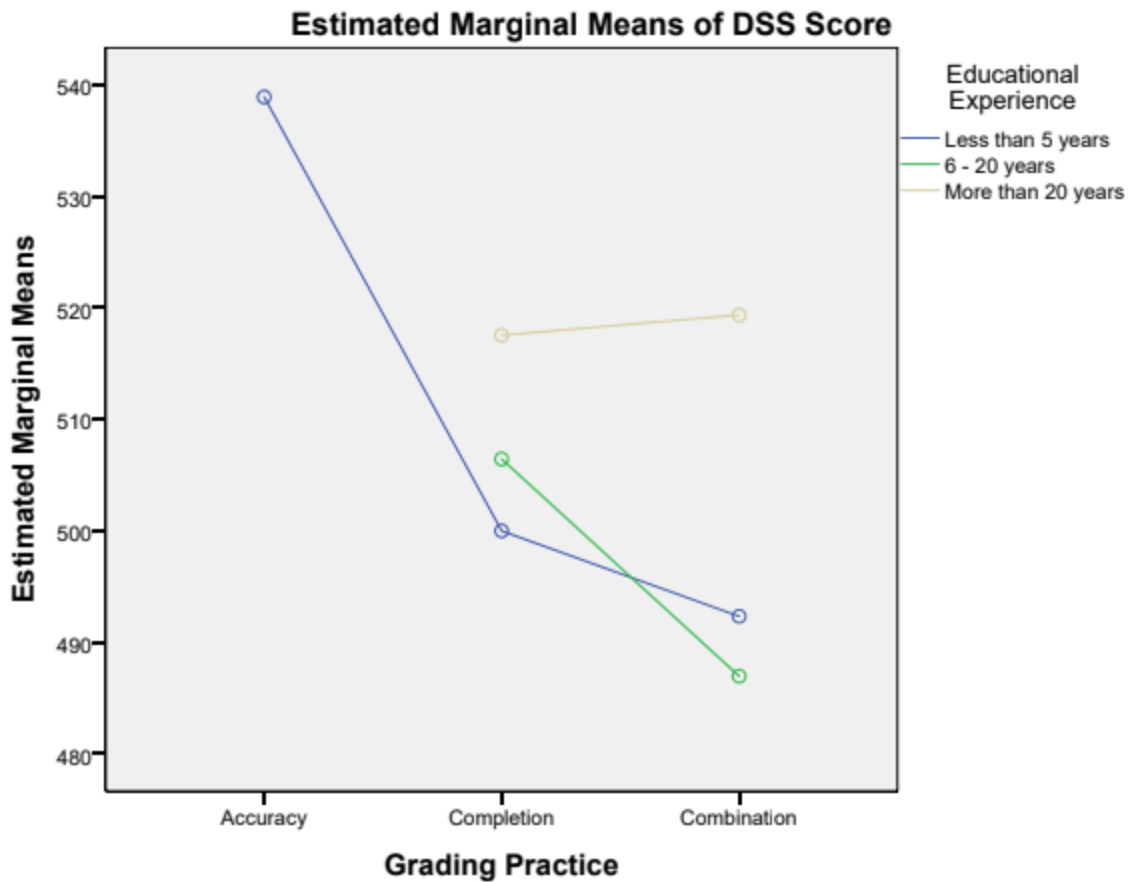


Figure 5. Algebra 1 end-of course assessment: Interaction effect between homework grading practices and educational experience of instructors.

A plot of the interaction effects of the homework grading practice and the educational attainment of the teacher is depicted in Figure 6. The figure reveals that students who were taught by teachers with bachelor’s degrees and had their homework graded for accuracy had higher mean scale scores on the Algebra 1 end-of-course assessment than did other students. Students who had their homework graded for accuracy and were taught by a teacher with a bachelor’s degree scored $M = 538.920$, $SD = 5.700$ on the Algebra 1 EOC. For students who had their homework graded for completion; students who were instructed by a teacher with a bachelor’s degree scored $M = 517.506$, $SD = 1.578$ on the Algebra 1 EOC, students who were instructed by a teacher with a master’s degree scored $M = 498.116$, $SD = 1.203$ on the Algebra 1 EOC. For students who had their homework graded for a combination of completion and

accuracy; students who were taught by an instructor with a bachelor's degree scored $M = 506.669$, $SD = 1.778$ on the Algebra 1 EOC, students who were taught by an instructor with a master's degree scored $M = 497.350$, $SD = 1.586$ on the Algebra 1 EOC.

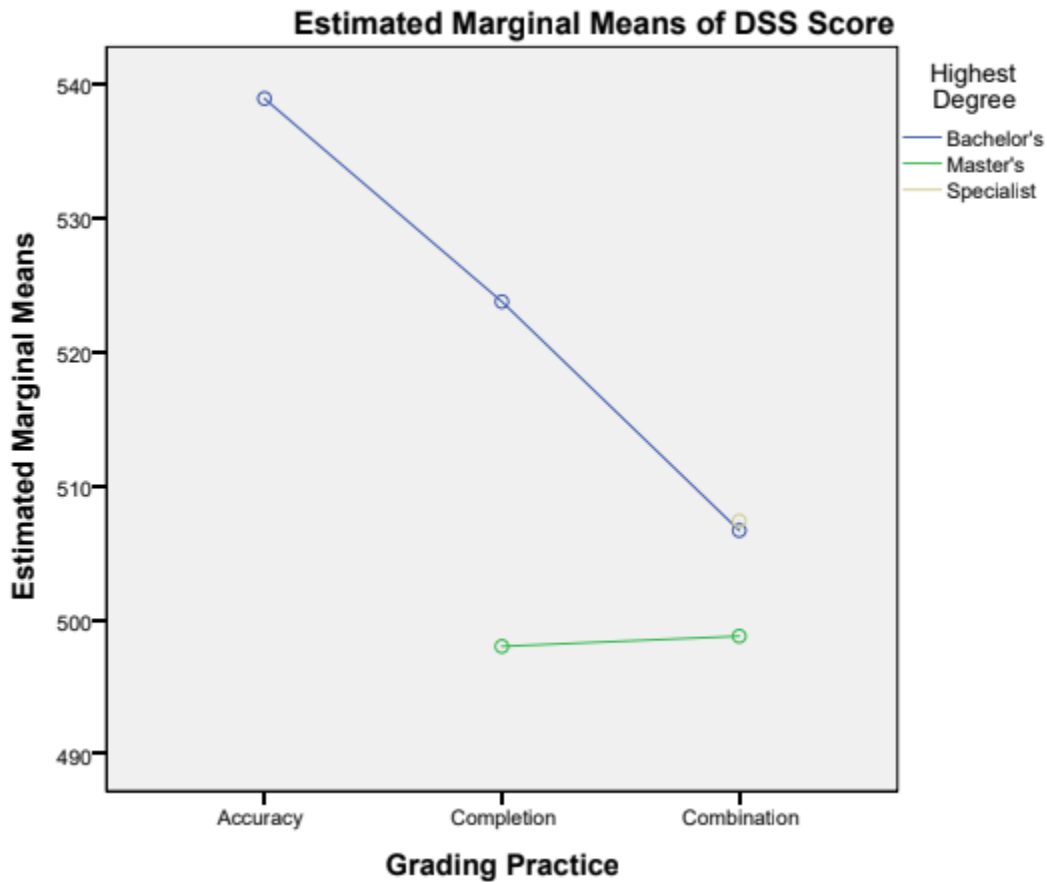


Figure 6. Algebra 1 end-of-course assessment: Interaction effect between homework grading practices and educational attainment of instructors.

Summary

This chapter presented the results of the study conducted to investigate the relationship between homework practices of teachers of Algebra 1 and student achievement as measured by the Florida Department of Education's (FDOE) Algebra 1 End-of-course Assessment (EOC). The results indicated a statistical significance for all variables and interactions with the exception of the interaction of grading practice and educational attainment by the teacher.

A cross-tabulation table was used to answer Research Question 1a, with results indicating that (a) middle school students were assigned homework more frequently than high school students; (b) students taught by teachers with master's degrees were assigned homework less frequently than students taught by teachers with bachelor's degrees or Specialist degrees; and (d) students taught by teachers with less experience were less frequently assigned homework.

A cross-tabulation table was used to answer research question, sub-question 1b with results indicating that (a) middle school students received homework more frequently than high school students; (b) students taught by teachers with bachelor's degrees or Specialist degrees were assigned homework more frequently than students taught by teachers with master's degrees; and (c) students taught by a teacher with 20 or more years of experience received homework more frequently than those students taught by a teacher with less experience.

A cross-tabulation table was used to answer research sub-question 1c, with results indicating that (a) high school students received a larger variety of homework than their middle school counterparts, (b) students taught by teachers with Specialist degrees saw less variety in their homework than did their counterparts taught by teachers with bachelor's or master's degrees; and (c) students taught by teachers with five or less years' experience had a larger variety of homework than did students taught by teachers with more than five years of experience.

A cross-tabulation table was used to answer sub-question 1d of Research Question 1, with results indicating that (a) middle school students were the only ones to have their homework graded exclusively for accuracy, (b) the homework of students taught by teachers with specialist degrees had their homework graded using a combination of completion and accuracy; and (c)

students who were taught by teachers with 20 years of experience or less were most likely to have their homework graded for completion.

A two-way ANOVA was used to answer Research Question 2 with results indicating that (a) the students who were assigned homework more frequently had a higher mean DSS score, (b) all interactions between variables were shown to be statistically significant at $p < .05$; and (c) students taught by teachers with a Specialist degree had the highest mean DSS scores.

A two-way ANOVA was used to answer Research Question 3. Results indicated that (a) students taught by a teacher with more experience had a higher mean DSS score; (b) all interactions, except the interaction between how homework was graded and the degree the teacher held, were statistically significant at $p > .05$; and (c) students who had their homework graded for accuracy had the highest mean DSS scores.

Chapter 5 contains a discussion of these findings, their relationship to teacher practice, and how the findings add to the literature. Recommendations for practice and recommendations for further research are also offered.

CHAPTER 5 DISCUSSION

Introduction

The results of the study were analyzed and presented in Chapter 4. This chapter contains a summary of the study, a discussion of the implications for practice, and recommendations for future researchers. The implications for practice are presented within the discussion of results for the individual research questions. The summary of the study includes a restatement of the problem of practice, purpose of the study, research questions, and methods used to collect and analyze the data.

Study Summary

Research on the relationship of homework and student achievement have shown mixed results (Cooper, 1989, Cooper & Valentine, 2001; Kunter & Baumert, 2010; Lee & Pruitt, 1979), and implications varied based on several factors (e.g., age of student, homework frequency, and homework type). The impact and importance of homework on student outcomes has been the frequent subject of research. (Cooper, 1989, Cooper et al., 2006; Cooper & Valentine, 2001; Trautwein et al., 2006; Walberg & Paik, 2000). Homework is different from practice completed in the classroom in that the homework is practice beyond the limits of the school and its faculty. The intention of homework has been to reinforce or introduce concepts that were explored in some type of educational setting.

At the time of the present study, Algebra 1 was a mathematics course taught at the secondary school level in the state of Florida and was also a Florida high school graduation requirement (Florida Constitution 1003.4282). In the study district there has historically been a disparate pass rate on the Algebra 1 end-of-course assessment (EOC) between students who take Algebra 1 at the middle school and high school levels. A review of the literature did not

adequately support conclusions as to whether or how the method the teacher uses to grade homework impacts student outcomes.

This study was designed to investigate the relationships, if any, between homework grading practices of teachers of Algebra 1 and student outcomes as measured by the Florida Department of Education's Algebra 1 EOC. Moderator variables of teacher educational attainment, and educational experience were used. The study was guided by the following three research questions.

1. In what ways and to what extent do homework practices vary with regard to teacher characteristics?
 - a. In what ways and to what extent do teacher practices vary regarding the assignment of homework in Algebra 1?
 - b. In what ways and to what extent do teacher practices vary regarding the frequency of assigning homework for Algebra 1?
 - c. In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?
 - d. In what ways and to what extent do teacher practices vary regarding the way in which homework for Algebra 1 is graded?
2. In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?
3. In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

Data to answer Research Question 1 (i.e., sub-questions 1a, 1b, 1c, and 1d) were obtained through a researcher created survey and administered to Algebra 1 teachers in the study

district. The survey was completed through Qualtrics and then transferred to an Excel spreadsheet for uploading and analysis into Statistical Package for Social Sciences (SPSS 24).

Research Question 2 data were obtained from two sources. Student achievement data were obtained through the study school district's central office and associated with each classroom teacher using an Excel spreadsheet. Teacher practice data was obtained through a researcher created survey and administered to Algebra 1 teachers in the study district. This data was also transferred to an Excel spreadsheet for uploading and analysis into SPSS 24. After merging the two Excel spreadsheets into SPSS, teachers' names were deleted from the SPSS file. The SPSS file was used to run a two-way ANOVA to answer Research Question 2.

Research Question 3 data were obtained from two sources. Student achievement data was obtained through the study district's central office and associated with each the classroom teacher using an Excel spreadsheet, which was then uploaded to SPSS. Teacher practice data was obtained through a researcher created survey and administered to Algebra 1 teachers in the study district via Qualtrics. The Qualtrics data was downloaded to an Excel spreadsheet. The two Excel spreadsheets were merged into SPSS 24, and teachers' names were deleted from the SPSS file. The SPSS file was used to run a two-way ANOVA to answer Research Question 3.

Discussion of Findings: Research Question 1

In what ways and to what extent do homework practices vary by school and teacher characteristics?

Research Question 1 was divided into four sub-questions to examine (a) homework assignment or non-assignment, (b) the frequency with which homework was assigned, (c) the type of homework assigned, and (d) the way in which homework was graded.

Research Sub-question 1a

In what ways and to what extent do teacher practices vary regarding the assignment of homework in Algebra 1?

Variances in teacher practices regarding the assignment of Algebra 1 homework were analyzed using cross-tabulation tables. Homework has been present in education for well over 100 years (Cooper, 1989). For the purposes of this study, homework was defined as “practice done outside the construct of a school, typically done at home” (Cooper, 1989, p. 86). Trautwein (2003) and Bembenuity (2011) wrote that although students are assigned homework, many students complete homework assignments during the school day during other instructional and non-instructional times.

Survey results indicated that, without exception, all middle school students were assigned homework and that the majority (87.9%) of high school students received homework. Survey results indicated that students who were not assigned homework had teachers with a bachelor’s or master’s degree. All students who were taught by an instructor with a specialist degree received homework for the 2017 – 2018 school year. Of the students’ not assigned homework, a majority (23.8%) were taught by a teacher with six to 20 years of experience. All of the students

who were taught by a teacher with a specialist degree (139) received homework during the 2017 – 2018 school year.

Implications for Practice

Students are commonly assigned homework as a means of extending the learning day. Cooper (1989) as cited in Kistansantas et al. (2011) said, “The most potent factor affecting achievement was the amount of homework the student actually completed as opposed to the amount of homework that was assigned” (p. 312). The findings of this study support the use of homework as practice to increase student achievement. The students who were assigned homework, practice outside the construct outside of the school day, had higher Algebra 1 end of course assessment scores than those students that were not assigned homework.

If students were not assigned homework they would not be afforded the opportunities that those students who were assigned homework were allowed. For students to have the opportunity to complete homework, they must first receive an assignment. Assigning homework to students allows them to practice skills and concepts they were taught in class, thereby increasing the learning time they are afforded by their school.

Research Sub-question 1b

In what ways and to what extent do teacher practices vary regarding the frequency of assigning homework for Algebra 1?

Variances in teachers’ frequency of assigning Algebra 1 homework were analyzed using cross-tabulation tables. This was appropriate given that the frequency with which homework is assigned can vary based on school level (middle school or high school), the educational experience of the teacher, the educational attainment of the teacher, and the schedule of the school day for the students.

Practice is a strategy used across many disciplines and fields. There is a colloquialism often used stating that “practice makes perfect.” Practice provides additional opportunities for people to practice skills; homework can be classified as a type of practice. According to Kunter & Baumert (2010), “Homework contributes substantially to time on task in core subjects and this provides additional opportunities to learn” (p. 468). The frequency with which homework is assigned dictates the opportunities that students have to practice skills they are learning in class (homework categorized as practice), preview material before receiving instruction (homework categorized as preparation) or apply what they are learning to new contexts (homework categorized as extension or creative). Assigning homework frequently supports the use of spaced practice and allows for students to continually practice the skills they are working on. The use of spaced practice provides students with more opportunities to learn. Spaced practice is also linked to higher student achievement. (Campitelli & Gobet, 2011; Hattie, 2009)

Students at the middle school level received homework more frequently than their high school counterparts. Survey results showed that 79.1% of students at the middle school level received homework three to five times a week, compared to 24.2% of students at the high school level. All students who received instruction from a teacher with a specialist degree received homework three to four times a week. Of students who received instruction from a teacher with a master’s degree, 66.6% received homework two or less times a week. For students of teachers with only a bachelor’s degree, 52.9% received homework three to five times a week. Regarding teachers’ years of experience, survey results indicated that 70.7% of students who were taught by teachers with less than five years’ experience received homework two times or less a week. In contrast, 57.1% of students who were taught by a teacher with six to 20 years’ experience received homework two times or less a week; and 86.4% of students who were taught by a

teacher with more than 20 years' experience were assigned homework three or more times a week.

Implications for Practice

The frequency with which homework is assigned depends on several factors one of which is beyond the control of the teacher. The schedule of the school day, periods and their length, and frequency of class sessions are often determined by the school principal or the school district. How often teachers meet their students can determine the frequency of their homework assignments. One way of dealing with this factor is for teachers to map out the homework they want to assign in advance for the students in a format easy to understand (e.g., a calendar).

Teachers' practice is shaped by their teaching experience, professional development, and the knowledge that they learn through advanced coursework. Cooper (1989), in *Homework*, identified several factors that influence the effectiveness of homework. As teachers learn more about the content they are teaching and continue their education, their knowledge base increases and their practice can be affected. This could be a reason that the frequency with which homework is assigned fluctuates.

Several schools and school districts have different policies for homework (Larsen, 2016). An examination of the policies at the school and school district level has the potential to make homework more effective in regard to student outcomes. The mandating of homework guidelines has the potential to undermine teacher autonomy in the classroom.

Research Sub-question 1c

In what ways and to what extent does the type of homework assigned (practice, extension, creative, preparation) vary among teachers of Algebra 1?

Variances in type of homework assigned were analyzed using cross-tabulation tables. Lee and Pruitt (1979) classified homework into four types: (a) practice, (b) preparation, (c) extension, and (d) creative (p.32). The student outcome for each type of homework is distinct, and each type of homework is usually assigned for a specific purpose. This research supports the literature on homework composition as the survey indicated that practice was the most commonly used type of homework. (Lee & Pruitt, 1979)

Across middle and high school, the majority of students (55.6% for middle school and 63.6% for high school) received homework categorized as practice. Homework categorized for practice and extension (41.3% for middle school only) was also widely assigned to students. Homework categorized as preparation and creative was the least assigned homework type. Having practice and extension as the most often assigned homework was aligned with the research results of Lee & Pruitt (1979) and Vatterott (2010).

The teachers who were most likely to assign homework from all four categories of homework were teachers who had earned only a bachelor's degree (17.7%). Regardless of the educational attainment of the teacher, however, practice and extension served as the majority type of homework assigned to students (74.9% for teachers with a bachelor's degree, 75.2% for teachers with a master's degree, and 100% for teachers with a specialist degree).

When considering experience teaching Algebra 1, teachers with six to 20 years of experience assigned homework categorized as practice and preparation (100%). Students who received instruction from a teacher with less than five years of experience saw the greatest variance of homework assigned to them. Teachers with more than 20 years of experience most often assigned homework categorized as practice or extension.

Implications for Practice

The type of homework assigned to students should “provide feedback to teachers about student understanding” (Vatterott, 2010, p. 11). This feedback is important for the instructor as it allows them the opportunity to change their instruction based on student learning. Teachers who assign different types of homework have the potential to allow students to show their understanding of the material in different ways. Lee and Pruitt (1979) identified practice as the most common type of homework assigned to students. Having students practice material has been shown to have the potential for students to become more adept at the content and applying the skill (Hattie, 2009). However, providing feedback to students is important when they practice so that they can make adjustments or become more efficient in their application practice material. Feedback can take different forms (e.g., written, verbal, or audio/visual), and be provided with different frequencies (e.g., every problem assigned, general comments for each assignment, or not at all).

Research Sub-question 1d

In what ways and to what extent do teacher practices vary regarding the way in which homework for Algebra 1 is graded?

Variances in teachers’ Algebra 1 grading practices were analyzed using cross-tabulation tables. This study focused on three different grading practices that teachers commonly employ: (a) grading for completion, (b) grading for accuracy, and (c) grading homework for a combination of completion and accuracy. Grading for completion refers to the instructor reviewing homework to see that the problems have an answer. “Studies conducted in several countries (e.g., Germany, Hong King, Singapore) reported homework control (i.e., checking whether students have completed their homework) as the homework follow-up practice teachers in class most often in elementary and middle school levels” (Rosario et al., 2015, p. 2). Teachers

grade for accuracy when they are looking for the true value or answers of the problems students were assigned. When teachers grade for a combination of completion and accuracy, they are looking at whether the assigned problems were completed (i.e., worked out) and for specific problems or number of problems that had the true value or answer of the problem (i.e., accuracy).

Survey results indicated that middle school students had their homework most often graded for a combination of completion and accuracy (56.2% of the students sampled). Middle school students were the only students who had their homework graded for accuracy (3.7% of the students sampled). When viewed through the lens of the instructor's educational attainment, the homework of students who were taught by an instructor with a bachelor's degree (53.6% of the students sampled) or master's degree (63.5% of the students sampled) was most often graded for completion. When viewed through the lens of the instructor's educational experience, the homework of students who were taught by a teacher with less than five years' experience (52.1% of the students sampled) and six to 20 years' experience (76.2% of the students sampled) was most often graded for completion).

The results of this study does not support the literature in regards to grading practices affect on student outcomes. In *Do homework grading policies affect student learning*, Yalcin & Kaw (2011) found that grading practices had no impact on the cohort of students that they studied (p. 1341). This research found that grading for accuracy resulted in the highest student outcomes.

Implications for Practice

Grading assignments/homework provides feedback to students. What the instructor grades is important in signaling to students what is important and how they should devote their

time. Grading practices vary based on many factors (educational attainment of the teacher, educational experience of the teacher, time spent on grading and providing feedback). Providing students specific feedback can help students understand and know what they are doing correctly and not doing correctly. Grading papers for completion sends the message that the correct answer is not important, only the compliant task of doing the work. Grading for accuracy provides students more feedback than does merely determining if the homework assignment was completed or not. Streamlining the process for teachers so that the volume of homework assigned to students can be feasibly graded for accuracy could provide students the feedback they need on each individual problem they are assigned.

Discussion of Findings: Research Question 2

In what ways and to what extent is student achievement in Algebra 1 associated with the frequency with which homework is assigned?

Data to respond to this question were analyzed using a two-way ANOVA. Florida students, as part of their Florida high school graduation requirement must pass the Algebra 1 end-of-course (EOC) examination. The passing score for the 2017 – 2018 school year on the Algebra 1 EOC was a 497 DSS score. (Florida Standards Assessment Fact Sheet, 2018).

Students who took the Algebra 1 EOC in middle school have had more advanced math than those students taking the Algebra 1 EOC in high school. This sets up a disparity where students who take the Algebra 1 EOC in middle school pass at a higher rate than those who take the Algebra 1 EOC in high school. Algebra 1 is important because of its integration with higher forms of mathematics. Wilder (2013) stated, “Mathematics, or more specifically, algebra is a gateway to the study of any STEM discipline that students may wish to embark on while in college” (p. 49). The successful completion of Algebra 1 in Florida is important to every

student's graduation from high school as well as serving as a gatekeeper for students into certain college and career tracks. Studying teacher homework practice in Algebra 1 has the potential to help more students successfully pass the Algebra 1 EOC and have opportunities afforded to them throughout their educational journeys.

Findings in the present study indicated that students who were assigned homework more frequently had a higher mean Algebra 1 EOC score. Similarly, a student who was taught by a teacher with more experience earned a higher mean Algebra 1 EOC score. However, students who were taught by a teacher with a Bachelor's degree had a higher Algebra 1 EOC score ($M = 508.41$) than those students taught by a teacher with a Master's degree ($M = 495.97$) or Specialist degree ($M = 507.38$). The group of students who earned the highest Algebra 1 EOC scores were students who received homework three to four times a week, were taught by a teacher with more than 20 years' experience who had earned only a Bachelor's degree ($M = 537.33$).

Implications for Practice

The results of the present study were aligned with the findings of earlier homework researchers (Cooper et al., 2006; Hattie, 2009; Kunter and Baumert 2010). Hattie (2009) found that secondary students received the most benefit from homework. Assigning students' homework allows students more opportunities to interact with course content. More interaction with the content allows students to be exposed to relevant material with greater frequency, and this allows students more opportunities for mastering the content. This research is similar to the findings of Kitsantas, Cheema, & Ware (2011) in that "students who are regularly assigned mathematics homework in their classes gain more understanding in mathematics" (p. 313).

However, school schedules often dictate the number of class meetings that students have with their instructors. This schedule is typically beyond the control of teachers, being determined by school or district administrators. Teachers can exercise some control by developing a homework schedule of assignments for students days or weeks in advance. A schedule of homework assignments (on class meeting days and non-class meeting days) provides a framework for students to space out their practice. With a schedule for practice laid out for class meetings and days without class meetings, students are provided additional time for practice. This type of practice “occurs when an individual intentionally repeats an activity to improve performance.” (Campitelli & Gobet, 2011, p. 281). With repeated exposure or practice, students are afforded time to work with the content they are learning.

Discussion of Findings: Research Question 3

In what ways and to what extent is student achievement in Algebra 1 associated with the way in which homework is graded?

Teachers often plan their instructional practices and frameworks based on their own experience, school and district policies, and what they have learned through their education. Data to respond to Research Question 3 were analyzed using a two-way ANOVA. The results from the study indicated that students who had their homework graded for accuracy, as opposed to grading for completion or a combination of accuracy and completion, scored highest on the Algebra 1 EOC.

Implications for Practice

Because students who had their homework graded for accuracy scored the highest of all students on the Algebra 1 EOC, it behooves teachers and instructional personnel to examine classroom, school, and school district policies and practices regarding homework. With students

receiving feedback based on each individual problem and the answer provided, more opportunities for instruction are possible. When providing feedback to students, teachers are helping students create what Ramdass & Zimmerman (2011) called “ownership of content” (p. 213). Vatterott (2010) concurred, stating, “Ideally, homework should provide feedback to teachers about student understanding, enabling teachers to adjust instruction, and, when necessary, reteach concepts before assigning practice” (p. 11). Feedback can provide the student and instructor with information on student progress (Hattie, 2009). With this information, corrections can be made by students in their processes and by teachers in their instruction and approach to the content with students.

Recommendations for Future Research

This study provides a basis for periodic evaluation of the relationships, if any, between homework grading practices and student outcomes. Such information could produce data on the types of practice teachers employ, and the changes over time in student achievement. It would also allow school administrators and classroom teachers to develop a set of standard homework practices to use with students.

Replication of this study with a different study district could provide information on what types of grading practices show significance regarding student outcomes. Replication of the study would also help to provide a larger sample of strategies and systems of homework being used with students.

Grading practices have the potential to affect student outcomes. Further research is needed on how the type of homework grading practice employed by the teacher affects course grades and pass rates.

Providing feedback to students can be challenging for teachers, specifically delivering specific feedback to all students regarding problems they were assigned for homework.

Feedback issues could be alleviated, in part, by using different technological platforms and applications to assist teachers in grading problems, and students in receiving feedback on their errors and misconceptions.

A close examination of the types of feedback and the frequency with which teachers provide feedback would be valuable in determining how students are receiving information regarding their progress. Assignments provide feedback to the student and to the instructor. Examining the types (e.g., written, verbal, or audio/visual) and frequency (e.g., every problem assigned, general comments for each assignment, or not at all) of feedback given provides a picture of the interactions around the assignment between the teacher and the student.

Closer examination of homework policies at the classroom, school, and school district level could provide a framework for understanding teacher practices regarding homework at the varying levels of an educational organization. Much research has been conducted on the type of homework assigned (Carr, 2013; Cooper & Valentine, 2001; Lee & Pruitt, 1979); as well as secondary effects of homework (Bas et al., 2017; Bembenutty, 2011; Cooper, 1989, Trautwein et al., 2006). Some research has been conducted at the post-secondary level regarding homework grading practices (Henderson et al., 2002; Hong et al., 2011) Closer examination of homework policies and practices at the secondary level, specifically at the high school level, can help to provide a more accurate picture of what students are experiencing in classrooms.

Research into how teachers are able to more efficiently and easily look into grading homework for accuracy could help to alleviate the time commitment teachers must make to grade each individual problem assigned. Having students grade their peer's homework in class

takes away instructional time and could be seen as a violation of student privacy laws (Mikk, 2006). Electronic and web-based applications provide one method of speeding up the grading process while providing the student with the correct answer and in some instances the steps needed to solve the problem. An analysis of the current electronic grading assistance platforms can aid teachers and school administrators in understanding what is available and what strategies best fit their organizations.

Summary

In this study, cross-tabulation tables were used to analyze the variance in homework practices for Algebra 1 teachers. Also, in this study a two-way ANOVA was used to identify relationships between homework practices of Algebra 1 teachers and student outcomes as measured by the Algebra 1 end-of-course (EOC) examination. Teachers who taught Algebra 1 at the middle and high school levels during the 2017 – 2018 school year in the study district and their students participated in the study.

Recommendations for further study include: replication of this study using a different study district, closer examination of homework policies and their alignment to the extant literature, and a closer examination of the types and frequency of feedback that students are given regarding homework.

APPENDIX A
HOMEWORK GRADING PRACTICE SURVEY

1. Did you teach Algebra 1 during the 2017 – 2018 school year?
 - a. Yes
 - b. No
2. Did you assign homework during the 2017 – 2018 school year?
 - a. Yes
 - b. No
3. With what frequency do you assign homework during the 2017 – 2018 school year?
 - a. Daily (at least 5 days in a week)
 - b. 1 – 2 times a week
 - c. 3 – 4 times a week
4. What type or kind of feedback do you provide students on their homework?
5. What type of homework did you assign students during the 2017 – 2018 school year?
 - a. Practice (practicing material presented in class)
 - b. Preparation (preparing students to gain maximum benefit from future lessons)
 - c. Extension (investigating if students can transfer a new skill or concept to a new situation, more abstract thinking required)
 - d. Creative (require students to integrate many skills and concepts to produce a response)
6. What percentage of homework that you assigned during the 2017 – 2018 school year was procedural?
 - a. 0 – 25%
 - b. 26 – 50%
 - c. 51% - 75%
 - d. 76 – 100%
7. Do you grade the homework you assigned during the 2017 – 2018 school year?
 - a. Yes, every time and all the assigned problems
 - b. Yes, but only for select problems
 - c. No

8. When you graded homework during the 2017 – 2018 school year how did you grade the homework?
 - a. Accuracy (looking that every problem is completed with the correct answer)
 - b. Completion (looking that every problem has been completed)
 - c. Combination of accuracy and completion

9. If you graded for a combination of completion and accuracy during the 2017 – 2018 school year, indicate which percentage of problems you look at for accuracy on a given homework assignment.
 - _____ %

10. How many years have you taught Algebra 1 prior to the 2018 – 2019 school year?
 - a. < 5 years
 - b. 6-20 years
 - c. >20 years

11. What is the highest professional degree that you hold?
 - a. Bachelors (B.A., B.S.)
 - b. Masters (M.A., M.S., M.Ed., MAT)
 - c. Specialist (Ed.S.)
 - d. Doctorate (Ph.D., Ed.D.)

APPENDIX B
INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Determination of Exempt Human Research

From: UCF Institutional Review Board #1
FWA00000351, IRB00001138

To: Jonathan Taylor
Date: December 05, 2018

Dear Researcher:

On 12/05/2018, the IRB reviewed the following activity as human participant research that is exempt from regulation:

Type of Review: Exempt Determination
Project Title: AN ANALYSIS OF THE RELATIONSHIPS BETWEEN
HOMEWORK FREQUENCY & HOMEWORK GRADING
PRACTICES OF ALGEBRA ONE TEACHERS ON
STUDENT OUTCOMES AS MEASURED ON THE
ALGEBRA ONE END OF COURSE EXAMINATION
Investigator: Jonathan Taylor
IRB Number: SBE-18-14412
Funding Agency:
Grant Title:
Research ID: N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the [Investigator Manual](#).

This letter is signed by:

A handwritten signature in black ink, appearing to read "Gillian Morien".

Signature applied by Gillian Morien on 12/05/2018 04:13:31 PM EST

Designated Reviewer

APPENDIX C
SEMINOLE COUNTY PUBLIC SCHOOLS RESEARCH APPROVAL



WALT GRIFFIN
Superintendent

Educational Support Center
400 E. Lake Mary Boulevard
Sanford, Florida 32773-7127
Phone: (407) 320-0000
Fax: (407) 320-0281

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December 7, 2018

Dear Mr. Taylor,

I am in receipt of the proposal and supplemental information that you submitted for permission to conduct research in the Seminole County Public Schools. Thank you for very clearly delineating the required components of your research request. You are granted permission to conduct the study described herein.

Please be sure you contact the Principals of Greenwood Lakes Middle School, Indian Trails Middle School, Oviedo High School and Seminole High School prior to conducting any research. As indicated in your Research Request addendum, potential participants will receive a letter with a link for participation in the study.

We would appreciate you sharing with district staff the outcome of your project, *An Analysis of Homework Grading Practices of Teachers of Algebra I and Their Relationship to Student Achievement as Measured by the Algebra I EOC*. Please maintain copies of the Teacher Informed Consent documents in your files.

Best of luck!

Respectfully,

Anna-Marie Cote, Ed.D.
Deputy Superintendent, Instructional Excellence and Equity

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