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National Implications: The Impact of Teacher Graduate Degrees on Student Math Assessments

Kevin Badgett, EdD
Assistant Professor of Educational Leadership
University of Texas of the Permian Basin
Odessa, TX

John Decman, EdD
Associate Professor of Educational Leadership
University of Houston-Clear Lake
Houston, TX

Carol Carman, PhD
Associate Professor Educational Foundations – Research
University of Houston-Clear Lake
Houston, TX

Abstract

Researchers have called for greater levels of teacher preparation. There remains many questions about the extent to which graduate education contributes in a positive way to student achievement. The purpose for this research was to ascertain the extent to which teacher graduate degrees contribute to student math achievement as measured by Texas state math exams. Results of this research demonstrated master's degrees have only a limited positive impact on student math achievement. Further study is recommended.

Keywords: Master's Degree, Student Achievement, Policy

In order to deal with a "widespread public perception that something" (The National Commission on Excellence in Education, 1983, p. 7) was very wrong with the American system of education, Reagan era Secretary of Education, T.H. Bell created the National Commission on Excellence in Education. The purpose of the commission's report, *A Nation at Risk,* was to highlight evidence of America's loss of standing in the world market and to provide recommendations which, if acted upon by policy makers, would lead to America's ability to compete in a new global market where intellectual capital was the currency necessary for success (The National Commission on Excellence in Education, 1983). According to Sunderman (2010),

A Nation at Risk contained recommendations which its authors proposed would mitigate the loss of standing through a shift of focus to the successful preparation of students for meaningful integration into the work force.

Continuing this work in a bipartisan effort, Congress enacted The No Child Left Behind Act of 2001 (NCLB). According to Williams, Tabernik, and Krivak (2009), NCLB "placed a spotlight on school improvement efforts designed to increase achievement for all students" (p. 437). Almost 20 years later, this act later showed that the question of inputs and outputs was still just as much at the crux of the national standards-based reform movement as it was when Secretary Bell released his committee's report.

In order to address the achievement requirements set out by NCLB, school leaders understand the question is not "what" but "how." New instructional methods purported to improve student achievement are always available. With more than three million returns on a Yahoo.com search for "research based math programs for struggling students," how can a practitioner know the most effective means for accomplishing the goal of improving student achievement? Beyond ensuring the tools are appropriate for the task or desired outcome, there is one player in the instructional scenario shown in research to make a strong impact on student achievement: the teacher (Timperley & Alton-Lee, 2008; Wayne & Youngs, 2003).

According to Timperley and Alton-Lee (2008), the teacher makes a "marked impact" (p. 330) on student achievement. Similarly, Wayne and Youngs (2003) assert there is a substantial connection between student achievement and the teacher who teaches that student. While this conclusion may seem logical and reasonable, the declaration of this fact does not give a clear understanding of how and why. Moreover, a teacher simply placed in a classroom has no magic from which to draw to make that impact positive. What, then, makes the teacher so important to student achievement?

Previous researchers have attempted to clarify teacher characteristics that contribute to student achievement. Hill, Rowan, and Ball (2005) found levels of teacher mathematics expertise are significant in relation to student achievement for first and third grade students. Although there is no clear conclusion that teacher motivation has an impact on student achievement (Muller, Alliata, & Benninghoff, 2009), Pelletier, Legault, and Séguin-Lévesque (2002) showed teacher motivation did have some impact on student motivation. In addition to research, reason and logic reinforce the idea that a motivated teacher is more likely to cultivate and nurture a learning environment where students are more motivated to work for their success.

Numerous researchers have considered the impact of certain kinds of pre-service inputs, in terms of teacher preparation/skill-set, on student achievement (Darling-Hammond, 2006, 2010; Dee & Cohodes, 2008; Scribner & Akiba, 2010), but learning for in-service teachers should not stop simply because they are no longer "pre" service. According to Porter et al. (2010), in-service professional development is one of the five key pieces of principal leadership. One type of important and widely-available in-service professional development is the graduate degree. However, while graduate studies are encouraged, there is a lack of quantitative evidence clarifying the impact of teachers' graduate degrees on student achievement (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Conway, Eros, & Stanley, 2009; Darling-Hammond, 2006).

Despite the fact that one can find a strong literature presence of research looking at how pre-service teacher training contributes to student achievement (Boyd et al., 2009; Darling-Hammond, 2006, 2010), there is little research that addresses the impact of teacher graduate education on student achievement. In fact, Conway et al. (2009) maintain there is altogether a

lack of research documenting that graduate work is "a powerful professional development experience" (p. 129).

A limited amount of research has been conducted. Knapp, McNergney, Herbert, and York (1990) asserted master's degrees have only a modest impact on student achievement. Ballou and Podgursky (2000) made this more complicated by highlighting some areas where the students of teachers with only a bachelor's degree outperformed students of teachers with a master's degree in eighth grade reading achievement. Hanushek (2003) analyzed findings from a data set with longitudinal information of student testing during the mid-1990s in Texas. In that analysis, the regression used also considered a number of other factors including class size, socio-economic status, and teacher experience, among other things. Conspicuously absent from the list of factors was graduate degrees. The absence of that kind of focus contributes to a persistent gap in the literature. Despite the fact that measurable data is "increasingly demanded by policy makers" (Darling-Hammond, 2006, p. 121), much of the limited research dealing with the impact of graduate-level teacher education and preparation on student achievement has focused on perception and not the preferred empirical data. Nevertheless, even in light of this void, districts and researchers have continually called for the use of using higher levels of educational attainment as a proxy for instructional skill and content knowledge (Boyd et al., 2009; Conway et al., 2010; Darling-Hammond, 2006, 2010).

Graduate degrees are one type of individualized preparation that receives consistent consideration in teacher compensation though the state of Texas has no requirement that a teacher hold a master's degree prior to being employed or for full certification. A review of a sample of school districts in Texas, including Pasadena ISD, Laredo ISD, Fort Stockton ISD, and Hurst, Euless, Bedford ISD, reveals the willingness of school boards to commit extra financial resources to attract more highly educated staff. Average annual compensation differences between teachers holding bachelor's degrees and master's degrees in these districts range from $1,000.00 to $2,580.00 (Fort Stockton ISD, 2012; Hurst, Euless, Bedford ISD, 2012; Laredo ISD, 2012; Pasadena ISD, 2012). Given the common practice across Texas of providing higher salaries to teachers with higher degrees, is there evidence that Texas teachers, with graduate degrees, impact student achievement in significant ways? In other words, what is the value of this policy as it relates to student academic achievement?

In the absence of clear and compelling evidence that graduate degrees do contribute to student achievement, this practice begs the question "why." If the purpose of policy is to "invoke the reality it seeks to create" (Hellstrom & Jacob, 2005, p. 463) then, the implication of this statement as it relates to teaching and learning is policy makers and educational leaders should advocate and work toward the development and implementation of policies which have a clear, positive impact on student achievement. According to McDonnell (2009), education policy should always be focused on student achievement. Moreover, because "hiring is a central activity in which school leaders can build professional communities" (Ingle & Rutledge, 2010, p. 44), policy makers and district leaders need information that can inform decision making related to how teachers are hired, trained, and compensated.

Other Considerations

When quantifying factors related to student achievement, it would be nearly impossible to control or even identify all influencing factors. According to Olson (2004), it is difficult to definitively identify causal factors on student achievement; the influence of other things cannot always be ruled out. Olson argued this reality compromises the researcher's ability to rule out causality. However, in his response to Olson's criticism regarding the lack of ability to bear out best practices due to the contamination of uncontrollable and various factors, Slavin (2004) asked "recognizing this variation, is it impossible to tell a teacher, principal or superintendent anything at all about the likely average effects of one or another program or practice?" (p. 27) Slavin continued his argument by stating "enlightened educators look to education research for well-founded evidence to help them do a better job with the children they serve" (p. 27). With Slavin's assertions and Olson's concerns, some of the common variables shown to impact student achievement have been considered in order to ensure the findings of this research are valid and reliable.

The literature is clear about the presence of factors other than teacher graduate educational attainment influencing student achievement (Anderson, 2008; Badgett, Harrell, Carman, & Lyles, 2012; Capps et al., 2005; Esters & Douet, 2001; Gottfried, 2009; Marks, 2005; Scanlon & Devine, 2001; Wiggins, 2007). In order to develop a better understanding of the degree to which teacher graduate educational attainment impacts student achievement, it is important to identify and control for other potentially confounding factors. These factors include race and ethnicity, limited English proficiency status, socio-economic status, attendance rate, percentage of students with disciplinary placement, at-risk status, and mobility rate. It is important to note the factors are based on variables tracked by the state of Texas and those frequently cited in a comprehensive review of literature on the topic (Anderson, 2008; Capps, et al., 2005; Gottfried, 2009; Marks, 2005; Wiggins, 2007).

Purpose of the Study

The purpose of this study was to ascertain the extent to which a higher level of education for a collective district teaching staff contributed to student math achievement as measured by the TAKS Math test. In order to accomplish this, district-level accountability data were analyzed. This was an important inquiry due to the intersection of two concepts. In addition to the absence of a sheltered or isolated focus on the contribution of teacher graduate degrees to student achievement in the literature, there have been recent and definitive calls for greater levels of teacher education for full certification. These conditions may have contributed to ambiguity and inconsistency in recruiting and compensation of teachers with graduate degrees at the district level. By specifically addressing the impact of teacher graduate education and measurable achievement in math, policy makers will have a clearer description of the relationship of the two.

While professional development comes in many forms and varied sources, this research sheds light on the value of completed programs of generic graduate study. In that this study adds one substantial point of knowledge to the literature, its scope, design, and intent were not broad enough to make definitive, long-term recommendations related to hiring and compensation of teachers. However, by adding this point of knowledge to the aggregate, this research can inform

policy and training at multiple levels. Data from this study may be useful for informing the creation and maintenance of policies affecting teacher preparation, teacher professional development, hiring practices, teacher compensation, and teacher retention. The research question guiding this study asked: To what extent does the collective teacher education level of a school district contribute to student achievement in math? Specifically, what is the impact of higher levels of teacher education on student achievement as measured by the Texas Assessment of Knowledge and Skills (TAKS) Math test?

Method

Sample

During the 2008-2009 school year, there were more than 1,200 total school districts and open charter schools across the state of Texas (TEA, 2009a). The researchers analyzed district level data for every district in Texas that met participation criteria. Only school districts serving Early Childhood or Pre-Kindergarten through 12th grade were included in this study. Districts were only judged on the above criteria for participation or exclusion. This criterion was set in an effort to ensure valid and generalizable results. The number of districts or open charters that met participation requirements for inclusion in this study was 1026.

Research Design

The researchers used a non-experimental correlational research design. This was an appropriate design because the data were pre-existing and could not be changed or influenced in any way for the purpose of understanding the impact of one (or multiple) variable(s) on another (Chatterji, 2007). The primary purpose for an analysis of data collected in this study was to identify the extent to which teacher educational attainment contributed to student achievement. The researchers made use of publicly available data on student achievement as measured by the state examination, the TAKS test from TEA. The researchers sought to provide measurable data related to the impact of higher levels of teacher education in a district on student achievement as measured by the TAKS test. In light of policy direction and expert recommendations, the hypothesis was that greater percentages of teachers with graduate degrees in a district would contribute to higher levels of student achievement in math as measured by the Math TAKS test.

Operational Definitions

Student achievement (the criterion) was defined in terms of the percentage of students designated as meeting the passing standards and the percentage of those designated as commended on the Math Texas Assessment of Knowledge and Skills (TAKS) test at the district level. The TAKS test is a state-level, criterion-referenced test students in Texas take in partial fulfillment of the requirements of NCLB. Student performance was reported according to the percentage of students achieving those designations at the district level. Only students included by the state in the level Academic Excellence Indicator System (AEIS) reports were included in

the data analyzed. Additionally, only those students reported in the category titled *TAKS Met 2009 Standard Sum of All Grades Tested, INCLUDES SELECTED TAKS (Accommodated)* and *TAKS Commended Performance Sum of All Grades Tested, INCLUDES SELECTED TAKS (Accommodated)* were included in the data considered as the dependent variable *Student Achievement*.

Collective teacher education level was operationally defined as the percentage of a district's teaching staff that holds master's degrees or doctorate degrees. Graduate education was the primary independent variable or predictor. For the purpose of this research, graduate education was used interchangeably with masters' and doctoral degrees. The researchers analyzed the impact of a district's teachers with doctoral degrees. However, as expected from a preliminary review of district-level AEIS reports, most teachers with graduate degrees held master's degrees. Operational definitions for possible confounding variables were limited to the nature of their use in Texas state AEIS report cards.

Research Procedures/Data Collection

All data necessary for this study were publicly available and were found in district-level AEIS reports from the Texas Education Agency, the department of education unit for the state of Texas. Since the study utilized archival data which reported on the district level thereby masking individual students, informed consent was not required. Upon having acquired all necessary data, all information pertinent to the data analysis was loaded into an Excel spreadsheet and imported into SPSS for analysis. The researchers then produced reports from SPSS which they analyzed and reported on as a part of the results section.

Instrumentation

The TAKS math test served as a measure of math achievement for the purposes of this study. The TAKS tests are "designed to measure the extent to which a student has learned and is able to apply the defined knowledge and skills at each tested grade level" (TEA, 2009b, p. 79). In the state of Texas, the defined knowledge and skills is the state curriculum, the Texas Essential Knowledge and Skills (TEKS). This pencil/paper test was administered to Texas students in grades 3 thru 9 each year. During the 2008-2009 school year, students were expected to earn a scale score of 2100 to be considered to have *met standard.*

The 2009 Technical Manual for the Texas assessment system reports reliability for the TAKS test as measured using the Kuder-Richardson Formula 20 (KR20) from 0.87 to 0.90 (TEA, 2009b). This manual reports reliability from 0.80 to 0.89 as considered good while reliability scores at 0.90 and higher were considered excellent (TEA, 2009b). Therefore, reliability for items on the TAKS tests is at strong levels. Other forms of reliability checks reported in the 2008-2009 Technical Manual included standard error of measurement, conditional standard error of measurement, and classification accuracy.

All information used for analysis in this research can be found in the AEIS report. This report is a tool employed by the state of Texas for the purpose of exhibiting various aspects of a school's and district's performance in academic and non-academic areas. Performance of district academic factors is based on results of students' TAKS testing while non-academic data used in

this research is aggregated at the district level, reported to the state by the district through PEIMS (Public Education Information Management System), and exhibited on the AEIS report.

Student performance on the TAKS test was reported for two different performance measures which were used for this research. The first was met standard and the second was "Commended." According to the 2008-2009 Technical Manual (TEA, 2009b), individual student confidential results report students as either "Yes" or "No" on both performance measures. The scale score for Met Standard was 2100 while it was 2400 for Commended. The equation for determining the scaled score range for each test was reportedly a Rasch proficiency level with the following equation: $SSj = (\theta j \times T1) + T2$, (TEA, 2009b, 103).

Data Analysis

The first statistical analyses conducted were multiple Pearson Product Moment Correlations. It was important to consider the impact of various possible confounding variables on the results of the key analyses (impact of teacher educational attainment on student achievement) in order to avoid the potential problem of the myth of monocausality (Miles & Shevlin, 2001). In order to ensure proper consideration of the contribution of any secondary predictors on the criterion, the multiple regressions were conducted by establishing a hierarchical order for input of the various predictors into the multiple regression equations (Miles & Shevlin, 2001).

The hierarchical entry began by simultaneously placing all potentially confounding variables into each of the regression equations. Whereas the primary purpose of this research was to determine the contribution of teacher graduate education to student achievement, there was limited value for analyzing each possible confounding variable independently of the other variables. After entering these variables into the regression collectively, the second and separate variable, percentage of teachers in a given district with master's or doctoral degrees, was entered. Average teacher educational attainment was entered into the regression analysis as the second and last entry of predictors as its potential contribution to student achievement is the major construct being measured in this research. Significance for this study was set at $p \leq .05$. Finally, the results of the multiple regressions were analyzed to determine the degree to which collinearity between two or more predictors existed. Using parameters established in Williams (2009) and Miles and Shevlin (2001), the researchers concluded an inappropriate degree of collinearity did not exist.

Results

There was a substantial amount of diversity in the 1026 school districts included in the data analyzed for the study (See Table 1). In addition to exploring the contribution of graduate training to student achievement, the researchers sought to isolate the contribution of teacher graduate education by exploring the impact of other district characteristics. After describing the districts included in the study, the researchers produced a correlation matrix to report the relationships between all analyzed predictors.

Table 1

Demographics for Study Sample (N = 1026*)*

	Min %	*Max %*	*Mean*	*Std. Dev.*
Math*	13	99	80.64	10.11
Commended Math*	1	75	26.92	10.05
Attendance*	77.7	99.4	95.72	1.16
Mobility *	3	100	18.35	9.83
Native American.*	.0	27.3	.51	1.06
Asian*	.0	48.3	1.11	2.77
African American*	.0	97.1	9.48	14.15
Hispanic*	.5	99.9	34.41	27.00
White*	.0	98.9	54.50	27.72
At Risk*	.0	100	42.13	14.76
Discipline*	.0	7.4	1.58	1.27
Economically Disadvantaged*	.0	100	54.49	19.33
LEP*	.0	66	7.84	9.37
Masters**	.0	81.41	15.85	7.86
Doctorate**	.0	13.39	.31	.84

* percentage of student population
** percentage of teaching staff

After conducting the correlation analyses (see Table 2), regression analyses were conducted in order to explore the district-level contribution of teacher graduate degrees to student achievement. In keeping with the hierarchical regression analysis design, four regression analyses were conducted with two analyses for each of the subsidiary questions. In all four analyses, the regression models were found to be significantly predictive of student achievement at the $p = .000$ level. As the second model for each question is the focus of this study, those questions are the focus of the following analysis.

Table 2

Correlations Among the 18 Variables Measured (N = 1026)

	Math	Com M	Atten	Mobility	1 - Nat Amer.	2 - Asian	3 - AA	4 - His	5 - White	At Risk	Discipline	Eco Dis	LEP	Masters
Com M	.84***													
Attendance	.43***	.36***												
Mobility	-.58***	-.48***	-.30***											
1 - Nat Amer.	.09**	.07*	.04	-.04										
2 - Asian	.17***	.34***	.09**	-.07*	-.01									
3 - AA	-.32***	-.24***	-.20***	.29***	-.08**	.09**								
4 - His	-.31***	-.26***	-.17***	.09**	-.22***	-.07*	-.20***							
5 - White	.44***	.34***	.26***	-.23***	.22***	-.08*	-.32***	-.86***						
At Risk	-.56***	-.53***	-.30***	.46***	-.14***	-.15***	.22***	.54***	-.62***					
Discipline	-.07	-.07*	-.20***	-.08*	-.03	-.02	.13***	.22***	-.27***	.21***				
Eco Dis	-.57***	-.62***	-.25***	.37***	-.15***	-.26***	.28***	.60***	-.70***	.70***	.21***			
LEP	-.14***	-.10**	-.04	.03	-.15***	.08*	-.01	.63***	-.61***	.51***	.13***	.45***		
Masters	.06	.16***	-.05	.00	.04	.20***	.11**	.03	-.10**	-.02	.14***	-.11**	.04	
Doctorate	-.01	.02	.01	.04	-.04	.09**	.03	.06	-.08**	.05	.00	.01	.06	.20***

*** p < .00

**p < .01

*p < .05

Explanation of Results

After conducting the correlation analyses, the researchers conducted four multiple regression analyses with one analysis for each of the two graduate levels (master's degree and doctorate) combined with each of the two measures of student achievement considered in this study (minimum passing standard and commended passing standard). The researchers then entered the variables into the regression analysis in a hierarchical fashion and removed the variance accounted for by the linear combination of those variables by entering all potentially confounding variables first. Removing the variance from the potentially confounding variables allowed the researchers to have a clearer understanding of the contribution of teacher graduate education at the respective levels on student achievement. This process allowed for a comparison of regression models between one model with teacher graduate education, master's or doctorate, and one model without for the purpose of identifying whether or not a significant change occurred when adding the teacher education variable. A significant change from model one to model two would indicate teacher graduate education contributes significantly to student achievement in that model. Each separate regression model accounted for at least 59% of why students perform at the minimum or commended standards.

While all four of the regression models were significantly predictive of student achievement, the analysis of greatest interest to this study was the isolated contribution of teacher graduate degrees to student achievement. Of the four models, only the contribution of

teachers' master's degrees were found to significantly (p = .000) impact math achievement at the recommended level. The change in math achievement at the minimum passing level for students of teachers holding master's and doctoral degrees and the change at the commended level for students of teachers who held doctoral degrees was insignificant (See Appendix for Tables 3 – 10). The researchers initially hypothesized the percentage of graduate degrees held by teachers would significantly predict and add a positive contribution to student achievement. Results of this research are largely contrary to the hypotheses. There are a number of possible reasons for the difference.

The design of this study proposed a general analysis of the impact of graduate degrees on student achievement. This focus was consistent with the documented absence of data related to this area (Conway et al., 2009). However, previous research demonstrated subject-specific certification can contribute to higher levels of student achievement. Dee and Cohodes (2008) reported findings linking higher levels of student achievement in math and social studies to subject-specific certification for teachers in those areas. It may be that graduate degrees do contribute to student achievement but, given the lack of distinction made between types of graduate degrees in this study; this contribution may have been masked.

It is possible that the setting for graduate training contributes to student achievement. Darling-Hammond (2010) argued teacher preparation plays a role in student achievement. She asserted that teachers prepared through a traditional certification route are generally more effective than teachers prepared through an alternative route. Darling-Hammond (2006) also argued alternative teacher preparation programs cannot create the learning experiences needed by new teacher candidates as effectively as traditional programs. While it appears there is little research dealing with the contribution of different types of graduate programs to student achievement, given the assertions in existing literature related to the impact of setting for initial teacher preparation on student achievement, it is reasonable to speculate the setting for graduate training may similarly impact student achievement.

One should also consider other possibilities for the existence of significance in the change in math achievement at the commended level in light of its absence at the minimum passing standard. It is possible that teachers with graduate degrees are differentially assigned responsibilities that include working with students who already perform at higher academic levels. Teachers new to the profession are often assigned responsibilities that include teaching in some of the most challenging situations. In her research, Kelley sought to "inform the decisions of local and national policy makers" (2004, p. 438). She showed educational leaders tend to abuse their newest members with impossible assignments and poor levels of support. Kelley also discussed the proclivity of new teachers to lack commitment to the profession when confronted with an environment of limited support. Given the practice of assigning new teachers to some of the most challenging situations, it may be that they lack the skills, experience, and/or confidence necessary to adequately meet the needs of the most challenged students. Conversely, by offering more comfortable teaching assignments to the more confident, experienced, and trained teachers, school leaders may be creating circumstances where higher performing students continue to perform at higher levels of achievement at the expense of students served by novice teachers.

Limitations

There are a number of potential limitations related to findings from this study. The results from this study are very broad and can be generalized to districts in the state of Texas. Therefore, districts should consider the fit of recommendations to their unique mixes and compositions. In order to determine the best fit related to any or all recommendations, each district that considers changes based on these recommendations should include representative stakeholders in conversations related to the impact of policy change on their operations and systems prior to making the changes.

The results from this study are generalizable to the state of Texas. They are not generalizable to other states in the United States. Despite the inability to make broad generalizations outside this state, Texas is home to many different groups. Being so diverse, there are many districts in the country with demographics and circumstances similar to districts in the state of Texas. As a consequence, there may be some limited ability to generalize to districts outside the state in a case by case manner if it is done judiciously.

While the large sample size helps ensure the data are representative of all districts meeting the participation criteria, that same sample size also supports finding statistical significance. This implies districts should not to rely too much on the statistical significance of the findings and reinforces the importance for districts to make decisions based on their individual needs.

This research revealed a lack of broad evidence supporting a positive and significant contribution of graduate education to student achievement as defined in this study. Educational leaders should be cautious about making abrupt changes to policies related to recruiting and compensation of teachers with graduate degrees. Though discontinuing practices related to compensation for graduate degrees may be an eventuality, there are still questions related to the potential contribution of graduate training to student achievement which need to be answered.

Implications for Further Research

Future research should be conducted related to the contribution of subject-specific graduate degrees, setting for graduate training, and teacher assignment to student achievement. Future research may be able to answer questions related to the efficient and effective application of resources to teacher compensation and hiring practices. Better use of limited resources could be supported by achieving a more textured understanding of the contribution of graduate training for improving teacher effectiveness. This understanding could potentially empower district leaders with the ability to apply a more surgical approach when crafting policy related to compensating teachers who hold graduate degrees.

The data produced in this study have shown a significant and positive change in the regression model that describes the contribution of master's degrees on percentage of students who achieve at the commended level on the TAKS Math tests. Given the desired end result of teaching and learning is increased student achievement (McDonnell, 2009); K-12 policy should be focused on impacting that desired reality (Hellström & Jacob, 2005). One option districts should consider is to determine ways to reward teacher effectiveness through a structured teacher compensation system that is consistent with comparable within- group growth in student

achievement. Future research may consider the impact of stipends related to the growth of academic achievement relative to teacher level of education. Effort should be made to determine why students perform at the commended level more frequently when taught by teachers with master's degrees. Studies that analyze comparable gains between demographically and academically similar groups of students where the only difference is teacher level of education should be conducted. Results from this study could provide more clarification related to the contribution of graduate degrees to student achievement.

This study has shed light on the contribution of graduate degrees to student achievement at the district level. Future research should seek to understand the contribution of graduate degrees to student achievement at the campus and local level. If any difference exists, this understanding could help researchers more effectively diagnose how some campuses more effectively utilize talents developed in graduate training than others. This understanding may lead to more effective collaboration between schools and districts.

Future studies should consider the contribution of teacher graduate degrees to student achievement as measured by other definitions including but not limited to student performance on assessments reserved for students served by special education. Given the absence of data related to assessments reserved for those Texas students who are more severely academically challenged, no conclusions can be made regarding the potential impact of general teacher graduate training on the academic success of these students. Research in this vein could lead to a more effective distribution of teacher skill that will better meet the differentiated academic needs of a diverse student population.

Other implications for future research concern developing a greater understanding of how teacher graduate education interacts with other factors that contribute to student achievement. For instance, to what degree can graduate education, either specific to a subject taught or in general, mitigate for the contribution of other factors, including the ones considered in this study to student achievement. This understanding could help districts more strategically distribute teacher skill and knowledge.

Finally, it could be beneficial to replicate this study in other states or within smaller geographic areas across the United States for the purpose of determining the degree to which findings are similar across different regions of the country. Arriving at this understanding could make a substantial contribution to the conversation related to what teacher preparedness looks like across the country. By analyzing this phenomenon on a local level, researchers may also be able to more effectively identify strategies that work, inclusively, with all student groups.

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Appendix

Table 3

ANOVA Output From Regression - Research Question 1
Master's/Math – Minimum Passing Standard

	Sum of squares	*Df*	Mean square	*F*	Sig.
Regression	58235.77	11	5294.16	115.24	.000
Residual	46583.90	1014	45.94		
Total	104819.67	1025			

Table 4

Research Question 1

				Change Statistics				
	R	*R* square	Adjusted *R* square	*R* Square Change	*F* Change	df1	df2	Sig. *F* Change
Model 1	.75	.56	.55	.56	126.42	10	1015	.000
Model 2	.75	.56	.55	.00	2.10	1	1014	.147

Table 5

ANOVA Output From Regression - Research Question 2
Doctorate/Math – Minimum Passing Standard

	Sum of squares	*Df*	Mean square	*F*	Sig.
Regression	58148.71	11	5286.25	114.852	.000
Residual	46670.96	1014	46.03		
Total	104819.67	1025			

Table 6

Research Question 2

				Change Statistics				
	R	*R* square	Adjusted *R* square	*R* Square Change	*F* Change	df1	df2	Sig. *F* Change
Model 1	.75	.56	.55	.56	126.42	10	1015	.000
Model 2	.75	.56	.55	.00	.21	1	1014	.650

Table 7

ANOVA Output From Regression - Research Question 3
Master's/Math – Commended Passing Standard

	Sum of squares	*Df*	Mean square	*F*	Sig.
Regression	56243.57	11	5113.05	109.64	.000
Residual	47287.55	1014	46.635		
Total	103531.12	1025			

Table 8

Research Question 3

				Change Statistics				
	R	*R* square	Adjusted *R* square	*R* Square Change	*F* Change	df1	df2	Sig. *F* Change
Model 1	.73	.54	.53	.54	118.48	10	1015	.000
Model 2	.74	.54	.54	.01	10.34	1	1014	.001

Table 9

ANOVA Output From Regression - Research Question 4
Doctorate/Math –Commended Passing Standard

	Sum of squares	*df*	Mean square	*F*	Sig.
Regression	55770.42	11	5070.04	107.64	.000
Residual	47760.70	1014	47.10		
Total	103531.12	1025			

Table 10

Research Question 4

				Change Statistics				
	R	*R* square	Adjusted *R* square	*R* Square Change	*F* Change	df1	df2	Sig. *F* Change
Model 1	.73	.54	.53	.54	118.48	10	1015	.000
Model 2	.73	.54	.53	.00	.20	1	1014	.659