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Research Article

The Influence of Teacher Graduate Degrees on Student Reading Achievement

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Abstract

In a time of limited means and continued calls for higher student achievement, school leaders need to be wise in their use of resources. Earlier research has called for greater levels of teacher preparation, and, while many school districts provide greater compensation for teachers with graduate degrees, some districts have begun phasing out this type of compensation. Complicating the question of the value of compensating teachers for graduate training is an absence of quantitative data that supports or rejects the concept that teacher graduate education positively contributes to student achievement. The purpose for this research was to ascertain the degree to which teacher graduate training supports student reading achievement. Results of this research demonstrated master's degrees have a limited positive impact on student reading achievement. However, more study is needed.

Key Words

master's degree, student achievement, policy

Introduction

According to the report *A Nation at Risk* (National Commission on Excellence in Education, 1983), Secretary of Education T. H. Bell created the National Commission on Excellence in Education because of a concern there was "widespread public perception that something" was very wrong with the American system of education. The commission's report highlighted evidence of America's loss of standing in the world market and provided 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 (National Commission on Excellence in Education, 1983).

According to Sunderman (2010), this report shifted the focus of education to the preparation of students for successful participation in the workforce. Sunderman (2010) continued by stating that *A Nation at Risk* made recommendations for changes that would impact the productivity and efficiency of students' work in the future marketplace.

The question of changes to public education is still just as much at the crux of the national standards-based reform movement as it was 30 years ago. In the early part of the 21st century, this focus on accountability was strongly reinforced by the bipartisan legislation entitled The No Child Left Behind Act of 2001(NCLB). Williams, Tabernik, and Krivak (2009) stated NCLB "placed a spotlight on school improvement efforts designed to increase achievement for all students" (p. 437).

Improving student achievement, however, is not a question of "what," but "how." As evidenced by a cursory search of reports provided by the Florida Center for Reading Research (FCRR, n.d.), many instructional methods purported to improve student achievement are available. This website revealed more than 100 research-based programs which have proven effective for remediating reading deficits. Beyond ensuring the tools are appropriate for the task or desired outcome, the one player in the instructional scenario shown in research to make a strong impact on student achievement is the teacher (Timperley & Alton-Lee, 2008; Wayne & Youngs, 2003).

According to Wayne and Youngs (2003), there is a substantial connection between student achievement and the teacher who teaches that student. Timperley and Alton-Lee (2008) asserted teachers have a "marked impact" (p. 330) on student achievement. This may seem a foregone conclusion; however, reaching this conclusion does not give clear understanding of how and why. While it is documented that teachers have a substantial impact on their students' futures, 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?

Several studies have attempted to clarify aspects of teacher impact on student achievement. According to Darling-Hammond (2010), teacher preparation plays a significant role in student achievement. Teachers who attain certification through traditional means are more effective and have higher rates of retention in the profession than those who attain certification through an alternative route. So important is some type of training, according to Darling-Hammond, that "the strongest negative effects on student achievement were produced by teachers who entered as 'lateral entry recruits' without prior teacher preparation, those who lacked certification in the field being taught, and those

who were inexperienced" (p. 39). Scribner and Akiba (2010) considered the impact of teachers' previous work experience on student achievement. They found individuals who enter the teaching profession "having more career experiences does not lead ATCP (alternative teacher certification program(s)) teachers to practice effective teaching" (p. 614).

An abundance of research has considered the impact of pre-service inputs for teacher preparation on student achievement (Darling-Hammond, 2006, 2010; Dee & Cohodes, 2008; Scribner & Akiba, 2010), but learning should not stop at pre-service.

According to Porter, Polikoff, Goldring, Murphy, Elliott, and May (2010), professional development is one of the five key pieces of principal leadership. One important type of in-service preparation is graduate training, although there is little research that addresses the impact of teacher graduate education on student achievement (Conway, Eros, & Stanley, 2010).

Yet, despite the lack of a substantial body of research on the effect of teachers' graduate education on student achievement, policy recommendations regarding the need for states to require teachers to have attained or be in the process of attaining a master's degree have continued (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Conway, Eros, & Stanley, 2010; Darling-Hammond, 2006, 2010).

According to Ballou and Podgursky (2000), the National Commission on Teaching and America's Future (NCTAF) has had an influence on educational policy discussions and is a proponent of state policies requiring teachers to attain master's degrees for full teacher certification. Moreover, several states have implemented policies requiring teachers to attain a master's degree in order to receive full certification. Knapp, McNergney, Herbert, and York (1990) cited New York, California, Arizona, Oregon, and Massachusetts as states which require graduate studies in order to acquire certification or recertification.

In light of this call for greater levels of teacher education, it is surprising to learn there is altogether a lack of research documenting that graduate work is "a powerful professional development experience" (Conway, Eros, and Stanley, 2009, p. 129).

In some of the limited amount of research that has been conducted, Knapp et al. (1990) stated that master's degrees have only a modest impact on student achievement. Hanushek and Rivkin (2007) also suggested master's degrees made little positive contribution to student achievement. Additionally, Ballou and Podgursky (2000) highlighted 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, socioeconomic status, and teacher experience, among other things. Conspicuously absent from the list of factors were graduate degrees. The absence of that kind of focus has contributed to a persistent gap in the literature.

Moreover, much of the limited research dealing with the impact of graduate-level teacher education and preparation on student achievement has focused on the perception of advanced teacher education and its impact on

student achievement. The existing literature has not adequately explored the impact of greater levels of teacher educational attainment (i.e., master's degree) on student success in measurable, quantitative terms. Despite the fact that measurable data is "increasingly demanded by policy makers" (Darling-Hammond, 2006, p. 121) and given the rare occurrence of research that provides measurable data related to the impact of graduate degrees on teacher effectiveness, districts and researchers, as previously demonstrated, have continually called for the use of higher levels of educational attainment as a proxy for instructional skill and content knowledge.

Graduate degrees are one type of individualized training that receives consistent consideration in teacher compensation, although 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 fiscal 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 to $2,580. Given the practice across Texas of differentially compensating teachers with higher degrees, is there evidence that Texas teachers with graduate degrees differentially impact student achievement? In other words, what is the value of this policy as it relates to student academic achievement?

Hellstrom and Jacob (2005) suggested the purpose of policy is to "invoke the reality it seeks to create" (p. 463). One 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.

In other words, education policy should always be focused on student achievement (McDonnell, 2009). In the ongoing conversation about improving student achievement, it is important that strategic decisions are made on the basis of measurable data. These types of decisions can ensure, to a reasonable degree, a method of accountability or means to measure return on investment.

Moreover, according to Ingle and Rutledge (2010), "Hiring is a central activity in which school leaders can build professional communities" (p. 44). In that light, information is needed that can inform districts' policies and practices as they relate to how teachers are hired, trained, and compensated. This is particularly true in a time of economic downturn, when operating with public funds under public trust.

Other Considerations

When quantifying factors related to student achievement, it would be nearly impossible to control for 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 and arguments in mind, some of the common variables shown to impact student achievement have been considered in order to ensure, to the greatest degree possible, 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, 2011; Capps, Fix, Murray, Ost, Passel, & Herwantoro, 2005; Esters & Douet, 2001; Gottfried, 2009; Marks, 2005; Scanlon & Devine, 2001). 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, socioeconomic 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).

This study made use of publicly available data on student achievement as measured by the state examination, the TAKS test from the TEA (Texas Education Agency). The research 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 reading as measured by the TAKS Reading test.

Purpose of Study

The purpose of this study was to ascertain the degree to which a higher level of education for a collective district teaching staff contributed to student reading achievement as measured by the TAKS Reading 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 the 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 reading, policy makers will have a clearer description of the relationship between the two.

While professional development comes in many forms and from 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 the 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 degree does the collective teacher education level of a school district contribute to student achievement in reading? 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) Reading test?

Method

Sample

During the 2008-2009 school year, there were more than 1,200 school districts and open charter schools across the state of Texas during that school year (TEA, 2009a). District level data were analyzed 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 judged only on the above criteria for participation or exclusion. The criteria were set in an effort to ensure valid and generalizable results.

Research design

This study 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 degree to which teacher educational attainment contributed to student achievement.

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 Texas Assessment of Knowledge and Skills (TAKS) Reading 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 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 variables "Student Achievement."

Collective teacher education level was operationally defined as the percentage of a district's teaching staff who hold 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 master's and doctoral degrees. Although the impact of a district's teachers with doctoral degrees was analyzed, 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. 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. Reports produced from SPSS were analyzed and reported on as a part of the results section.

Instrumentation

The TAKS reading test served as a measure of reading 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 through 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 reading test as measured using the Kuder-Richardson Formula 20 (KR20) as from 0.87 to 0.90 (TEA, 2009b). This manual reports reliability from 0.80 to 0.89 to be considered good, while reliability scores at 0.90 and higher are 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 are 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).

Data analysis

The first statistical analyses conducted were multiple Pearson Product Moment Correlations. The results of this analysis are reported in a correlation matrix in Table 2 (see Appendix B).

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 possible confounding 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 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 (Appendix A, Table 1). Furthermore, 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 among all analyzed predictors. The full set of data indicating relationships among all predictors can be reviewed in Table 2, see Appendix B.

After conducting the correlation analyses, 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 analysis.

Discussion

Explanation of results

After conducting the correlation analyses, four multiple regression analyses were performed with one analysis for each of the two graduate levels combined with each of the two measures of student achievement considered in this study. Variables were entered into the regression analysis in a hierarchical fashion. In order to remove the variance accounted for by the linear combination of those variables, all

potentially confounding variables were entered 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 also 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 1 to Model 2 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 reading achievement at the commended level.

The change in reading 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 data in Tables 3—10, Appendix C).

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, these results may have been masked.

Further, 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 alternate 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 reading 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 research that sought to "inform the decisions of local and national policy makers" (p. 438), Kelley (2004) 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 those students who struggle and the teachers who teach them.

Limitations

There are a number of potential limitations related to findings from this study. While the results from this study can be generalized to districts in the state of Texas, they are also very broad. Therefore, districts should consider the fit of recommendations to their unique mixes and compositions.

No one study can offer a clear prescription for all districts, as each district is composed of diverse people with diverse needs. In order to determine the best fit related to any or all recommendations, each district which 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.

Although the results from this study are generalizable to the state of Texas, they are not generalizable to other states in the union.

However, 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.

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

Further, while 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 the recruitment 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 related to the contribution of subject-specific graduate degrees, setting for graduate training, and teacher assignment to student achievement should be conducted. With this understanding, 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. Further, 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 Reading tests. Districts should consider ways to reward teacher effectiveness through a structured teacher compensation system that are 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.

Future research should seek to understand the contribution of graduate degrees to student achievement at the campus and local level. By attaining this understanding, researchers may be able to more effectively diagnose how some campuses more effectively utilize talents developed in graduate training than others, if any difference is found to exist. This understanding may also lead to more effective collaboration between schools and districts.

Future studies should also 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 A

Table 1

Demographics for Study Sample (N = 1026)

	Min %	*Max %*	*Mean*	*Std.Dev.*
Reading*	44	99	91.35	5.69
Commended Reading*	1	70	32.01	9.19
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

APPENDIX B

Table 2

*Correlations Among the 18 Variables Measured (*N = 1026*)*

	Reading	Commended Reading	Attendance	Mobility	Native American	Asian	African American	Hispanic	White	At Risk	Economically Disadvantaged	LEP	Masters
Commended Reading	.79***												
Attendance	.40***	.39***											
Mobility	-.57***	-.49***	-.30***										
Native American	.11***	.11**	.05	-.04									
Asian	.15***	.32***	.09**	-.07*	-.01								
African American	-.32***	-.28***	-.20***	.29***	-.08**	.09**							
Hispanic	-.42***	-.40***	-.17***	.09**	-.22***	-.07*	-.20***						
White	.55***	.50***	.26***	-.23***	.22***	-.08*	-.32***	-.86***					
At Risk	-.61***	-.64***	-.30***	.46***	- .14***	-.15***	.22***	.54***	-.62***				
Discipline	-.11***	-.15***	-.20***	-.08*	-.03	-.02	.13***	.22***	-.27***	.21***			
Economically Disadvantaged	-.62***	-.72***	-.25***	.37***	-.15***	-.26***	.28***	.60***	-.70***	.70***			
LEP	-.31***	-.26***	-.04	.03	-.15***	.08*	-.01	.63***	-.61***	.51***	.45***		
Masters	.04	.14***	-.05	.00	.04	.20***	.11**	.03	-.10**	-.02**	-.11**	.04	
Doctorate	-.02	.03	.01	.04	-.04	.09**	.03	.06	-.08**	.05*	.01	.06	.20***

***p < .00

**p < .01

*p < .05

APPENDIX C

Table 3

ANOVA Output From Regression—Research Question 1: Master's/Reading and Minimum Passing Standard

	Sum of squares	***df***	Mean square	*F*	Sig.
Regression	**19601.44**	**11**	1781.95	133.17	.000
Residual	**13568.84**	**1014**	13.38		
Total	**33170.28**	**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	**.77**	**.59**	**.59**	**.59**	146.01	10	1015	.000
Model 2	**.77**	**.59**	**.59**	**.00**	2.17	1	1014	.141

Table 5

ANOVA Output From Regression—Research Question 2: Doctorate/Reading and Minimum Passing Standard

	Sum of squares	*df*	Mean square	*F*	Sig.
Regression	19577.69	11	1779.79	132.77	.000
Residual	13592.59	1014	13.41		
Total	33170.28	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	.77	.59	.59	.59	146.01	10	1015	.000
Model 2	.77	.59	.59	.00	.40	1	1014	.528

Table 7

ANOVA Output From Regression—Research Question 3: Master's/Reading and Commended Passing Standard

	Sum of squares	*df*	Mean square	*F*	Sig.
Regression	55979.80	11	5089.07	168.40	.000
Residual	30644.01	1014	30.22		
Total	86623.81	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	.80	.64	.64	.64	181.63	10	1015	.000
Model 2	.80	.65	.64	.01	13.58	1	1014	.000

Table 9

ANOVA Output for Model Two—Research Question 4: Doctorate/Reading and Commended Passing Standard

	Sum of squares	*df*	Mean square	*F*	Sig.
Regression	55642.35	11	5058.40	165.56	.000
Residual	30981.46	1014	30.55		
Total	86623.81	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	.80	.64	.64	.64	181.63	10	1015	.000
Model 2	.80	.64	.64	.00	2.39	1	1014	.122

Research Article

The Superintendent's Influence on Student Achievement

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ABSTRACT

The purpose of this quantitative study was to examine the relationship between the length of superintendent tenure, longevity, and continuity relative to student achievement as evidenced by the 2008-2009 Grade 3 New Jersey Assessment of Skills and Knowledge (NJ ASK) in Language Arts. The researcher focused on New Jersey school districts in the lower socioeconomic categories of A-CD. In the District Factor Grouping (DFG) of A-CD, the researcher examined all 161 A-CD school districts in New Jersey. Nineteen districts were removed based on the removal criterion and not having data on the New Jersey School Report Card and Data Universe. The study then examined the remaining 142 A-CD school districts in New Jersey.

Key Words

superintendent influence, achievement

Introduction

"Research increasingly points to the relationship between effective leadership and increased student achievement" (McREL, 2006, p. 12).

In *School Leadership That Works: From Research to Results*, Marzano, Waters, and McNulty reported that there is a significant relationship between the principal and average student achievement in school with a correlation of .25 (Marzano, Waters, & McNulty, 2005). It is only recently that an interest has emerged in the role the superintendent plays in impacting student outcomes.

One significant study that explored the connections between the superintendent and the impact on student outcomes was a working paper called *District Leadership that Works*, or *Leadership at the Top* (Marzano & Waters, 2006).

In this meta-analysis study, four major findings emerged. In Finding 1, the authors found that district level leadership matters. They found a statistically significant relationship (with a positive correlation of .24) between district leadership and student achievement (Marzano & Waters, 2006).

In Finding 2, the authors found that effective superintendents focus their efforts on creating goal-oriented districts. Five district level leadership responsibilities were found to have a statistically significant correlation with average student achievement (Marzano & Waters, 2006).

The five district level responsibilities most used in creating a goal-oriented district according to Marzano and Waters (2006) are:

- collaborative goal setting;
- non-negotiable goals for achievement and instruction;
- board alignment and support of district goals;
- monitoring goals for achievement and instruction;
- use of resources to support achievement and instruction goals.

In Finding 3, the authors found that superintendent tenure is positively correlated with student achievement. They found two studies that focused on superintendent tenure and student achievement. The weighted correlation average of these two studies was statistically significant at a .19 level. A .19 level suggests that experience and the length of a superintendent's tenure in a position positively correlates to student achievement (Marzano &Waters, 2006).

In Finding 4, the authors defined "autonomy" as positively impacting student achievement. This study, in looking at "building autonomy" with a positive correlation of .28, indicates that student achievement in a district *increases* when a superintendent provides more building-level autonomy. In addition to the landmark work of Marzano and Waters (2006), several other studies have supported a relationship between the superintendent and student achievement (Bredeson, 1995; Brunner et al., 2002; Kowalski, and Brunner, 2005).

Given the increasing interest in the superintendent's role in influencing student outcomes, this study attempted to build on the extant research by separating and examining three variables that may influence student outcomes: the impact of the length of superintendent longevity, continuity, and tenure

in New Jersey schools on student achievement as evidenced by students scoring Proficient in 2009 on the New Jersey Assessment of Skills and Knowledge in Grade 3 for Language Arts.

The study looked at predictive variables from the percentage of students who scored at or above the Proficient level on the Assessment of Skills and Knowledge Language Arts in 2009 for Grade 3 to other district demographic information. Examining and identifying the practices of superintendents who have met accountability standards and Adequate Yearly Progress by having their students in Grade 3 pass Language Arts on the New Jersey Assessment of Skills and Knowledge at the Proficient level will provide great insight for future superintendents on how their longevity, continuity, and tenure may positively impact student achievement.

This study is significant because much of the research data adds to the extant literature on superintendent tenure, continuity, and longevity relative to student achievement on the New Jersey Assessment of Skills and Knowledge (NJ ASK) for Grade 3 in Language Arts.

Currently, greater emphasis is being placed on New Jersey superintendents because of greater accountability since the No Child Left Behind Act of 2001. New Jersey's achievement scores have risen each year since the inception of the No Child Left Behind legislation with a culminating 100% proficiency level by the year 2014.

With the knowledge gained from this research, district administrators may be better able to retain their superintendents and will be more apt to offer longer tenure, continuity, and longevity as long as there is a positive correlation to increased student achievement.

Specifically, two research questions guided this study:

1. What is the relationship between New Jersey superintendent's district continuity, such as length of tenure as a superintendent; and their longevity, such as years of experience as a superintendent and the total number of years in education as they relate to student academic achievement as evidenced on the 2008-2009 Grade 3 New Jersey Assessment of Skills and Knowledge (NJ ASK) in Language Arts?

2. What is the relationship between New Jersey superintendent's district demographics relative to student academic achievement as evidenced by the 2008-2009 Grade 3 New Jersey Assessment of Skills and Knowledge (NJ ASK) in Language Arts?

Literature Review

The role of the superintendent of schools has become a hotbed of political focus in recent years. In New Jersey, for example, superintendent contracts are being capped since Governor Christie took office. No longer is it sufficient for the designated leader of a school district to be an accomplished educator and respected person.

In a climate of high expectations and blame placing, superintendents are expected to be all things to all populations. From adept politicians to visionaries, superintendents are asked to meld the confusion of here and now, while focusing on a future vision of sweeping success for all.

Further, school leaders are expected to perform these functions in the context of institutional hierarchies that allow blame for failure to be placed squarely on the doorstep of the superintendent's office. In short, the role of the superintendent is complex and fraught with potential failure" (Brown, Swenson, & Hertz, 2010).

The ever-changing roles of 21st century superintendents have now shifted to where they are devoting the majority of their time as managers and politicians, thinking about and dealing with issues both inside and outside of the school districts, rather than serving as an instructional leader (Cuban, 1998; Hodges, 2005; Howley & Pendarvis, 2002).

Glass, Bjork and Brunner (2000) conducted a national study that found only one-fourth of superintendents felt they were hired for their skills and abilities in instructional leadership.

A report by the American Association of School Administrators (AASA) and the National School Boards Association (NSBA) identified specific responsibilities for superintendents.

The following three responsibilities are seen as the most significant changes to the superintendency:

1. Serving as the school board's chief executive officer and preeminent educational advisor who keeps board members informed about school operations, programs, and district needs. The superintendent also provides complete background information on policy and procedure recommendations that ultimately assist the school board with its governance role.

2. The oversight and management of district operations and serving as the primary educational leader for the school system and chief administrative officer of the entire school district and support staff.

3. The responsibility for instituting a process for long-range and strategic planning as well as informing the board of the administrative procedures needed to implement board policy at the public school level (AASA, 1994, pp. 11-12).

In *School District Leadership that Works*: *The Effects of Superintendent Leadership on Student Achievement*, the following research questions were used to guide the study:

- What is the strength of relationship between leadership at the district level and average student academic achievement in the district?
- What specific district-level leadership responsibilities are related to student academic achievement?
- What specific leadership practices are used to fulfill these responsibilities?
- What is the variation in the relationship between district leadership and student achievement? Stated differently, do behaviors associated with strong leadership always have a positive effect on student achievement?
- Is there a relationship between length of superintendent service and student achievement? (Marzano &Waters, 2006)

The findings to these specific five questions are that district leadership does make a difference and sound leadership at the district level adds value to an educational system. This belief stands in contrast with the images of superintendents and their impact on student achievement. There are other studies that

support the findings of Marzano and Waters, especially those studies that have been done since the inception of NCLB that establish the overall importance of the superintendent's instructional leadership on building a strong district culture that focuses on learning and student achievement (Brunner et al., 2002; Kowalski and Brunner, 2005).

In 2009 Marzano and Waters released their latest book called *District Leadership That Works: Striking the Right Balance*. This book was guided by the focus question: Does district leadership matter? Based on this study's findings, it does.

In 1987 Secretary of Education William Bennett attached the nickname "the blob" to administrators and administrative systems in public schools (Marzano &Waters, 2009, p. 1).

The blob is made up of people in the education system who work outside of classrooms, soaking up resources and resisting reform without contributing to student achievement (Walker, 1987). According to Bennett, the term *blob* is an acronym for "bloated educational bureaucracy." To Bennett, the blob includes superintendents, district office staff, and local board members as an amorphous mass.

Methodology

The purpose of this descriptive, quantitative, non-experimental study was to examine the impact a superintendent's length of tenure, longevity, and continuity relative to student academic achievement as measured by the 2008-2009 New Jersey Assessment of Skills and Knowledge (NJ ASK) for Grade 3 in Language Arts.

Multiple regression was applied to explore the relationship of three predictive variables as they relate to the dependent variable of this quantitative study, the academic achievement of students. The researcher focused on the superintendents' time spent in education, regardless of the position they held.

The predictive variables, including the primary focus of the study, were used to describe data from the 2008-2009 school year regarding the following:

1. Each superintendent's length of tenure in district (experience in district) in New Jersey;
2. Each superintendent's experience in New Jersey (total years);
3. Each superintendent's total experience in education (total years);
4. Each district's student attendance rates;
5. Percent of each district's students who were eligible for free lunch;
6. Percent of each district's students who were eligible for reduced lunch;
7. percent of each district's students who were Limited English Proficient (LEP), and;
8. Each districts total students.

The research was focused on New Jersey school districts in the lower socioeconomic groupings of A, B, and CD in the New Jersey State Department of Education District Factor Grouping Rating Scale (DFG).

This population was chosen to examine if there was a relationship between superintendent tenure and its impact on student achievement as measured by the New Jersey Assessment of Skills and Knowledge in Grade 3 for Language Arts in lower socioeconomic school districts.

The DFG's for New Jersey are broken down into eight different categories by socio-

economics. They are rated by A (39 districts in New Jersey), B (61 districts in New Jersey), CD (61 districts in New Jersey), DE (83 districts in New Jersey), FG (89 districts in New Jersey), GH (76 districts in New Jersey), I (103 districts in New Jersey) and J (25 districts in New Jersey). A is the lowest socioeconomic class with J being the most affluent. "The District Factor Groups (DFG'S) were first developed in 1975 for the purpose of comparing students' performance on statewide assessments across demographically similar school districts.

The categories are updated every ten years when the Census Bureau releases the latest Decennial Census data" (New Jersey State Department of Education District Factor Groups, 2004, p.1).

The purpose of this study was also to use the theoretical constructs of the reviewed literature, as well as the practices outlined by the New Jersey State Department of Education, the NSDC, PROQUEST, Data Universe, The New Jersey School Report Card, and ERIC to guide implementation.

The study researched if superintendent tenure, longevity, and continuity have a relationship with student achievement as evidenced by the New Jersey Assessment of Skills and Knowledge (NJ ASK) in Language Arts for Grade 3.

The research design of this study was a non-experimental, explanatory, cross-sectional design that used a multiple regression analysis. Under the guidance of Johnson (2001), an explanatory study must meet the following criteria: (a) Were the researchers trying to develop or test a theory about a phenomenon to explain "how" and "why" it operates? (b) Were the researchers trying to explain how the phenomenon operates by identifying the causal factors that produce change in it (p. 9)?

In order to determine which district and school variables had a statistically significant relationship to student achievement, the researcher used simultaneous multiple regression models for the study. This strategy is used when the researcher has no logical or theoretical structure of the data. This method is typically used to explore and maximize prediction (Pedhauzer, 1997). Scatter diagrams of residuals and normal probability plots of residuals were conducted to test assumptions.

Given the sample size of the population, 161 school districts within the New Jersey demographics of an A, B, or CD district were examined. The 161 school districts were broken down accordingly:

District	Number of Schools	Number of Schools meeting AYP
A	39	3
B	61	14
CD	61	17
TOTAL	161	34

This data was acquired, compiled, and analyzed using Data Universe and the New Jersey School Report Card for the 2008-2009 school year. The 2008-2009 New Jersey

Assessment of Skills and Knowledge (NJ ASK) for Grade 3 in Language Arts had a raised linked cut score of 182 for proficiency. The percentage for proficiency under the "New Target" for the 2008-2009 New Jersey Assessment of Skills and Knowledge was 59%.

In the data analysis of the New Jersey School Report Card, the researcher looked at all districts that had less than 41% of their students in the Partially Proficient category on the 2008-2009 NJ ASK. If a district fell below the 41% in the Partially Proficient category of the 2008-2009 NJ ASK for Grade 3 Language Arts, this meant that 59% of the students in that district scored a Proficient or better for literacy (New Jersey State Department of Education Adequate Yearly Progress, 2000, p. 2).

Multiple regression analysis was applied because according to Field, "Regression analysis … enables us to predict future [outcomes] based on values of predictive variables" (Field, 2009, p. 198). This methodology allowed for a statistical analysis of the data. It was also an efficient means of gathering data without introducing threats of reliability that can occur with other data collection means (Suskie, 1996).

Given the size of the population, 161 districts, observations and personal interviews were impractical to use for this study. Observations and personal interviews would have introduced the potential of bias and inconsistency in the administration of the interview or observation, and the data collected would not have been appropriate for statistical analysis.

Specifically, the backward method of multiple regression "calculates the contribution of each predictive variable by looking at the significance value of the t-test for each predictor … If a predictor meets the removal criterion (i.e., if it is not making a statistically significant contribution to how well the model predicts the outcome variable), it is removed from the model" (Field, 2009, p. 213). After this is completed, any remaining variable would then be assessed to determine its contribution to the outcome of the dependent variable.

The two research questions were examined by conducting a descriptive correlational analysis to discover if the significance of the predictor variables contributes to the independent variable. According to Field (2009), in a multiple regression analysis it is important for the researcher to check and ensure that the assumption of no multi-collinearity (heavily related variable) had not been violated.

This research design set the level of statistical significance at $p \leq .05$, the customary level used when working on significance (Krawthol & Anderson, 2001). To check the statistical significance and relative importance of each predictive variable, the researcher examined the unstandardized coefficient beta weights and the standardized beta weights of each predictive variable. In addition, an R-square was used to examine the relationships between the various predictive variables and the dependent variable.

Sample

The sample for this study was comprised of looking at third grade students' achievement scores on the 2008-2009 New Jersey Assessment of Skills and Knowledge from the New Jersey School Report Card and Data Universe in 161 A-CD districts.

Of the 549 total districts in the State of New Jersey, the researcher chose to look at

those districts that were in the District Factor Grouping ranges of A, B, and CD. There were 142 districts included in the final sample.

Results

The researcher chose to utilize the backward design method of multiple regression for analyzing the data and summary models were produced. Three predictive variables were shown to be significant at the .05 level (Eligible for Free Lunch .000, Attendance .013, and Experience in New Jersey .018); all of the models showed significance levels of $p < .05$.

Only data for the third model is included here, as it was found to be most closely related (See Table 1).

Table 1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.546[a]	.299	.256	10.98433	.299	7.074	8	133	.000

[a] Predictors: (Constant), Experience Total, Eligible For Reduced Lunch, Attendance, LEP, Total Student Population, Experience as Superintendent in District, Eligible For Free Lunch, Experience in New Jersey

[b] Dependent Variable: Student Achievement

Overall 26% of the variance is explained by the model. The predictive *variables of Total Student Population, Eligible for Free Lunch, Eligible for Reduced Lunch, LEP, Attendance, Experience as Superintendent in District, Experience in New Jersey, Experience Total are displayed in this model.*

The R-square in a multiple regression represents explained variance that can be contributed to all the predictors in a progression. The R Square gives explanatory power. The percentage of students who scored Proficient or better on the 2008-2009 Grade 3 New Jersey Assessment of Skills and Knowledge in Language Arts was accounted for by the predictive variables in the model. ($F = 7.074$; $df = 8, 133$; $p = .000$ or $p < .05$).

From the two main research questions we sought to discover the relationship between each individual predictive variable and the

dependent variable. Using the backward method of multiple regression, we examined the following predictive variables: Total Student Population, Eligible for Free Lunch, Eligible for Reduced Lunch, LEP, Attendance, Experience in District, Experience in New Jersey, and Total Experience.

Analysis was then conducted to test the unique contribution between the predictive variables and the dependent variable, assigning coefficients to each predictive variable.

Three statistically significant ($p \leq .05$) variables emerged from our models. We present them in order from the strongest predictor to the weakest:

(1) Percentage of students eligible for free lunch, -.348;

(2) Years of experience as a superintendent in New Jersey, .315; and

(3) Student attendance rates, .199.

Our results suggest that as the percentage of students eligible for free lunch increases in a school district, standardized test scores in Grade 3 decrease.

However, our results also suggest that the years of experience a superintendent had New Jersey can help offset that negative influence.

In other words, the greater the years of experience a superintendent had in New Jersey, the higher the Grade 3 standardized tests scores. Student attendance rates also influenced achievement positively, although to a lesser degree.

Discussion

A superintendent with more experience in the state in which he/she is employed has a larger influence on student achievement than one with less experience in the state.

Our results suggest that experienced superintendents can have a positive influence on achievement. These results begin to call into question policies in New Jersey that influence superintendents to leave the state and seek employment elsewhere. Policies like salary caps, drain the state of the experienced superintendents that are needed to raise achievement.

The superintendent in today's modern era is measured by standards of student achievement accountability on standardized tests never seen before the No Child Left Behind Act of 2001. The fact that 100% of all students have to make Adequate Yearly Progress (AYP) to be Proficient or better by 2014 has put increased pressure on the position of superintendent.

With the increased pressures of accountability, the superintendency has become more of a Jack-of-all-Trades manager than an instructional leader and our results suggest that "Jack" is more effective as she/he gains more experience in his/her state.

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Commentary

Supporting Mathematics Teachers in the Common Core Implementation

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Abstract

Based on work with elementary grades teachers in mathematics professional development to prepare for the implementation of the Common Core State Standards for Mathematics, we offer a set of recommendations for school leaders who wish to assist teachers in adjusting their instruction to meet the challenges that the new standards present.

Key Words

Common Core State Standards, mathematics, professional development, learning progressions

Now that the Common Core State Standards have been adopted by 45 states, the District of Columbia, and four U.S. territories, schools are on the frontline in proactively shaping these changes in ways that support teachers in assisting students in meeting them. Yet monthly curriculum updates, documents that crosswalk previous standards with the new ones, the barrage of commercially available curriculum and training programs, and uncertainties of future assessments have placed school leaders in the difficult but all too familiar place of "building a plane while flying it."

While trying to make sense of these myriad changes with incomplete information, they must still move forward in supporting teachers in preparing for these new standards. Many are left with questions: What really *is* different about these standards? How can I best support my teachers in the transition? In response, we draw upon our experiences from professional development, specifically from a year-long project with the teachers of two elementary schools, in preparation for the implementation of the Common Core State Standards for Mathematics (CCSS-M) (CCSSI, 2010). We describe two broad issues for school leaders to consider and offer a set of recommendations for school administrators working in similar schools to assist teachers in adjusting their instruction to meet the challenges that the new standards present.

So, What *Is* Different?

The CCSS-M[i] is comprised of two connected sets of expectations for student learning: the Standards for Mathematical Content and the Standards for Mathematical Practice. Together, they "define what students should understand and be able to do in their study of mathematics" (p. 4) and in our view represent major advances in standards-based reform in at least two distinct ways.

First, the writers began with "research-based learning progressions" to inform the priorities and sequencing of the topics that students encounter (p. 4). Using this approach, the Standards for Mathematical Content are aligned with research on mathematics learning regarding the ways children develop mathematical ideas over time (Daro, Mosher, & Corcoran, 2011).

Scholars working in the area of learning progressions point to numerous benefits, including opportunities for assessment systems that provide instructional guidance for teachers (Battista, 2004; Confrey & Maloney, 2012) and more coherent curricular programs (Clements & Sarama, 2008).

In the classroom, emerging research indicates that knowing learning progressions supports teachers in preparing instruction that simultaneously takes into account students' experiences and prior knowledge, creating instructional environments more aligned with students' likely paths of learning, assessing students with a focus on what they know (as opposed to what they do not know), and documenting common misconceptions (Edgington, 2012; Fennema, Carpenter, Franke, Levi, Jacobs, & Empson, 1996; Sztajn, Wilson, Edgington, & Confrey, 2011; Wilson, 2009). Thus, the Standards for Mathematical Content put into place a foundation that allows for student-centered mathematics instruction throughout their K-12 experiences.

Second, the Standards for Mathematical Practice "describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical

maturity and expertise throughout the elementary, middle, and high school years" (CCSSI, 2010, p. 8).

These practices include behaviors and skills such as persevering in problem solving, critiquing others' mathematical arguments, and using tools strategically. Though the inclusion of expectations that describe the processes and dispositions of mathematical proficiency is not new in the standards tradition, two national groups developing assessments aligned with the CCSS-M–-the Smarter Balanced Assessment Consortium (SBAC) and the Partnership for Assessment of College and Careers Readiness (PARCC)–-formally include the Standards for Mathematical Practice in the frameworks for their assessment design.

Such an inclusion suggests that high-stakes tests will not only assess concepts and procedures but also promote these ways of engaging in mathematics. There is a concern that these practices will be marginalized in classrooms (Confrey & Krupa, 2010), and research suggests that teachers require time and resources to develop instructional routines that support the Standards for Mathematical Practice (Krupa, 2011).

From our work with elementary grades teachers, we believe that these advances–-the foundation of learning progressions and an emphasis on mathematical practices–-warrant two considerations for school leaders wishing to support teachers in the CCSS-M implementation:

1. Opportunities for teachers to learn about and engage with the learning progressions on which the new standards are designed enrich their understandings of the mathematics students bring to the classroom and how students' understandings are likely to progress.
2. Opportunities to learn and adopt new pedagogical strategies to create nurturing environments for students to develop these mathematical practices lead to instruction that is more student-centered.

Supporting Teachers in Implementation

After the adoption of the Common Core State Standards by our state, leaders from two schools approached us to design and facilitate professional development to support elementary grades teachers in preparing for the CCSS-M implementation. Both schools were identified as "high need" by the state, using criteria that included a large percentage of economically disadvantaged students, teachers working outside of their area of licensure or holding provisional licenses, and low performance on year-end testing in reading and/or mathematics.

In response to their request, our project team created a 120-hour professional development program for elementary grades teachers to plan for the new standards. To do so, we aimed to share with teachers (1) a selection of the learning progressions that underlie the standards and (2) student-centered instructional practices that create spaces for students to experience and gain expertise with the Standards for Mathematical Practice.

Over the course of the 2011-2012 school year, our team worked with 30 teachers, 15 from each school, who demonstrated moderate to large effect sizes on pre/post measures of content knowledge, pedagogical content knowledge, and the ability to identify and analyze student-centered instructional practices. As we reflected on the project and its

success, two broad ideas emerged that we believe offer direction for school leaders wishing to assist teachers in adjusting their instruction to meet the challenges of the CCSS-M.

More Than Just Content Knowledge

Undoubtedly, the CCSS-M represents a curriculum significantly different than previous state standards, both in terms of sequencing and cognitive demand (Porter, McMaken, Hwang, & Yang, 2011), and will require that teachers teach mathematical topics with which they may be unfamiliar. Yet learning *more* mathematics is unlikely to assist teachers in implementing the new standards. It has been shown that teachers' content knowledge alone is insufficient to support student learning (Begle, 1972; Kilpatrick, Swafford, & Findell, 2001).

Instead, understandings of particular mathematics concepts that are flexible and multifaceted allow teachers to recognize and build upon students' prior knowledge in instruction (Ball, Thames, & Phelps, 2008), and such knowledge has been demonstrated to be a strong predictor of student achievement (Hill, Rowan, & Ball, 2005). Research on teachers' learning about learning progressions suggests deeper content and pedagogical content knowledge in mathematics result from a focused study on students' mathematical thinking described by the progressions (Mojica, 2010; Wilson, 2009).

Thus, rather than simply assisting teachers in learning "more math," our work with them stressed learning about and engaging with the mathematical ideas that students bring with them to the classroom through focusing on learning progressions. Tools such as the *Progressions Documents for the Common Core Math Standards* http://ime.math.arizona.edu/progressions/ and the *Learning Trajectory Display of the Common Core State Standards for Mathematics* posters (Confrey, Maloney, & Nguyen, 2011) were particularly useful in supporting teachers in learning to consider the mathematics of their grade level in relation to their students' previous and future understandings rather than as a set of isolated procedures for students to apply.

For example, consider the development of multi-digit multiplication of whole numbers. Although the formalization of this idea with the familiar algorithm is delayed until Grade 5 in the CCSS-M, the new standards expect students to begin building multiplicative understandings much earlier. In Grades 1 and 2, students work with equal-sized parts, a foundational idea for multiplication. They investigate and use properties of operations in Grades 3 and 4, gaining deeper understandings of the ways multiplication works. Only in Grade 5 are students expected to learn and apply the formal procedure.

Without an understanding of the ways these ideas build across grades, one can imagine a well-intentioned teacher, desiring to help his or her students, prematurely introducing the algorithm and curtailing the development of a deeper understanding of the concept.

For the teachers with whom we worked, knowing how students' understanding of multiplication develops across grades as described by the learning progression assisted them in identifying the ideas that students already knew, such as repeated addition or decomposing into tens and ones, and in customizing their instruction in response to those understandings. For these teachers, the learning progressions helped them make informed instructional choices in relation to their students' understandings and their own knowledge of content and curriculum.

More Than Just "Good Teaching"

Terms like *good teaching* and *best practices* are commonly used when referring to markers of quality instruction, such as cooperative learning and formative assessment strategies.

Yet the implicit, and perhaps unintended, message of these phrases is that effective instructional approaches are independent of the content being taught. Put another way, the language of "it's just good teaching" leads many to believe that, for example, high quality mathematics instruction entails the same pedagogical strategies as effective literacy instruction and that the same strategies for teaching mathematical procedures are appropriate for teaching mathematical concepts. Yet progress in the learning sciences suggests that this overgeneralization is misleading (cf. Sawyer, 2006). Some instructional approaches are more effective at assisting students in learning domain-specific knowledge than others.

Piaget (1950) made distinctions among different types of knowledge, two of which he called social-conventional and logical-mathematical knowledge. For social-conventional knowledge, the source of ideas is outside of the learner and must therefore be internalized from a more knowledgeable other, such as pre-reading strategies in literacy or locating continents on a globe in social studies. In mathematics, examples of this kind of knowledge include mathematical vocabulary and notation, like the word *rhombus* for a figure with four sides of the same length or the symbol = for denoting equivalence. Instructional practices aimed at supporting students in developing social-conventional knowledge might include direct instruction, modeling, or the gradual release of responsibility (Pearson & Gallagher, 1983) with an "I do—We do—You do" format (Fisher & Frey, 2008).

In contrast, learning concepts requires students to bring their prior knowledge to bear on a novel, problematic situation. Logical-mathematical knowledge exists as relationships among ideas in one's mind and must therefore be constructed by adapting one's current understandings to address new situations, such as understanding changing states of matter or the relationship between mass and density in science. Examples of this type of knowledge in mathematics include concepts and relationships, such as an understanding of place value or the connections among arithmetic operations.

In contrast with direct instruction, student-centered mathematics instruction for developing logical-mathematical knowledge might include the use of high cognitive demand tasks to elicit multiple approaches from students (Stein, Grover, & Henningson, 1996) and the careful sequencing and connecting of these approaches through discussion (Smith & Stein, 2011) in a "Launch-Explore-Discuss" format (Smith, Bill, & Hughes, 2008).

As we worked with teachers during the project, there was often confusion and tension about selecting instructional approaches to address particular Mathematical Content Standards. Perhaps an unintended consequence of intensive literacy initiatives that they had experienced, many of the teachers advocated using "gradual release" and "modeling" to support their students in learning mathematical concepts and wrestled with how to organize their instruction differently.

Not only are these strategies likely to be ineffective at supporting learning of logical-mathematical knowledge, we argue that these approaches provide only limited opportunities for students to gain expertise in the Mathematical Practice Standards. Over the course of the project, however, teachers began

to differentiate instructional approaches that were likely to engender the types of mathematical understandings that meet the CCSS-M from others they used for other content areas.

Recommendations

Based on these two broad ideas, we offer a set of recommendations for school leaders working in similar schools wishing to assist teachers in adjusting their mathematics instruction to meet the challenges of the CCSS-M. Though we acknowledge that our suggestions are based on experiences from one year-long project with a small number of teachers from two schools with particular contexts, we contend that these recommendations may prove useful and resonate with the findings of other scholars working in the areas of professional development (e.g., Garet, Porter, Desimone, Birman, & Yoon, 2001; Heck, Banilower, Weiss, & Rosenberg, 2008; Wei, Darling-Hammond, & Adamson, 2010) and teachers' learning of learning trajectories (Sztajn, Confrey, Wilson, & Edgington, 2012).

1. *Offer and personally participate in professional development on learning progressions*. Professional development opportunities for teachers and school leaders should ensure that the content includes attention to children's mathematical thinking and the learning progressions that describe its development across grades.

2. *Provide time for teachers to articulate students' mathematical development across grades*. School leaders should provide time and support for cross-grade conversations that examine and describe their own students' development of mathematical understanding over time.

3. *Support teachers in understanding effective instruction for mathematics concepts*. Professional development and instructional support for teachers should emphasize the importance of pedagogical strategies for teaching mathematics concepts that allow students to engage in the Standards for Mathematical Practice.

4. *Allocate time for cross-subject matter discussions*. Provide opportunities for teachers to clarify the similarities and differences of effective instructional practices in mathematics and other disciplines such as literacy.

5. *Understand that learning new instructional practices takes time*. Professional development should offer scaffolded opportunities for teachers to try new practices over extended periods of time in their own classrooms.

6. *Acknowledge examples of quality mathematics instruction*. Mark instances of mathematics instruction that builds upon students' thinking in walk-throughs and formal observations and communicate with all faculty that such instruction is valued.

AUTHORS' NOTE

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Further, one anonymous reviewer pointed out that the CCSS are not field-tested and lack empirical support for claims related to college and career readiness. Our purpose is not to advocate for these standards but rather to share our experiences in supporting classroom teachers and school administrators in meeting standards that have been set for them.

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  - **2014 Legislative Advocacy Conference, July 8-10, 2014, Washington, D.C., Hyatt Regency Washington on Capitol Hill**

  - **2015 National Conference, February 26-28, 2015, San Diego, Calif., San Diego Convention Center celebrating the 150th Anniversary of the founding of AASA**

  - **2016 National Conference, Feb. 11-13, 2016, Phoenix, Ariz., Phoenix Convention Center**