When Learning is at Stake: Exploration of the Role of Teacher Training and Professional Development Schools on Elementary Students' Math Achievement

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ABSTRACT

The purpose of this article is to explore how a professional development school (PDS) collaboration project contributed to improved elementary students' math achievement in an urban setting. Finding ways to maximize the educational outcomes of P-12 students and pre-service teacher candidates in their school-based practicum is an ongoing challenge for teacher educators and school instructional leaders but is not always a joint venture. In this case, funds were provided to develop a PDS partnership between a public charter school educating underachieving students and a small private university preparing teacher candidates.

***Key words*: student achievement, math education, charter school, minority students, professional development schools, and teacher quality**

Introduction

This article describes a collaborative professional development school (PDS) project between a university and a charter school aiming to increase young elementary students' math achievement while providing pre-service teacher candidates meaningful opportunities and rich teaching experiences to face the challenges and demands of urban teaching. The University in this collaborative project is a small, private institute of higher learning located in the Mid-Atlantic region serving 3,469 undergraduate and 3,236 graduate students from all 50 states. The student population of the University consists of 4.9% African American, 63.5% Caucasian, 7.3% Hispanic, 0.3% Native American, 3.3% Asian American, 3.3% Non-Resident Alien, and 17.4% unknown. The teacher education unit is NCATE (National Council for Accreditation of Teacher Education) accredited and its teacher education programs are state approved.

The charter school (referred to as *Children's Charter*) is a relatively small, award-winning public charter school located in the same urban setting in the Mid-Atlantic region. It serves 244 diverse students in its PreK-8th grade classes. The students come from all parts of the city representing diverse socioeconomic and ethnic backgrounds (34% Black, not Hispanic, 34% White, not Hispanic, 27% Hispanic, 43% Low Income, 12% Limited/Non English Proficiency, and 19% Students with Special Needs). The main goal of Children's Charter is to develop students' higher order thinking and problem solving skills and assist them in attaining a deep conceptual understanding of the material while being in a vibrant learning community that respects all cultural, linguistic, and learning diversity.

Children's Charter and the University joined forces to increase teacher candidates' learning while helping young students reach their full potential. In this case, funds were provided to develop a PDS relationship to promote teacher candidate learning and increase underachieving students' learning. The purpose of this paper is to present the results of an evaluation of the PDS relationship and its impact on student achievement.

The evaluation posed the following questions:

1. What is the pattern between the baseline math achievement scores of low-achieving children from different sub-groups and post-test measures spanning the first and second years of the PDS university-school relationship?
2. How did the instructional and assessment components of the math tutoring program contribute to an increase in student achievement?

Literature Review

Teacher Quality and Student Learning Outcomes

Teacher quality, teaching effectiveness, and the performance of schools have become a national priority in addressing the quality of education students receive. Standards-based educational attainment is evaluated using high-stakes testing, and the consequences for poor performance are unforgiving. Low student achievement is a concern in many areas, however, learning outcomes in the areas of STEM (science, technology, engineering and mathematics) –

the focus of this study - are especially troubling (TIMSS, 2007). In response to this educational crisis, initiatives have been created to address the declining power of the U.S. in the areas of science, technology, engineering, and mathematics. Charged with helping the U.S. regain its leading position in STEM disciplines, initiatives have identified strategies to increase the U.S. STEM workforce and encourage students to excel in STEM and related professions necessary for our country's economy, leadership, and security (ACTE, 2009). STEM also strives to attract underrepresented populations, such as females and minority students, to STEM professions. In order to address low student achievement, teacher education universities and P-12 schools are expected to collaborate and provide more potent professional development opportunities for all educators to increase student learning.

Teachers' impact on student learning. Accumulating evidence suggests that teacher quality is the largest factor impacting student learning; it even moderates the effect of certain risk factors for poor achievement, such as level of parental educational attainment, students' gender, as well as socio-cultural and socio-economic backgrounds (Darling-Hammond, 2000; Pianta, Belsky, Bendergrift, Houts, & Morrison, 2008; Rowe, 2003). In fact, there are many schools and districts where minority children and children in poverty outperform their more advantaged peers when they receive high quality instruction (Haycock, 2005).

In order to increase student achievement and comply with high-stakes testing requirements (see annual yearly progress of No Child Left Behind), schools and school districts continue searching for the best curricula, professional development opportunities, and instructional supports (Pianta et al., 2008). As teachers are now responsible for the types of learning their students experience as well as the attainment of educational goals, teacher education and professional development are implicitly included in President Obama's educational agenda along with his commitment to math and science education (Whitcomb, Borko, & Liston, 2009).

Researchers have documented the effects of well-designed professional development opportunities on student achievement. A meta analysis conducted by Blank and de las Alas (2009) included studies that provided scientifically-based evidence for the positive effects of content-focused teacher professional development on student learning in math. Based on multiple measures in the studies, they concluded that students whose mathematics teachers participated in professional development scored above those whose teachers did not, though gains were larger in elementary school than in middle and high schools.

Student teachers' impact on student learning. The focal point in teacher education has shifted from an *input model* that examines instruction provided to pre-service teachers to an *output model* that studies the impact teacher quality has on student outcomes. This shift in focus has made the question of teacher preparation and its impact on P-12 learning central. Smith, Desimone, and Ueno (2005) propose that teachers who meet the criteria for 'highly qualified' status set by No Child Left Behind (bachelor's degree, license, and content proficiency in the discipline taught) tend to focus more on conceptual math and use reform-oriented teaching methodology more than their less qualified colleagues. A greater emphasis on conceptual learning goals rather than computational math is associated with improved reasoning and problem-solving skills resulting in higher student achievement in mathematics (Smith, Lee, &

Newmann, 2001). Comparing the impact of candidates with formal teacher education preparation to that of non-teacher education college students in Arts & Sciences programs, Konold et al. (2008) concluded that teacher education candidates are more likely to teach in a way that contributes to student learning. For example, teacher candidates in formal preparation programs plan instruction to meet their diverse students' needs, focus more on mastery and independent learning, encourage deeper thinking about the material, break problems into components, provide meaningful examples, and give appropriate feedback.

Many questions are still debated: What pre-service learning experiences add value over time to achievement growth? How can teachers be supported in these endeavors, in particular when they are assigned to low-performing children who are at risk for school failure? What outcomes should be assessed and documented, how, and by whom (Cochran-Smith, 2001; Darling-Hammond, 2000)? How can teacher preparation programs respond to the mandate to document their student teachers' impact on P-12 student learning using multiple measures over time? Would some of the solutions include P-12 students' pre-post testing, collections of work samples, use of expert judgment, or candidates' reflections and self-evaluation (Hamel & Merz, 2005)? Others ask what learning experiences contribute to higher quality teacher preparation programs and what combination of coursework and field experiences are the most conducive to teacher preparation (Beeth & Adadan, 2006). Zeicher (2010) has criticized the traditional division between campus courses and field experiences as well as the hegemony of teacher preparation institutions. He argues for a more integrated, coequal, and mutually respectful interdependence of academic, practitioner, and community expertise. He also promotes linking the knowledge from coursework and practice by bringing P-12 teachers to campus as adjunct faculty and incorporating mentor teachers' practices and knowledge from the community into courses. Many teacher preparation programs have responded to the need for more integration by creating campus-based laboratories and professional development schools where academics and practitioners collaborate to effect change and contribute to pre-service teachers' learning. As teacher preparation has moved to the spotlight, professional development schools have regained their importance both in research and practice.

The Definition and Benefits of Professional Development Schools

Professional Development Schools (PDSs) are productive partnerships between teacher education programs and P-12 schools. The manifold purposes of PDSs are to maximize P-12 learning, provide a site for teacher candidates' field experiences, engage faculty in meaningful professional development, increase all parties' teaching effectiveness, and eventually lead to the transformation and strengthening of teacher preparation (Darling-Hammond, 1994; Ridley, Hurwitz, Davis Hackett, & Knutson Miller, 2005; Taack Lanier, 1994) as well as to the reform of P-12 education (Yahnke, Shroyer, Bietau, Hancock, & Bennett, 2005). PDS partnerships between universities and schools afford a place for reliable and lasting innovation, invention, and discovery (Taack Lanier, 1994). It is here that "practice-based" and "practice-sensitive" research is implemented collaboratively by student teachers, classroom teachers, teacher educators, and researchers (Darling-Hammond, 1994).

Having reviewed the literature, Ridley et al. (2005) found six studies that provided observation-based evidence for pre-service teachers' effectiveness. Ridley et al. point to these studies as limited evidence that teacher candidates in PDS-based teacher preparation programs seem to be more successful than those prepared in traditional campus-based programs in terms of lesson planning, teaching effectiveness, post hoc lesson reflections, classroom management, questioning skills, interactions with students, use of technology in instruction, quality of feedback, and content retention of pedagogical knowledge. The literature suggests that the differences may be partially due to the fact that PDS arrangements are collaboratively designed to allow for extended and better-distributed field experiences, powerful connections between theory and practice, more systematic and careful feedback, effective monitoring and supervisory structures, and more authentic and diverse learning experiences (Ridley et al., 2005). Value-added evidence of pre-service teachers' impact on P-12 student learning has also been provided by Castle, Fox, and O'Hanlan Souder (2006), who found that PDS-prepared candidates scored significantly higher in the areas of planning, instruction, classroom management, assessment, reflection, and professionalism compared to their non-PDS peers. More specifically, they found that PDS candidates applied and integrated the Interstate New Teacher Assessment and Support Consortium (INTASC) standards in a more sophisticated manner; focused more on their students' learning rather than on their own practice; and showed a higher sense of ownership when discussing their practice, students, classroom, and school.

P-12 students. Professional Development Schools are designed to be beneficial to school-based and university-based faculty as well as students (Campoy, 2000; Fisher, Frey, & Farnan, 2004). P-12 students receive intensive and effective instruction from classroom teachers, student teachers, and university faculty as they collaborate to design the best instruction to meet all students' needs. Designed to be sites of collegiality, inquiry, accountability (NCATE, n.d.), professional collaboration, and collegial problem-solving, PDSs lead to increases in student learning (Darling-Hammond, 1994).

Teacher candidates. PDSs provide a knowledge-rich, reflective environment for combining research- and practice-based knowledge for teacher candidates. As candidates implement their book knowledge in the classroom, analyze their own teaching, and consider areas of improvement, they are mentored, guided, and supported in reflection, self-evaluation, and decision-making. Teacher candidates can freely communicate with experts about successes, challenges, and possible solutions to identified problems. Ultimately, teacher candidates gain proficiency in enactments of effective teaching (Darling-Hammond, 1994). Student teachers are also encouraged to elicit their mentor teachers' practical knowledge when trying to relate theories learned on campus to practices observed in the classroom. Besides observation, Meijer, Zanting, and Verloop (2002) recommend that teacher candidates and university faculty use stimulated recall (a substitute for the think-aloud protocol) and concept mapping to gain a deeper insight into mentor teachers' cognitive processes, the complexities of teachers' knowledge, and how all these variables impact teaching practice.

Mentor Teachers. The positive effects of professional development have been documented widely, and various designs have been proposed for encouraging teachers to produce new knowledge and consider new methodologies for their teaching (Kazemi & Hubbard, 2008). In a PDS environment, schoolteachers can take on the role of a mentor and contribute to the identification of best teaching practices. Through collaboration with university-based faculty, mentor teachers can deepen the understanding of teaching and learning. By modeling, mentoring, and guiding teacher candidates throughout their practice and reflection, mentor teachers also increase their own instructional effectiveness. In this setting, mentor teachers help build, expand, transform, and share knowledge about best research-based practices and can also create shared norms for learner-centered practice. Thoroughly examining 'research-based' and 'context-based' knowledge (Darling-Hammond, 1994) leads to knowledge transformation that brings about changes in practice. Mentor teachers – especially those who work in cultures that are not conducive to shared decision-making and which control every aspect of teachers' lives through mandates and regulations – may be given opportunities to become decision makers, teacher educators, and most of all, empowered individuals who develop their own voices (Yendol-Silva & Fichtman Dana, 2004).

The No Child Left Behind Act

The No Child Left Behind Act of 2002, the reauthorization of the Elementary and Secondary Education Act (ESEA), is the most recent public law that applies to all students from kindergarten to high school. The main goal of No Child Left Behind (NCLB) is to close the achievement gap by race, ethnicity, language, and special education status and to ensure that all students including those who are disadvantaged achieve high academic proficiency.

NCLB possesses four components: stronger accountability for student achievement, more choices for parents, greater freedom and control for states, and more focus on research-based teaching practice (U.S. Department of Education, 2004). In order to achieve accountability that holds states, school districts, and teachers responsible for closing the achievement gap, teacher quality and outcome-based evidence linked to student achievement have become a priority. As a measure of student achievement, standardized test scores are used to determine whether schools meet adequate yearly progress expectations (AYP). AYP is a minimum level of improvement each state needs to achieve, i.e., a measure of a percentage of students who move to a minimum level of proficiency in reading/language arts, math, and science. Other academic indicators are also used, such as graduation rates for high schools and attendance rates for elementary and junior high schools in a given state each year. States select their academic standards and assessment instruments for certain grades with the goal of 100 percent of all students achieving these benchmarks by 2014. Schools that fail to meet AYP for two consecutive years are required to provide supplemental education services, offer school choice, or take corrective actions. Schools that do not make AYP within 5 years are restructured or closed.

NCLB underscores the importance of effective educational practice based on sound research. In this vein, funding supports instructional programs with a proven track record to increase student achievement. NCLB also supports university-school partnerships to increase teacher quality and student learning.

What is at Stake? NCLB's Impact on Student Achievement, Curriculum, and Testing

The debate over the importance and necessity of high-stakes testing has divided educators into camps of advocates, partial skeptics, and critics. Advocates believe that data derived from such testing provide a roadmap for meeting student needs and an impetus for programmatic and systemic change (Middleton & Thomas, 2000). They propose that using high-stakes testing is the most effective and cheapest way of measuring success. Even advocates, however, caution about policy and decision-making based on a single measure of performance. They remind us that failure to meet standards is not the responsibility of the child alone when many variables (teacher quality, funding for the school, availability of resources, quality of instruction, and so forth) are out of their control (McGuire, 2000).

Partial skeptics think that the original idea is worthwhile and accept the necessity of testing as a possible solution to the concerns of our educational system today. They address intended benefits and potential unintended negative consequences (Thurlow & Johnson, 2000). They consider student achievement data from high-stakes testing as the only and indispensable indicator of student learning and view testing as an essential tool to provide information on school effectiveness (McGuire, 2000). In their view, student test results allow teachers and schools to adapt the curriculum and instructional strategies to address identified areas of knowledge and skills that need improvement (Thurlow & Johnson, 2000). Critics believe that NCLB, with its high-stakes testing mandate, resulted in a narrowed curriculum, lower standards, and more limited learning opportunities for minority, poor, and immigrant students; and it also contributed to the deprofessionalization of teachers' work and a school practice to push minority students out in order to raise the schools' test scores (Cochran-Smith, 2005).

Achievement. Advocates of high-stakes testing believe that it increases achievement because teachers work harder, especially with lower-achieving students, and students study harder. Roderick, Jacob, and Bryk (2002) make the point, however, that higher scores do not necessarily mean a learning gain - they may simply mean that students focus on the test more. Of course, it is also possible that students study harder if tested because they understand the importance of the stakes in their lives and want to demonstrate their knowledge. This is probably true for higher achieving students who have higher self-efficacy, value the future opportunities high test scores bring, and also feel that these goals are attainable. However, struggling students who need to make the most gains to catch up with their advantaged peers could be less motivated for the same exact reasons, e.g., it may be harder to be motivated when one sees particular learning goals as unattainable.

Kober, Chudowsky, and Chudowsky (2008) reported that all subgroups (low income, special education, and minority linguistic cultural groups) showed more growth on all three performance levels in Grade 4, and the gap among subgroups had decreased based on percentages of students scoring proficient at all levels of schooling. Nonetheless, it is acknowledged that in some cases the gap widened and the mean scores (rather than percentages of students scoring proficient) illustrate a wider achievement gap. Other studies show that the introduction of high-stakes testing has increased test scores including those at lower-achieving schools (Roderick et al., 2002). However, the NAEP results from 2000 cited by the U.S. Department of Education noted only a slight improvement in 4th, 8th, and 12th grade math scores with only 25% of the 4th and 8th graders performing at proficient or higher levels. Twelfth grade scores had not improved since 1996, and the biggest drop in scores was observable in the low achieving students' performance.

The U.S. Department of Education cites NAEP results from July 2005 indicating NCLB's effectiveness in increasing elementary students' achievement in reading and math to an all-time high and in closing the achievement gap (U.S. Department of Education, 2006b). Specifically, the report asserts that 4th graders have scored the highest in math since 1973, and the 8th graders have scored the highest in math since the introduction of the test. They conclude that minority students' math achievement reached an all-time high and the achievement gap an all-time low.

NAEP data analyses from 2007 continue to report record highs in 4th and 8th graders' math scores including those of African-American and Latin-American students. Other studies point out that NCLB increased student achievement especially in states that established accountability measures sooner (Carnoy & Loeb, 2005; Hanushek & Raymond, 2005). NAEP (2009) pointed out, however, that even though most urban districts' scores were higher in 2009 than in 2003, very few made gains since 2007. The gains were made only in Grade 8 but not in Grade 4, which scored essentially the same in 2009 as in 2007. Several studies demonstrate NCLB's positive impact on student learning (see Chudowsky, Chudowsky, & Kober, 2009). Nonetheless, Lee's report released by The Civil Rights Project at Harvard University (2006) states that NCLB had not improved test scores or reduced the achievement gap and will not meet its goal of 100 percent proficiency if the present trends continue. In sum, the reported positive results and thus the effectiveness of NCLB have been hotly debated (see Fusarelli, 2004).

Curriculum. Though NCLB's primary focus is to increase student achievement through research-based instruction, rigorous curriculum, and high academic standards (Hardman & Dawson, 2008), concerns have been voiced about the unintended harmful effects of NCLB, namely the unfavorable impact of this standards-based accountability system on the curriculum, teaching practices (CEP, 2009) and standards setting policies. The pressure to increase student achievement and the accountability measures to document that the results are achieved have resulted in most cases in a narrowing of the curriculum (Au, 2007; National Center for Education Statistics, 2007) and a slower pacing of instruction (Gross et al., 2009).

Testing. NCLB requires all students to be tested in order to determine students' and states' progress, and assessment data are shared with families and other stakeholders. Special populations, such as English language learners (ELL) and students with special needs, are included in NCLB's testing requirement though exemption policies allow states to exclude some students' data from state reports. Each state is mandated to test at least 95% of these groups of children but is given flexibility in accounting for their results while being held accountable for the quality education these students receive. States are expected to provide reasonable accommodations for these special populations, such as 1) alternate assessments and/or appropriate accommodations for students with special needs and 2) translated tests for ELL students who have been in the U.S. for fewer than 3 years. ELL students who have spent less than a year in the U.S. are exempt from one administration of the reading/ language arts test but are still required to take the math and science tests. Though states must test even these recently arrived ELL students, it is at the states' discretion whether they report their scores in a separate category (U.S. Department of Education, 2006a). However, student achievement data reported by states also reveal idiosyncratic reporting procedures that various states employ in order to make AYP, which leads to a deceptively decreasing gap between White and non-White, high and low SES, and normally developing children vs. children with special needs. Jennings and Beveridge (2009) point out that exempting lower performing students from NCLB reporting has another unintended but significant consequence: students who “pull down” a school’s achievement scores are less likely to receive the quality education they deserve because the scarce resources are redirected to those students who have the potential of making an increase in the school’s standing.

More recently, alternatives to NCLB’s approach to measuring student achievement have been designed. While NCLB has a goal that all children will meet minimum proficiency by 2014 and that testing will measure gradual attainment, other alternatives have been recommended, such as growth trajectories that look at individual achievement based on each individual's rate of growth. In the new *Race to the Top* state application, considered to be a prototype for future changes to NCLB or Title 1, an effective teacher is rated as someone whose students achieve acceptable rates of growth (at least one grade level in an academic year), and a highly effective teacher is rated as someone whose students achieve high rates of growth or at least one and one-half year's growth in an academic year (U.S. Department of Education, 2009). The next section of this paper will examine learning math from a cognitive perspective and assessing math achievement of children who have special and other unique needs.

Learning Math from a Cognitive Perspective

Mastering mathematics includes the learning of declarative knowledge (concepts and schemas) and acquiring procedural knowledge (skills and strategies) (Anderson, 1983). Students may struggle in any, or a combination of, areas in math including concept comprehension, calculation, application strategies, or problem solving skills. Students who have processing difficulties may experience additional challenges in learning math. ELL students may experience difficulty with linguistic constructions when solving math word problems, adding to the list of possible challenges. The knowledge of how experts solve math problems, represent knowledge, and acquire skills informs teachers’ practice to enhance children’s expertise.

Many effective classroom strategies have been devised based on cognitive theory. Boaler (2008) depicts two programs used in high school math instruction, the tenets of which are easily applicable to teaching elementary math. The *Communicative Approach* allows students to communicate about math in multiple ways: through words, diagrams, symbols, graphs, tables and objects. Unlike the traditional method where teachers model procedures that students need to imitate, this method allows students to discover mathematical principles while working on interesting problems that require higher-order thinking skills. During the problem-solving process students talk to each other, ask questions and rephrase problems, justify their approaches, provide a rationale, draw pictures and diagrams, and interpret findings, in addition to manipulating numbers and calculating with procedures. Students can choose what they work on, how, and with whom. Students ask teachers to demonstrate knowledge and skills that they need in order to grapple with their problems; at other times teachers pre-teach material that they know their students would need. Using this approach, students benefit not only from the opportunities to explore mathematical ideas but also from the social milieu of the learning environment. They learn that there can be more ways of solving a problem and more answers to the same question. They also discover the joy of math and come to see its applicability in their everyday lives.

Another powerful method that Boaler (2008) describes is the *Project-Based Approach*. Instead of teaching procedures, teachers give students projects that require mathematical methods. The projects, carefully selected by teachers, are usually very open, for example, “Volume 216” where students have to find an object that has a volume of 216. Necessary mathematical content is taught on a need-to-know basis. Students are given considerable freedom to decide what project to work on and the direction they want to take.

Other methods, such as schema-based transfer (Fuchs, Fuchs, Finelli, Courey, & Hamlett, 2004) and *Cognitively Guided Instruction* (CGI) (Franke, Webb, Chan, Ing, Freund, & Battey, 2009) have also resulted in improved mathematical performance. Fuchs et al. (2004) examined how schema-based transfer instruction helped third graders solve real-life mathematical problems and found that learning problem-solving rules, sorting problems into categories, and differentiating between relevant and irrelevant information all resulted in superior mathematical problem-solving for students including those with low achievement. Franke et al. (2009) studied CGI and concluded that it is an effective method to support students’ understanding of mathematical concepts and processes by ‘probing sequences,’ which are appropriate sets of questions teachers can use to understand student thinking and adjust instruction. Encouraging students’ justifications of their problem-solving and elucidation of constructs forces students to readjust their thinking, compare their understanding to that of their peers, and correct their misconceptions -- all enhancing their mathematical knowledge and skills.

Assessment of Math Achievement

Schools generally use a variety of assessment methods but usually do not routinely carry out individualized quantitative assessment on standardized instruments due to time and resource limitations. However, individualized quantitative assessments are indispensable to determine if a child has a disability, to evaluate program outcomes, or to conduct research. Students learning were individually diagnosed and assessed in this study and will be discussed in a later section.

Special Populations: Students in Poverty, Students with Special Needs, and Students with Limited English Proficiency

Math learning and achievement among students in poverty. Children in poverty usually have lower math achievement and lag behind their socio-economically more advantaged peers in performance. Even when these lower performing students demonstrate growth in learning, their gain is less than that of students in high SES status, and this trend continues to widen the gap between the “haves” and the “have nots.” Another factor that impacts low SES children’s math progress is the fact that effective and highly qualified teachers are unevenly distributed in the United States, i.e., more affluent students are likely to have better prepared teachers (Hill, 2007). The achievement gap can be closed when highly focused and effective teaching methods are implemented for all students (Pianta et al., 2008).

Math learning and achievement among students with special educational needs. Difficulties with conceptual comprehension of numbers ("number sense") and computational fluency describe mathematics learning disabilities that are experienced by 6 to 10 percent of elementary school children (Barbaresi, Katusie, Colligan, Weaver, & Jacobsen, 2005). Children with both math and verbal learning disabilities perform more poorly than children with only a mathematics learning disability (Geary, Hoard, Byrd-Craven, Nugent, & Turntee, 2007; Geary & Hoard, 2001; Hanich, Jordan, Kaplan, & Dick, 2001). Severe dyscalculia, a form of mathematics learning disability with a neurological cause, has been found in an longitudinal study to persist from fifth grade through eleventh grade (Shaley, Manor, & Gross-Tsur, 2005) and is significantly associated with lower IQ, inattention, and writing difficulties, but not with verbal tasks, family SES, or family patterns of learning disabilities. Several authors have identified distinct patterns of math difficulties that may involve poor working memory (Ashcraft, 1995; Swanson, 2006) and visual-spatial deficits in sequencing time, events, and objects (Kable, Coles, & Taddeo, 2007). Children with brain damage taught effectively can show improved working memory skills (Swanson, 2006), behavior, and math (Coles, Kable, & Taddeo, 2009).

Math learning and achievement among students with limited English proficiency. Relatively little research has been done regarding English language learners' mathematics achievement though one study found that ELL status did not impact word problem solving skills in first grade (Secada, 1991). The effects of instructional methodology and bilingual education are also the subject of research (Barnett, Yarosz, Thomas, Jung, & Blanco, 2007) that is favorable towards the ELL population's ability to learn in different environments. Research related to language does note that there is inherent variation among languages regarding how mathematical concepts are represented, and this phenomenon impacts child acquisition of mathematical concepts (Coggins, Kravin, Coates, Carroll, 2007).

Minority Students and Their Self-Efficacy

Students from special populations often struggle not only with learning but also with their low self-efficacy that in turn negatively impacts their ability and willingness to learn (Usher, 2009). Self-efficacy, defined as the belief in one's ability to acquire skills and learn knowledge in a particular area (Bandura, 1986), is a powerful determinant of one's learning. As Bandura (1986) stated in his social cognitive theory, students obtain their sense of self-efficacy from various sources: mastering experiences, social persuasions, vicarious experiences, as well as physiological and affective states. The tutoring component of this PDS project was designed to provide many meaningful positive experiences for the children to increase their achievement and their self-efficacy, which in turn would fuel their motivation to continue studying math.

Methods

Participants

The participants in the program were 5^{th}-8^{th} graders. The students came from all parts of the city representing diverse socioeconomic and ethnic backgrounds. Of the 244 students served by the school, 34% were African American, 34% are Caucasian, 27% were Hispanic, 43% came from low income families [qualifying for free or reduced-price lunch], 12% had limited/non-English proficiency, and 19% had special needs.

The teacher candidates who tutored these students were Caucasian college students attending a university that has little diversity (4.9% African American, 63.5% Caucasian, 7.3% Hispanic, 0.3% Native American, 3.3% Asian American, 3.3% Non-Resident Alien, and 17.4% unknown).

The Needs of Children's Charter and Its Partnership with the University

Children's Charter is a small inclusive school with a curricular focus on project-based learning that incorporates instruction across disciplines. Mathematics is taught using a problem-based approach, science instruction utilizes hands-on activities in an inquiry-based methodology, and literacy instruction is implemented to increase students' desire to read and become lifelong learners. Spanish is taught to all students, and English as a Second Language (ESL) and bilingual education are available for ELL students.

Children's Charter had many identified strengths. All their subgroups met AYP in reading in 2003; however, their low-income students did not meet AYP in mathematics in 2003. Forty-three percent of their children were eligible for free lunch under Title I of the ESEA Act and among these, only 38% met AYP in math on the required accountability tests, *Stanford Achievement Tests - 9th edition*. The Title I math scores for this age group showed a significant discrepancy in the area of math operations compared to those of other youth. The principal and faculty identified 23 children for remedial math tutoring. All 23 students were from sub-groups (low SES, ELL, and special education) that had not met AYP in the prior year.

At the same time, the University also had a goal to provide authentic teaching experiences for its elementary and early childhood teacher candidates. Naturally, it served the purpose of both Children's Charter as well as the University to assign the teacher education candidates as math tutors of these elementary students. Having taken their formal math methods course, teacher candidates were supervised in their practicum placement at Children's Charter. This field experience was one of three placements that each teacher candidate is required to complete in the teacher education program. (Teacher candidates complete two practicum experiences during the junior year prior to their 14-week long student teaching, which is the capstone experience in the senior year.) Candidates were trained in the math curriculum including instructional and assessment strategies. As a well coordinated tutoring experience integrated into a systematic, consistent, and extended practicum, this teaching opportunity served not only the teacher candidates but also the children who had very diverse needs. Graduate special education candidates were taught to administer the formal pre/post Key Math assessments to evaluate student learning in math.

Math Curriculum and Testing at Children's Charter

Math curriculum at Children's Charter. Children's Charter boasts of research-based math programs that incorporate differentiated instruction to gain an in-depth understanding of concepts. The math curriculum for Kindergarten through 5th grade is *Investigations in Number,* *Data, and Space*, a comprehensive curriculum that was developed at TERC and funded partly by the National Science Foundation (NSF). This curriculum is inquiry-based with the purpose of deepening all learners' conceptual understanding of mathematical knowledge and acquisition of mathematical skills. The main goal of this curriculum is to engage children in mathematical thinking, amplify their interest in math, and increase their self-confidence. When students feel that they have mastered the prerequisite skills and completed challenging tasks, their belief in their own capacity increases (Usher, 2009), and they become more motivated in future tasks.

For the older students in Grades 6 and 7, Children's Charter implemented *Connected Mathematics*, developed by the Connected Mathematics Project at Michigan State University and funded by NSF. This problem-centered curriculum was designed to teach concepts and skills embedded within problems through an investigative and inquiry-based approach using motivating, interesting, and interactive problems and engaging everyday situations. Teaching for deep conceptual understanding and providing sufficient practice for mastery are key elements to ensure success in math. Both the University and school-based faculty agreed philosophically regarding the importance of a conceptual approach to teaching math.

Key Math Testing. The Key Math Diagnostic Arithmetic Tests-Revised (Key Math-R) is an untimed, norm-referenced and domain-referenced diagnostic test used to assess K-12 students' mathematical concepts and skills in the areas of basic concepts, operations, and applications. These three areas are broken down into 14 subtests: numeration, rational numbers, geometry, addition, subtraction, multiplication, division, mental computation, measurement, time, money, estimation, interpretation of data, and problem solving. Graduate special education candidates administered the test to individual students from kindergarten through 9^{th} grade in approximately 30-45 minutes. Key Math tests were given individually to children eligible for Title 1 at the beginning and end of Year 1 and at the end of Year 2.

The Key Math assessment produces normed scores for each section and a total score. Of interest is a comprehensive diagnostic assessment sheet, which is produced from the raw data. This sheet offers an individualized portrait of each child's math skills including strengths and needs. The most recent version of the test, the *KeyMath3 Diagnostic Assessment* (Key Math 3 Da) has been updated and is recently re-aligned with current standards.

Parental involvement in the project. Besides teachers and the junior teacher education candidates, parents also received the Key Math comprehensive diagnostic sheet showing their children's profile of strengths and needs in the areas of applications, concepts, and operations as well as the total score. These test results and reports, including individual child profiles, were written for all of the children who were tested.

Limitations and Assumptions

This case study is an evaluation of the work of a charter school and a university, and its results may not be generalized to other settings. Further, the sample size of the students whose test scores were analyzed in a correlated t-test was small and was not selected randomly. The original sample size (n=23) was decreased to n=11 when the older students graduated or left for other reasons in Year 2.

Results

Baseline math scores for targeted low-performing students in 5th-8th grades and other students in 6th and 7th grades were analyzed in the first year. The Title 1 math scores for this age group show a discrepancy in the area of math operations from the performance of other children and youth (see Table 1), consistent with the stakeholder accountability testing.

Table 1

Means for the Title I, English Language Learners, and Special Education Groups

	Title 1				English Language Learners				Special Education		
		Total Year 1	Total Year 2			Total Year 1	Total Year 2			Total Year 1	Total Year 2
No-Title I	M	94.50	94.00	No-ELL	M	92.29	92.50	No-IEP	M	87.00	92.50
	n	4	1		n	14	8		n	14	6
	SD	22.41			SD	13.94	3.38		SD	12.92	2.25
Title I	M	86.89	92.20	ELL	M	81.89	92.00	IEP	M	90.11	92.20
	n	19	10		n	9	3		n	9	5
	SD	9.83	3.25		SD	6.31	3.00		SD	12.31	4.26
Total	M	88.22	92.36	Total	M	88.22	92.36	Total	M	88.22	92.36
	n	23	11		n	23	11		n	23	11
	SD	12.50	3.13		SD	12.50	3.13		SD	12.50	3.13

In the first year, analyses of the data on a classroom basis, revealed strong mentor teacher and teacher candidate relationships to achievement in one classroom. That particular teacher continued to teach at the school and focused the second year of the PDS grant on math with children in the 7th and 8th grades.

Changes from the Beginning of the PDS Work to the End

Eleven of the initial 23 children were tested on the Key Math tests at the end of Year 2. The Key Math tests from the spring of Year 1 and the spring of Year 2, when viewed by sub-test and overall, show increases in the means of standard scores from one year to the next. The largest change in means was seen with the ELL subgroup whose performance increased from a mean of 81.89 to 92.00. The IEP group changed from 90.11 to 92.20. The Title 1 group, which included the ELL and IEP groups, showed a change from 86.89 to 92.20.

An exploratory analysis was conducted to understand any possible effects of student strength in one area as compared to later gain in one of the other two sub-tests. Of interest is one significant relationship between concepts scores in the first year and operations scores in the second year *(p< .05). The benefit to operations from the students' earlier growth in concepts scores is consistent empirically with the theoretical framework that the school operates within; i.e., a focus on conceptual math will later yield operational math competency. Given the small number of children, these results point to the need of further studies in to validate these findings.

T-tests of significance of difference between scores were done with the paired samples of each sub-test on the Key Math test from Year 1 to Year 2 (see Table 2). By examining the results (for 11 children), on the sub-tests of concepts, operations, and applications, it can be seen that the operations sub-test showed highly significant differences between the Key Math test scores in the beginning of Year 1 and the end of Year 2, (mean score difference = 7.45; $p < .01$) (See Table 2).

Table 2

Paired Samples – Pre-test Year 1 to Year 2

Test (n = 11)	Mean	SD	SE Mean	Sig.
Concepts 1	95.64	10.25	3.09	
Concepts 2	97.81	6.85	2.06	0.410
Operations 1	86.55	6.15	1.85	
Operations 2	94.00	6.27	1.89	0.003**
Applications 1	88.91	15.80	4.76	
Applications 2	91.54	4.27	1.28	0.552
Total 1	88.27	9.01	2.71	
Total 2	92.36	3.13	0.94	0.088

Note: When t-tests were run and missing values imputed, n = 23 and significant probabilities were found for Concepts*, Operations ** and the Total Score ***.
*$p < .05$. **$p < .01$. ***$p < .001$

Discussion

Taken as a whole, the data appear to show that children gained in math scores more than expected. It is of interest that higher concept subscale scores in the first year showed a significant relationship to the operations subscale in the second year testing in a separate analysis. The emphasis of the school on the conceptual math area is based on education theory that posits that conceptual understanding is the most important area to focus on in math instruction. Skills in the operations area are needed to carry out math calculations and may have benefited from the instructional approach to build strong conceptual understanding in math first. The applications area showed initial progress in the first year with the ELL population. The applications items are "word" problems that may improve with the enhanced use of language and experience with word problems. The relative intransigence of the math scores of children in special education with Individual Education Plans (IEPs) demonstrates the need for more individualized approaches to math, beyond tutoring and general curriculum enhancements. Emphasis might be placed on "number sense," "working memory," or organizational skills depending upon individual needs.

It appears that the math tutoring program conducted by the Professional Development School collaboration, including teacher candidate tutors and in particular, the work of the instructional staff at Children's Charter, was successful if uneven in execution in each classroom. We found that intentional interventions informed by systematic assessment and coupled with effective instruction based on strong theoretical and empirical research can increase student achievement rapidly. Data substantiated our assumption that conceptual understanding is primary to focusing on procedural knowledge. However, with individual learning styles and/or disabilities, this may not be the case. In the final analysis the disaggregated data indicated distinct profiles for different populations. The children with disabilities showed very little gain (less than 2 points) in terms of standard scores while the ELL students performed much higher (more than 10 points) by the end of Year 2. The disaggregated Title 1 group scores were in between the ELL and Special Education groups. There was also an observed difference in students' math achievement in three classrooms in the second year of the project. The classroom with the highest gains had a teacher who had made the most use of the individual assessments as well as the extra assistance from the college tutors by providing clear guidelines about each student's learning needs and expectations about the outcome of the tutoring sessions. In this instance, use of the resources that the PDS provided seemed to benefit children directly in the classroom. Overall, instructional leadership in the school, along with the flexibility to implement new approaches and partnerships, appears to be a major force in the changes in student achievement.

Future studies involving true experimental designs would substantially contribute to a deeper understanding of how various variables, such as additional instructional support, more student-centered activities, pre-service teacher candidates' data-based instructional decisions, and the use of children's individualized profiles impact student achievement. Another recommendation is to study the full impact of tutoring experiences on junior candidates' learning.

References

Anderson, J. R. (1983). *The architecture of cognition.* Cambridge, MA: Harvard University Press.

Ashcraft, M. H. (1995). Cognitive psychology and simple arithmetic: A review and summary of new directions. *Mathematical Cognition, 1*, 3–34.

Association for Career and Technical Education. (2009). Issue brief: CTE's role in science, technology, engineering & math. Alexandria, VA: ACTE.

Au, W. (2007). High-stakes testing and curricular control: A qualitative metasynthesis. *Educational Researcher, 36*(5), 258-267. doi: 10.3102/0013189X07306523

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall.

Barbaresi, M.J., Katusie, S.K., Colligan, R.C., Weaver, A.L., & Jacobsen, S.J. (2005). Math learning disorder: Incidence in a population-based birth cohort. 1976-1982. Rochester, Minnesota. *Ambulatory Pediatrics 5*(5), 281-289.

Barnett, W.S., Yarosz, D.J., Thomas, J., Jung, K., & Blanco, D. (2007). Two-way monolingual English immersion in preschool education: An experimental comparison. *Early Education Research Quarterly, 22*, 277-293.

Beeth, M.E., & Adadan, E. (2006). The influences of university-based coursework on field experience. *Journal of Science Teacher Education*, *17*(2), 103-120. doi: 10.1007/s1097200690138

Blank, R.K., & de las Alas, N. (2009). *Effects of teacher professional development on gains in student achievement: How meta analysis provides scientific evidence useful to education leaders.* Washington, DC: Council of Chief State School Officers.

Boaler, J. (2008). *What's math got to do with it? Helping children learn to love their least favorite subject – and why it's important for America*. New York, NY: Viking.

Campoy, R.W. (2000). *A professional development school partnership: Conflict and collaboration.* Westport, CT: Bergin & Garvey.

Carnoy, M., & Loeb, S. (2005). Does external accountability affect student outcomes? A cross-state analysis. *Educational Evaluation and Policy Analysis 24*(4), 305-331.

Castle, S., Fox, R.K., O'Hanlan Souder, K. (2006). Do professional development schools (PDSs) make a difference? A comparative study of PDS and Non-PDS teacher candidates. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 57*(1), 65-80. doi: 10.1177/0022487105284211

Center on Education Policy (2009). *How state and federal accountability policies have influenced curriculum and instruction in three states: Common findings from Rhode Island, Illinois, and Washington.* Retrieved from http://www.cep-dc.org/document/docWindow.cfm?fuseaction=document.viewDocument&documentid=296&documentFormatId=4396

Chudowsky, N., Chudowsky, V., & Kober, N. (2009). *State test score trends through 2007-08: Are achievement gaps closing and is achievement rising for all?* Washington, DC: Center on Education Policy.

Cochran-Smith, M. (2001). The outcomes question in teacher education. *Teaching and Teacher Education, 17*(5), 527-546.

Cochran-Smith, M. (2005). No Child Left Behind: 3 years and counting. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 56*(2), 99-103. doi: 10.1177/0022487104274435

Coggins, D., Kravin, D., Coates, G.D., & Carroll, M.D. (2007). *English language learners in the mathematics classroom*. Thousand Oaks, CA: Corwin Press,

Coles, C.D., Kable, J.A., & Taddeo, E. (2009). Math performance and behavior problems in children affected by prenatal alcohol exposure: Intervention and follow-up. *Journal of Developmental & Behavioral Pediatrics, 30*(1), 7-15.

Darling-Hammond, L. (Ed.). (1994). *Professional development Schools: Schools for developing a profession.* New York, NY: Teachers College Press.

Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives, 8*(1). Retrieved from http://epaa.asu.edu/epaa/v8n1

Fisher, D., Frey, N., & Farnan, N. (2004). Student teachers matter: The impact of student teachers on elementary-aged children in a professional development school. *Teacher Education Quarterly, 31*(2), 43-56.

Franke, M.L., Webb, N.M., Chan, A.G., Ing, M., Freund, D., & Battey, D. (2009). *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 60*(4), 380-392. doi: 10.177/0022487109339906

Fuchs. L. S., Fuchs, D., Finelli, R., Courey, S. J., & Hamlett, C. L. (2004). Expanding schema-based transfer instruction to help third graders solve real-life mathematical problems. *American Educational Research Journal, 41*(2), 419-445.

Fusarelli, L.D. (2004). The potential impact of the No Child Left Behind Act on equity and diversity in American education. *Educational Policy, 18*(1), 71-94. doi: 10.1177/0895904803260025

Geary, D.C., & Hoard, M.K. (2001). Numerical and arithmetical deficits in learning-disabled children: Relation to dyscalculia and dyslexia. *Aphasiology, 15*(7), 635-647.

Geary, D.C., Hoard, M.K., Byrd-Craven, J., Nugent, L., & Turntee, C. (2007). Cognitive mechanisms underlying achievement deficits in children with mathematical learning disability. *Child Development, 78*(4), 1343-1359.

Gross, B., Booker, T. K., & Goldhaber, D. (2009). Boosting student achievement: The effect of comprehensive school reform on student achievement. *Educational Evaluation and Policy Analysis, 31*(2), 111-126.

Hamel, F. L., Merz, C. (2005). Reframing accountability: A pre-service program wrestles with mandated reform. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 56*(2), 157-167. doi: 10.1177/0022487105274458

Hanich, L., Jordan, N.C., Kaplan, D., and Dick, J. (2001). Performance across different areas of mathematical cognition in children with learning difficulties. *Journal of Educational Psychology, 93*(3), 615-626.

Hanushek, E.A., & Raymond, M.E. (2005). Does school accountability lead to improved student performance? *Journal of Policy Analysis and Management, 24*(2), 297-327.

Hardman, M.L., & Dawson, S. (2008). The impact of federal public policy on curriculum and instruction for students with disabilities in the general classroom. *Preventing School Failure, 52*(2), 5-11.

Haycock, K. (2005). Choosing to matter more. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 56*(3), 256-265. doi: 10.1177/0022487105275552

Hill, C. H. (2007). Mathematical knowledge of middle school teachers: Implications for the No Child Left Behind policy initiative. *Educational Evaluation and Policy Analysis, 29*(2), 95-114.

Jennings, J. L., & Beveridge A. A. (2009). How does exemption affect schools' and students' academic performance? *Educational Evaluation and Policy Analysis, 31*(2), 153-175.

Kable, J. A., Coles, C. D., & Taddeo, E. (2007). Socio-cognitive habilitation using the Math Interactive Learning Experience Program for alcohol-affected children. *Alcoholism: Clinical and Experimental Research, 31*(8), 1425-1434.

Kazemi, E., & Hubbard, A. (2008). New directions for the design and study of professional development. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 59*(5), 428-441. doi: 10.1177/0022487108324330

Kober, N., Chudowsky, N., & Chudowsky, V. (2008). (2008). *State test score trends through 2006-07: Has student achievement increased since 2002?* Washington, DC: Center on Education Policy.

Konold, T., Jablonski, B., Nottingham, A., Kessler, L., Byrd, S., Imig, S., Berr, R., & McNergney, R. (2008). Adding value to public schools: Investigating teacher education, teaching, and pupil learning. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 59*(4), 300312.doi:10.1177/002248710832137

Lee, J. (2006). *Tracking achievement gaps and assessing the impact of NCLB on the gaps: An in-depth look into national and state reading and math outcome trends.* Cambridge, MA: The Civil Rights Project at Harvard University.

McGuire, K. (2000). Agora: The impact of high-stakes testing. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 51*(4), 289-292.

Meijer, P.C., Zanting, A., & Verloop, N. (2002). How can student teachers elicit experienced teachers' practical knowledge? *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 53*(5), 406-419. doi: 10.1177/002248702237395

Middleton, R. & Thomas, A. (2000). Agora: The impact of high-stakes testing. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 51*(4), 289-292.

National Assessment of Educational Progress (2009). *The nation's report card.* Retrieved from http://nationsreportcard.gov/math_2009/index_alt.asp

National Center for Education Statistics, (2007). *Changes in instructional hours in four subjects by public school teachers of grades 1 through 4* (Issue Brief). Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007305

National Council for Accreditation of Teacher Education. (n.d.). Retrieved from www.ncate.org

Pianta, R. C., Belsky, J., Bendergrift, N., Houts, R., & Morrison, F. J. (2008). *American Educational Research Journal, 45*(2), 365-397.

Ridley, D.S., Hurwitz, S., Davis Hackett, M.R., & Knutson Miller, K. (2005). Comparing PDS and campus-based preservice teacher preparation: Is PDS-based preparation really better? *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 56*(1), 46-56. doi: 10.1177/0022487104272098

Roderick, M., Jacob, B., & Bryk A. S. (2002). The impact of high-stakes testing in Chicago on student achievement in promotional gate grades. *Educational Evaluation and Policy Analysis, 24*(4), 333-357.

Rowe, K. J. (2003, October). *The importance of teacher quality as a key determinant of students' experiences and outcomes of schooling*. Background paper to keynote address presented at the 2003 Australian Council for Educational Research Conference, Melbourne, Australia. Available: http://www.acer.edu.au/research/programs/learningprocess.html.

Secada, W.G. (1991). Degree of bilingualism and arithmetic problem solving in Hispanic first graders. *Elementary School Journal*, *92,* 213-231.

Shaley, R. S., Manor, O., & Gross-Tsur, V. (2005). Developmental dyscalculia: A prospective six-year follow-up. *Developmental Medicine & Child Neurology, 47,* 121-125.

Smith, T. M., Desimone L. M., & Ueno K. (2005). "Highly qualified" to do what? The relationship between NCLB teacher quality mandates and the use of reform-oriented instruction in middle school mathematics. *Educational Evaluation and Policy Analysis, 27*(1), 75-109.

Smith, J., Lee, V., & Newmann, F. (2001). *Instruction and achievement in Chicago elementary schools: Improving Chicago's schools.* Chicago, IL: Consortium and Chicago School Research.

Swanson H.L. (2006). Cross-sectional and incremental changes in working memory and mathematical problem solving. *Journal of Educational Psychology*, *98*, 265–281.

Taack Lanier, J. (1994). Foreword. In L. Darling-Hammond (Ed.), *Professional development schools: Schools for developing a profession* (pp. IX-XII). New York, NY: Teachers College Press.

Thurlow, M.L., & Johnson, D.R. (2000). High-stakes testing of students with disabilities. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education*, *51*(4), 305-314.

Trends in International Mathematics and Science Study (TIMMS). (2007). *Mathematics Achievement of Fourth- and Eighth-Graders in 2007.* Retrieved from http://nces.ed.gov/timss/table07_1.asp

U.S. Department of Education (2004). *Overview: Four pillars of NCLB*. Retrieved from http://www2.ed.gov/nclb/overview/intro/4pillars.html

U.S. Department of Education (2006a). *New No Child Left Behind regulations: Flexibility and accountability for limited English proficient students.* Retrieved from http://www2.ed.gov/admins/lead/account/lepfactsheet.html

U.S. Department of Education (2006b). *No Child Left Behind Act is working.* Retrieved from http://www.ed.gov/nclb/overview/importance/nclbworking.html.

US. Department of Education (2009, November 18). *Overview information: Race to the Top Fund: Notice inviting applications for new awards for fiscal year (FY) 2010 notice,* Federal Register.

Usher, E. L. (2009). Sources of middle school students' self-efficacy in mathematics: A qualitative investigation. *American Educational Research Journal*, *46*(1), 275-314.

Whitcomb, J., Borko, H., & Liston, D. (2009). Growing talent: Promising professional development models and practices. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 60*(3), 207-212. doi: 10.177/0022487109337280

Yahnke, S., Shroyer, G., Bietau, L., Hancock, M., & Bennett, A. (2005). Collaborating to renew and reform K-16 education. In L. Darling-Hammond (Ed.), *Professional development schools: Schools for developing a profession* (pp. 21-36). New York, NY: Teachers College Press.

Yendol-Silva, D., & Fichtman Dana N. (2004). Encountering new spaces: Teachers developing voice within a professional development school. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 55*(2), 128-140. doi: 10.1177/0022487103261447

Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college-and university-based teacher education. *Journal of Teacher Education: The Journal of Policy, Practice, and Research in Teacher Education, 61*(1-2), 89-99. doi: 10.1177/0022487109347671