MATHEMATICS TEACHING-RESEARCH JOURNAL ONLINE
VOL 5, N 1
December 2011

ELEMENTARY TEACHERS' MATHEMATICAL CONTENT KNOWLEDGE, EFFICACY, PROBLEM SOLVING ABILITIES, AND BELIEFS IN TWO ALTERNATIVE CERTIFICATION PROGRAMS

Evans Brian

Pace University

bevans@pace.edu

ABSTRACT

The purpose of this study was to understand teachers' mathematical content knowledge, efficacy, problem solving abilities, and teacher beliefs in an elementary education mathematics methods course for special education teachers in the New York City Teaching Fellows and Teach for America alternative certification programs. Teachers were given mathematics content examinations, efficacy questionnaires, and a problem solving examination in a reformed-based mathematics methods course. Further, teachers were required to keep teaching and learning journals throughout the semester to reflect on their own teaching in their classrooms and learning in the methods course. Findings revealed a significant increase in mathematical content knowledge and teacher efficacy. Additionally, teachers were found to have high efficacy at the end of the semester and strong problem solving abilities. Further, teachers generally found that helping students with disabilities learn mathematics was the biggest issue in their teaching, and that the use of technology and manipulative were the most important topics addressed in their learning. Finally, the majority of teachers considered themselves to be reformed-based teachers.

INTRODUCTION

This study examined mathematics content knowledge, efficacy, problem solving abilities, and teacher beliefs among new elementary school mathematics teachers in two alternative certification programs, New York City Teaching Fellows (NYCTF) and Teach for America (TFA). Understanding teacher knowledge is important because it is directly related to student achievement (Hill, Rowan, & Ball, 2005). Efficacy is a teacher's belief in his or her ability to teach effectively and positively affect student learning outcomes (Bandura, 1986; Enochs, Smith, & Huinker, 2000), and is an important component for successful teaching. It is recommended that mathematics should be taught through a problem solving perspective (NCTM, 2000; Schoenfeld, 1985).

Teachers' concepts of efficacy affect instructional decision-making, which impacts students learning (Parajes, 1992; Soodak & Podell, 1997). Soodak and Podell (1997) argued that teachers with high efficacy devote more time to instruction than teachers with lower levels of efficacy (Gibson & Dembo, 1984). Soodak and Podell (1997) found that preservice teachers exhibited higher levels of efficacy than when they began teaching in the field. However, through experience the level of efficacy rose again. Soodak and Podell (1998) suggested a reexamination of teaching training programs in this respect.

Few studies have addressed mathematics knowledge with teacher efficacy (Newton, Leonard, Evans, & Eastburn, in press; Swars, Daane, & Giesen, 2006; Swars, Hart, Smith, Smith, & Tolar, 2007). Newton et al. (in press) found a relationship between mathematics content knowledge and concepts of efficacy for elementary teachers taking a mathematics methods course. Swars et al. (2006) examined the relationship between mathematics anxiety and teacher efficacy in elementary pre-service teachers, and it was found that lower mathematics anxiety was related to higher efficacy. Further, Swars et al. (2007) found an increase in teacher efficacy over the course of an elementary mathematics methods class. It is possible that efficacy may be a greater variable in quality teaching than content knowledge alone (Bandura, 1986; Ernest, 1989). In a study of science teachers, it was found that teachers with high efficacy were more likely to teach through a student-centered inquiry approach (Rubeck & Enochs, 1991).

Problem solving continues to be of high importance in mathematics education (NCTM, 2000; Posamentier & Krulik, 2008; Posamentier, Smith, & Stepelman, 2008). It is one of the five National Council of Teachers of Mathematics (NCTM) process standards (NCTM, 2000), and is critically important in how students best learn mathematics (Posamentier et al., 2008). The National Council of Supervisors of Mathematics (NCSM) has considered problem solving to be the principal reason for studying mathematics (NCSM, 1978).

In order to understand what problem solving is, first it must be understood the definition of a mathematical "problem." Charles and Lester (1982) defined a mathematical problem as task in which (a) The person confronting it wants or needs to find a solution; (b) The person has no readily available procedure for finding the solution; and (c) The person must make an attempt to find a solution. According to Krulik and Rudnick (1989), problem solving is a process in which an individual using previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. Polya (1945), in his seminal work *How to Solve It*, outlined a general problem solving strategy that consisted of (a) Understanding the problem; (b) Making a plan; (c) Carrying out the plan; and (d) Looking back.

Understanding the level of elementary school mathematics teachers' problem solving abilities is critical in supporting them to teach their students from a problem solving perspective. For example, teachers are critically important in developing abstract thinking in students during the problem solving process. The problem is that many students rarely use abstract thinking in the problem solving process as Cai (2000) found among sixth grade students. Strong problem solving abilities for teachers are needed if teachers are to teach mathematics well because content knowledge by itself, while being necessary, is not sufficient for good teaching (Ball, Hill, & Bass, 2005; Ma, 1999). The NCTM (2000) said, "Problem solving is not only a goal of learning mathematics but also

a major means of doing so" (p. 52). If there is interest in good student problem solving, teachers need to be more than proficient in their own problem solving abilities.

Ball et al. (2005) had emphasized the importance of content knowledge for teachers. Additionally, Bandura (1986) stressed that teacher efficacy can be subdivided into a teacher's belief in his or her ability to teach well, and his or her belief in a student's capacity to learn well from the teacher. NCTM (2000) and Schoenfeld (1985) have emphasized problem solving as a way of teaching though an emphasis on problem solving as an important process standard. The work of Ball et al., Bandura, Schoenfeld, and the NCTM formed the theoretical framework for this study.

PURPOSE OF THE STUDY

The purpose of this study is to add to the literature by providing an understanding of teachers' mathematical content knowledge, efficacy beliefs, level of problem solving abilities, and general teaching beliefs in an elementary education inquiry-based mathematics methods course for special education teachers in the NYCTF and TFA programs. This study expands upon the literature by examining the field experience relationship, specifically in-service teaching, with content knowledge, efficacy beliefs, problem solving, and new teacher beliefs in the two alternative certification programs. At the beginning and end of the semester teachers took a mathematics content examination and efficacy questionnaire, and at the end of the semester teachers took a problem solving examination. Finally, teachers were required to keep reflective teaching and learning

journals, and state and justify their teaching philosophies in terms of back to the basics approach and reformed-based constructivist methods.

ALTERNATE CERTIFICATION PROGRAM

There has been a recent interest in studying the effects of alternative teacher certification in America's classrooms with a particular interest in teacher quality issues (Boyd, Grossman, Lankford, Michelli, Loeb, & Wyckoff, 2006; Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006; Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2007; Darling-Hammond, 1994, 1997; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Humphrey & Wechsler, 2007; Kane, Rockoff, & Staiger, 2006; Laczko-Kerr & Berliner, 2002; Stein, 2002). The NYCTF and TFA programs are two large alternative certification programs, particularly in New York.

BACKGROUND ON NEW YORK CITY TEACHING FELLOWS. The NYCTF program is an alternative certification program developed in 2000 in conjunction with The New Teacher Project and the New York City Department of Education (Boyd et al., 2007). The program goal was to recruit professionals from other fields to supply the large teacher shortages in New York City's public schools with quality teachers. There was a 7000 teacher shortage predicted for fall 2000 with a possible shortage of 25,000 teachers over the next several years (Stein, 2002). Prior to September 2003, New York State allowed for teachers to obtain temporary teaching licenses to help fill the teacher

shortage. NYCTF teachers are generally recruited to teach in high needs schools throughout the city (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006).

The NYCTF program has grown very quickly since its inception in 2000. "Fellows grew from about 1 percent of newly hired teachers in 2000 to 33 percent of all new teachers in 2005" (Boyd, Loeb, Lankford, Rockoff, & Wyckoff, 2007, p. 10). Of all alternative certification programs in New York City, NYCTF represent the most alternative certification teachers in New York City (Kane et al., 2006). NYCTF teachers represent 11 percent of all New York City public school teachers, and 22 percent of all special education teachers (NYCTF, 2011).

A concern with alternative certification is the lack of retention, especially in large urban areas such as New York City (Darling-Hammond et al., 2005). Sipe and D'Angelo (2006) found when surveying NYCTF teachers that about 70 percent of them intended to stay in education. NYCTF reports that 92 percent of NYCTF teachers completed their first year of teaching, 73 percent completed at least three years of teaching, and half have taught for at least five years (NYCTF, 2011). Boyd, Grossman, Lankford, Michelli, Loeb, and Wyckoff (2006) reported that about 46 percent of NYCTF teachers stayed in teaching after four years as compared to 55 to 63 percent of traditionally prepared teachers. Kane et al. (2006) found that NYCTF and traditionally prepared teachers had similar retention rates.

BACKGROUND ON TEACH FOR AMERICA. TFA is a non-profit organization formed in 1990 with the intention of sending college graduates to low-income schools to make a difference for the underserved students. Its founder, Wendy Kopp, was herself a new graduate of Princeton University looking to do something more with her life after graduation (Kopp, 2003). She considered that many recent college graduates at America's top universities would consider teaching low-income students if given the opportunity. The idea was that there should be a teachers' corps that would allow new graduates at top universities with an interest in teaching to quickly begin teaching students in underserved communities. Kopp considered that her idea could be a Peace Corps for the 1990s, and that the teachers would either stay in education or go into other sectors and remain advocates for public education. Thus, the framework for what would become TFA was developed. Recent college graduates would commit to teaching for two years while taking coursework in teacher education, and they would serve in low-income schools throughout the United States.

There have been several prominent studies conducted on TFA teachers in the elementary schools specifically (Darling-Hammond, 1994, 1997; Darling-Hammond et al., 2005; Laczko-Kerr & Berliner, 2002). These studies focused primarily on student achievement and teacher retention, clearly two of the most important variables. However, examine only these variables is not sufficient. Suell and Piotrowski (2007) called for a strong academic coursework component for alternative pathways teachers, which makes

determining quality teacher preparation important. Generally, findings on the effectiveness of TFA teachers in the classroom have been mixed. Humphrey and Wechsler (2007) called for more research into alternative certification pathways. They said, "Clearly, much more needs to be known about alternative certification participants and programs and about how alternative certification can best prepare highly effective teachers" (p. 512). Humphrey and Wechsler said that more research is needed specifically on teacher backgrounds.

Research has found that certified teachers consistently produced significantly higher student achievement gains as compared to uncertified teachers, including typically uncertified TFA teachers (Darling-Hammond et al., 2005; Laczko-Kerr & Berliner, 2002). According to Darling-Hammond et al., certified TFA teachers, after two to three years of teaching and enrolling in a teacher preparation program, performed just as well as generally certified teachers in the field. However, Darling-Hammond et al. caution that upon becoming certified, many TFA teachers leave teaching. Moreover, this is in contrast to TFA's own report of teacher retention on the TFA website. TFA claimed that nearly two-thirds of alumni stay in the field of education, which is about 13,000, with about half of those alumni remaining in the classroom, which is about 6,500 (TFA, 2011). This means that about one-third of TFA alumni stay in the classroom upon completion of their commitment.

RESEARCH FRAMEWORK

Research Questions

1. What differences existed between teachers' mathematical content knowledge before and after an elementary mathematics methods course?
2. What differences existed between teachers' efficacy before and after an elementary mathematics methods course? Further, what level of efficacy did teachers possess at the end of the semester?
3. What level of problem solving abilities did new teachers have in an elementary mathematics methods course?
4. Was there a difference between NYCTF and TFA teachers in their mathematical content knowledge, concepts of efficacy, and problem solving abilities?
5. What were teachers' beliefs about teaching and learning mathematics?

METHODOLOGY The methodology of this study involved both quantitative and qualitative methods. The sample in this study consisted of 24 new teachers in the NYCTF (N = 9) and TFA (N = 15) programs. One third was male and two thirds were female. Participants were enrolled in an inquiry-based elementary mathematics methods course for elementary school special education teachers that involved both pedagogical and content instruction.

Teachers were given mathematics content examinations and efficacy questionnaires at the beginning and the end of the semester, and were given a problem

solving examination at the end of the semester. The mathematics content examination consisted of 20 multiple choice items that measured knowledge of number sense, fractions, decimals, and percents (6 items); probability and statistics (4 items); measurement and geometry (5 items); and algebra (5 items), and was based on the PRAXIS mathematics examination (Educational Testing Service, 2005), as adapted by Newton et al. (in press). Possible scores ranged from zero to 20 points. To further determine content knowledge, sub-scores from mathematics section of the New York State Content Specialty Test (CST) and Liberal Arts and Sciences Test (LAST) were used in answering research question four. The CST and LAST are required by New York State for teacher certification and teachers generally take the test upon entering the graduate program.

The efficacy questionnaire used was the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs et al. (2000), and measured concepts of teacher efficacy. The MTEBI was a 21-item five-point Likert scale instrument with choices of strongly agree, agree, uncertain, disagree, and strongly disagree, and was grounded in the theoretical framework of Bandura's efficacy theory (1986). Based on the Science Teaching Efficacy Belief Instrument (STEBI-B) developed by Enochs and Riggs (1990), the MTEBI contained two subscales: Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE) with 13 and 8 items, respectively. Possible scores ranged from 13 to 65 on the PMTE, and 8 to 40 on the

MTOE. The PMTE specifically measured a teacher's self-concept of his or her ability to effectively teach mathematics. The MTOE specifically measured a teacher's belief in his or her ability to directly affect student learning outcomes. Enochs et al. (2000) found the PMTE and MTOE had Cronbach alpha coefficients of 0.88 and 0.77, respectively.

The problem solving examination consisted of five problem solving situations as adapted from the literature (Krulik & Rudnick, 1989; NCTM, 2000; Posamentier & Krulik, 2008; Posamentier et al., 2008). It is important that students be unfamiliar with the problems because in order to be authentic problem solving students should encounter unfamiliar situations with no immediate solutions available. Each item was worth two points and possible scores ranged from zero to 10 points. Sample problems were as follows.

> A bicycle dealer just put together a shipment of two-wheel bicycles and three-wheel tricycles. He used 50 seats and 130 wheels. How many bicycles and how many tricycles did he make if he used all seats and wheels available?
>
> Jim bought a new camera that cost more than $30 but less than $40. He paid for the camera with $5 bills and $1 bills. He paid with the same number of each. What did the camera cost?

Teachers were required to keep reflective journals on their teaching and learning over the course of the semester, which provided qualitative data regarding their beliefs about teaching and learning mathematics. The teaching journal had guiding questions such as: How are your students learning? What challenges do you face? What successes have you had? Has your attitude toward teaching shifted over the course of the semester?

The learning journal had guiding questions such as: How has this course affected your teaching? What has been helpful? What are the most important concepts you've learned in this class? Finally, the final item on the final examination in the class required the teachers to state and justify their own positions toward teaching mathematics from a traditional back to the basics approach to a reform-based constructivist approach, and then justify their responses.

LIMITATIONS. A limitation in this study is the role of the teacher-researcher since the instructor in the mathematics methods course was also the researcher in this study. Therefore, consideration must be given for possible bias in student reporting since the students in this study knew that the instructor would be conducting the research. As in all survey research, internal validity issues arise due to student self-report.

The sample in this study consisted of a small convenience sample due to availability, which restricts the generalizability of this study. Therefore, teacher content knowledge, efficacy, problem solving abilities, and beliefs should be further investigated with randomly selected larger samples in future research.

RESULTS

The first research question was answered using the mathematical content knowledge test, and data were analyzed using paired samples *t*-test (see Table 1). The results of the paired samples *t*-test revealed a statistically significant difference between

pretest scores and posttest scores for the mathematics content knowledge test, and there was a large effect size.

The second research question was answered using the MTEBI with two subscales: PMTE and MTOE, and data were analyzed using paired samples *t*-tests (see Table 1). The results of the paired samples *t*-test revealed a statistically significant difference between pretest scores and posttest scores for the PMTE, and the effect size was moderate. Further, the results of another paired samples *t*-test revealed no statistically significant difference between pretest scores and posttest scores for the MTOE.

Table 1
Paired Samples t-Test Results for Content Test and Efficacy Test (PMTE and MTOE)

Assessment	Mean	SD	*t*-value	*d*-value
Content Test				
Pretest	75.00	16.151	-3.778**	0.85
Posttest	87.08	11.971		
PMTE				
Pretest	2.70	0.504	-2.575*	0.45
Posttest	2.91	0.478		
MTOE				
Pretest	2.69	0.691	-0.213	
Posttest	2.71	0.666		

$N = 24$, $df = 23$, two-tailed
** $p < 0.01$
* $p < 0.05$

Further, the second part of the second research question was answered using independent samples *t*-tests to determine if the participants had significantly higher efficacy at the end of the semester as compared to a neutral value coded as "2" on the

survey sheet (see Table 2). For the PMTE the results of an independent samples *t*-test revealed a statistically significant difference between PMTE scores and neutral scores, and the effect size was very large. For the MTOE the results of an independent samples *t*-test also revealed a statistically significant difference between MTOE scores and neutral scores, and the effect size was also very large.

Table 2
Independent Samples t-Test Results for PMTE and MTOE Scores

Assessment	Mean	SD	*t*-value	*d*-value
PMTE Actual Scores	2.91	0.478	-9.310**	2.69
Neutral Scores	2.00	0.000		
MTOE Actual Scores	2.71	0.666	-5.249**	1.50
Neutral Scores	2.00	0.000		

$N = 24$, $df = 23$, two-tailed
Equal variances not assumed.
** $p < 0.01$

Descriptive statistics were used to answer research question three. At the end of the semester teachers had a mean score of 8.54 out of 10 possible points on the problem solving examination with a standard deviation of 1.615, which represents the teachers' level of problem solving abilities.

The fourth research question was answered by using independent samples *t*-tests to determine if the NYCTF and TFA teachers differed in their content knowledge, efficacy, and problem solving abilities. No statistically significant differences were found between NYCTF and TFA teachers on all three variables including using CST and LAST scores.

The fifth research question was answered using data collected from the teaching and learning journals. The teaching journal was used as a reflection upon the teachers' actual teaching and classroom experiences. As part of the mission of the school of education where this study took place, teachers are encouraged to be reflective practitioners. Similarly, the learning journal was used as a reflection on the learning in the mathematics methods course. Analysis of the teaching journals revealed that the most commonly addressed topic was special education issues in the classroom. Teachers addressed their struggles and successes of working with students with disabilities. The next most frequently mentioned topic was mathematics anxiety. Teachers not only addressed the anxiety their students experienced, but also the anxiety they themselves held as teachers of mathematics. Teachers also expressed concerns about a lack of conceptual understanding in their students. Teachers lamented the difficulty in helping their students learn mathematics for understanding, as well as the lack of understanding students possessed prior to entering the classroom. Finally, teachers often reflected upon the emphasis placed upon standardized testing in their schools and the need to prepare students for the examinations, and they resented the emphasis on standardized testing. Surprisingly, very few teachers reported difficulty with classroom management.

Analysis of the learning journals revealed that the most commonly addressed topics were the use of technology and manipulatives in the classroom. Teachers appreciated exposure to these learning tools and implemented them in their own

classroom. Manipulatives used in class included base ten blocks, Unifix cubes, Cuisenaire rods, and the Tower of Hanoi, among others. Next, teachers most often addressed their conceptual understanding of mathematics content. Teachers in the methods course appreciated the focus on understanding mathematics since many of them lacked conceptual understanding themselves. Recall that the teachers reflected upon their concern that their own students lacked conceptual understanding in their teaching journals. The topic of differentiation and numeracy were frequently mentioned in the journals. Additionally, microteaching was a topic that many teachers thought enhanced their learning in the course. Every teacher was required to present a 10 minute microlesson that involved a "hook" to get students interested. Many teachers found observing other teachers teach to be a very valuable aspect of this course. Finally, problem solving was often mentioned in the reflective journals. Teachers were given a "problem of the day" problem solving situation that they were to solve in groups at the beginning of each class.

Research question five was also answered using the data collected from the final item on the final examination of the methods course, in which teachers were required to rank their teaching philosophies as traditional, moderate, or reform. Teachers were evaluated based upon their justification for their positions, but not the positions themselves. The number of teachers who had traditional views was two; the number who had moderate views was eight; and the number who had reform views was 14. These

numbers, however, do have some overlap. Of the two traditional oriented teachers, one stated that she would like reformed-based teaching ideally, but that traditional methods were more practical. Of the eight moderate oriented teachers, two stated that they ranked themselves as moderate, but tended to align more with reformed-based methods. Two teachers said they think reformed-based methods are better for teaching, but traditional methods of evaluation are better for student assessment. All of the 14 reform-oriented teachers firmly placed themselves as reformed-based instructors. They generally stressed the need for understanding, inquiry, critical thinking, problem solving, and real-world connections.

DISCUSSION

It was found that elementary teachers increased their mathematical content knowledge and self-perception of their abilities to teach effectively over the course of a one semester inquiry-based mathematics methods course for special education teachers while teaching in the own classrooms. Further, it was found that at the end of the semester the teachers generally had high efficacy both in terms of their ability to teach well (as measured by the PMTE), as well as their ability to positively affect student outcomes (as measured by the MTOE). Additionally, teachers had relatively high problem solving abilities, and no differences were found between NYCTF and TFA teachers in terms of content knowledge, efficacy, and problem solving abilities. Analysis of the reflective journals revealed that teachers most commonly addressed topic was

special education issues in the classroom. Teachers reflected on their struggles and successes of working with students with disabilities. Teachers found that the use of technology and manipulative were the most important topics addressed in their learning. Finally, the majority of teachers considered themselves to be reformed-based teachers.

Over the semester there was an increase in mathematics content knowledge, which is attributed to the combination of focus on content and pedagogy in the mathematics methods course, along with the teaching experience the teachers in this study were gaining. Future studies should focus on the contributions to an increase in content knowledge from the coursework and teaching components, separately.

The results of this study are consistent with the finding of Palmer (2006) and Swars et al. (2007), who found that there was an increase in teacher efficacy in terms of elementary pre-service teachers' ability to teach well and their ability to positively affect student outcomes. However, Palmer (2006) and Swars et al. (2007) examined pre-service elementary school teachers, while in this study teachers were in-service and enrolled in alternative certification programs. Also, Palmer examined efficacy using the STEBI-B for science, and Swars et al. used the MTEBI for mathematics, as was done in this present study. Soodak and Podell (1997) also found that preservice teachers exhibited higher levels of efficacy than when they began teaching in the field, but through experience the level of efficacy rose again. The results of this study were somewhat inconsistent with the results found by Hoy and Woolfolk (1990), who found a significant decline in beliefs to

positively affect student learning outcomes during student teaching, which had been attributed to teachers' exposure to the realities of the classroom. However, in this present study teachers had an increase in this belief despite early encounters with the realities of the classroom. Perhaps there is something different about alternative certification preparation that could explain this difference. Change in efficacy should be further investigated, especially for alternative certification teachers.

It was found that teachers had relatively high problem solving abilities. This is in contrast to findings in the literature (Ball et al., 2005; Ma, 1999), and commonly held perceptions of teacher problem solving ability (Paulos, 1990). The translation of strong problem solving abilities into the classroom to increase student achievement should be further investigated, and it is suggested that alternative certified elementary school teachers be evaluated on their implementation of their problem solving abilities into the classroom. No statistically significant differences were found between NYCTF and TFA teachers on the three variables examined. It is commonly claimed by TFA that their candidates come from the most highly ranked and selective universities in the United States, with the implication is that those among America's brightest become TFA teachers. These results are surprising considering there is a common perception held by those working with the programs in New York that TFA teachers, while not staying in education quite as long at NYCTF teachers, have stronger mathematics content knowledge. However, Constantine et al. (2009) claimed that of the various alternative

pathways programs, NYCTF and TFA were the more selective of the other alternative pathways programs in candidate selection.

Since the teachers in this study were special education teachers, it was not surprising that teachers most often reflected upon the challenges and successes they had with their special education students in their teaching journals. It was surprising, however, that very few teachers reflected on classroom management issues. Classroom management is often considered a high concern among new teachers (Costigan, 2004; Cruickshank, Jenkins, & Metcalf, 2006; Evans, 2009; Veenman, 1984). This should be examined in future studies.

Teachers expressed concern about lack of conceptual understanding in their students and an appreciation for the emphasis on understanding in the methods course. The method course in which these teachers were enrolled had a strong emphasis on teaching for understanding. It has been shown that many U.S. elementary teachers lacked the content understanding needed to teach well (Ma, 1999), and that this should not be a surprise given that these teachers graduated from the same system that researchers wish to improve (Ball et al., 2005). Hence, a cycle of non-understanding persists. Nurturing conceptual understanding in teachers is important given the relationship between teacher knowledge and student achievement (Hill et al., 2005).

Teachers most commonly addressed the use of technology and manipulatives in the classroom in their learning journals. The methods course placed strong emphasis on

using technology and manipulatives to enhance student learning in line with the NCTM *Principles and Standards for School Mathematics* (NCTM, 2000).

Teachers often discussed problem solving in their learning journals. Problem solving as a way of teaching was thoroughly addressed in the course with considerable time devoted to problem solving in the mathematics classroom as recommended in the literature (NCSM, 1978; NCTM, 2000; Schoenfeld, 1985).

Ball et al. (2005) found that teacher knowledge is an important variable in improving achievement in high need urban schools. Additionally, teacher efficacy highly impacts student learning (Parajes, 1992; Soodak & Podell, 1997), and it is possible that efficacy beliefs may be a greater variable in quality teaching than content knowledge alone (Bandura, 1986; Ernest, 1989). Future studies should examine content knowledge, teacher efficacy, and problem solving abilities in the special education context. Considering the high need for special education teachers, schools of education must be careful in ensuring that special educators have high content knowledge and strong efficacy beliefs. Further, considering the large number of alternative certification program candidates who teach in high need schools (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006; Kopp, 2003), it is extremely important for the sake of these students that educational researchers understand teacher knowledge, efficacy, and problem solving abilities.

REFERENCES

Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide? *American Educator, 14-17, 20-22, & 43-46.*

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

Boyd, D. J., Grossman, P., Lankford, H., Loeb, S., Michelli, N. M., & Wyckoff, J. (2006). Complex by design: Investigating pathways into teaching in New York City schools. *Journal of Teacher Education, 57*(2), 155-166.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2006). How changes in entry requirements alter the teacher workforce and affect student achievement. *Education Finance and Policy*, *1*(2), 176-216.

Boyd, D., Lankford, S., Loeb, S., Rockoff, J., & Wyckoff, J. (2007). *The narrowing gap in New York City qualifications and its implications for student achievement in high poverty schools* (CALDER Working Paper 10). Washington, DC: National Center for Analysis of Longitudinal Data in Education Research. Retrieved August 26, 2008, from http://www.caldercenter.org/PDF/1001103_Narrowing_Gap.pdf.

Cai, J. (2000). Mathematical thinking involved in U.S. and Chinese students' solving of process-constrained process-opened problems. *Mathematical Thinking and Learning, 2*(4), 309-340.

Charles, R. I., & Lester, F. K., Jr. (1982). *Teaching problem solving: What, why, & how.* Palo Alto, CA: Seymour.

Constantine, J., Player, D., Silva, T., Hallgren, K., Grinder, M., & Deke, J. (2009). *An evaluation of teachers trained through different routes to certification, final report* (NCEE 2009-4043). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Costigan, A. (2004). Finding a name for what they want: A study of New York City's Teaching Fellows. *Teaching and Teacher Education: An International Journal, 20*(2), 129-143.

Cruickshank, D. R., Jenkins, D. B., & Metcalf, K. K. (2006). *The act of teaching*. New York, NY: McGraw Hill.

Darling-Hammond, L. (1994). Who will speak for the children? How "Teach for America" hurts urban schools and students. *Phi Delta Kappan, 76*(1), 21-34.

Darling-Hammond, L. (1997). *The right to learn: A blueprint for creating schools that work.* San Francisco, CA. Jossey-Bass.

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Heilig, J. V. (2005). Does teacher

preparation matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. *Education Policy Analysis Archives, 13*(42), 1-32.

Educational Testing Service. (2005). *The PRAXIS series: Middle school mathematics (0069).* Retrieved on August 5, 2009 from ftp://ftp.ets.org/pub/tandl/0069.pdf.

Enochs, L. G., & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale. *School Science and Mathematics, 90*(8) 695-706.

Enochs, L. G., Smith, P. L., & Huinker, D. (2000). Establishing factorial validity of the Mathematics Teaching Efficacy Beliefs Instrument. *School Science and Mathematics*, *100*(4), 194-202.

Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching*, *15*(1), 13-33.

Evans, B. R. (2009). First year middle and high school teachers' mathematical content proficiency and attitudes: Alternative certification in the Teach for America (TFA) program. *Journal of the National Association for Alternative Certification (JNAAC), 4*(1), 3-17.

Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76,* 569-582.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Education Research Journal, 42*(2), 371-406.

Hoy, A. W., & Woolfolk, A. E. (1990). Socialization of student teachers. *American Educational Research Journal, 27,* 279-300.

Humphrey, D. C., & Wechsler, M. E. (2007). Insights into alternative certification: Initial findings from a national study. *Teachers College Record.* Retrieved August 27, 2008, from http://www.tcrecord.org/content.asp?contentid=12145.

Newton, K. J., Leonard, J., Evans, B. R., & Eastburn, J. (in press). Preservice elementary teachers' mathematics content knowledge and teacher efficacy. *School Science and Mathematics Journal.*

Kane, T. J., Rockoff, J. E., & Staiger, D. O. (2006). What does certification tell us about teacher effectiveness? Evidence from New York City. Working Paper No. 12155, National Bureau of Economic Research April 2006.

Kopp, W. (2003). *One day, all children: The unlikely triumph of Teach for America and what I learned along the way* (2nd ed.). Cambridge, MA: The Perseus Books Group.

Krulik, S., & Rudnick, J. A. (1989). *Problem solving*. Boston: Allyn and Bacon.

Laczko-Kerr, I., & Berliner, D. C. (2002). The effectiveness of "Teach for America" and other under-certified teachers on student academic achievement: A case of harmful public policy. *Education Policy Analysis Archives, 10*(37).

Ma, L. (1999). *Knowing and teaching elementary mathematics.* Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

National Council of Supervisors of Mathematics. (1978). Position paper on basic mathematical skills. *Mathematics Teacher, 71*(2), 147-152.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

New York City Teaching Fellows (NYCTF). (2011). *Our impact.* Retrieved February 8, 2011, from https://www.nycteachingfellows.org/purpose/impact.asp.

Palmer, D. (2006). Durability in changes in self-efficacy of preservice primary teachers. *International Journal of Science Education, 28*(6), 655-671.

Parajes, M. F. (1992). Teacher beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Polya, G. (1945). *How to solve it.* Princeton, NJ: Princeton University Press.

Posamentier, A. S., & Krulik, S. (2008). *Problem-solving strategies for efficient and elegant N solutions grades 6-12.* Thousand Oakes, CA: Corwin Press.

Posamentier, A. S., Smith, B. S., & Stepelman, J. (2008) *Teaching secondary mathematics: Teaching and enrichment units* (8th ed.). Boston: Allyn & Bacon.

Rubeck, M. L., & Enochs, L. G. (1991). A path analytical model of variables that influence science and chemistry teaching self-efficacy and outcome expectancy in middle school science teachers. Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), Anaheim, CA.

Schoenfeld, A. (1985). *Mathematical problem solving.* New York: Academic Press.

Sipe, P., & D'Angelo, A. (2006.). *Why do Fellows stick around? An inquiry into the retention of New York City Teaching Fellows.* Paper presented at the annual conference of the National Center for Alternative Certification (NCAC), San Diego, CA.

Soodak, L. C., & Podell, D. M. (1997). Efficacy and experience: Perceptions of efficacy among pre-service and practicing teachers. *Journal of Research and Development in Education, 30,* 214-221.

Soodak, L. C., & Podell, D. M. (1998). Teacher efficacy and the vulnerability of the difficult-to-teach student. In J. Brophy (Ed.). *Advances in Research on Teaching, 7: Expectations in the Classroom.* New York: JAI Press.

Stein, J. (2002). Evaluation of the NYCTF program as an alternative Certification program. New York: New York City Board of Education.

Suell, J. L., & Piotrowski, C. (2007). Alternative teacher education programs: A review of the literature and outcome studies. *Journal of Instructional Psychology*, *34*(1),

Swars, S. L., Daane, C. J., & Giesen, J. (2006). Mathematics anxiety and mathematics teacher efficacy: What is the relationship in elementary preservice teachers? *School Science and Mathematics, 106*(7), 306-315.

Swars, S., Hart, L. C., Smith, S. Z., Smith, M. E., & Tolar, T. (2007). A longitudinal study of elementary pre-service teachers' mathematics beliefs and content knowledge. *School Science and Mathematics, 107*(9), 325-335.

Teach for America. (2011a). *The role of Teach for America alumni in fueling the movement to eliminate educational inequity.* Retrieved May 18, 2011, from http://www.teachforamerica.org/mission/documents/2010_ASIR_Final.pdf.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research, 54*(2), 143-178.