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A Comparison of Two Alternative Pathway Programs in
Secondary Mathematics Teacher

Certification

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Abstract

The purpose of this study was to compare the mathematics content knowledge, attitudes toward mathematics, and concepts of self-efficacy held by teachers in two alternative pathways to mathematics teacher certification: New York City Teaching Fellows and Teach for America. Findings revealed that there were no differences between Teaching Fellows and TFA teachers in mathematics content knowledge, attitudes toward mathematics, and concepts of self-efficacy. However, learning and teaching journals revealed several differences between Teaching Fellows and TFA teachers.

Introduction

The purpose of this study was to compare the mathematics content knowledge, attitudes toward mathematics, and concepts of self-efficacy held by teachers in two alternative pathways to mathematics teacher certification: New York City Teaching Fellows (NYCTF) and Teach for America (TFA). Secondly, the purpose was to determine differences in their attitudes toward their own learning and teaching as new mathematics teachers in New York City.

Strong teacher content knowledge is an important factor for teaching mathematics successfully (Ball, Hill, & Bass, 2005). Further, negative teacher attitudes toward mathematics often lead to avoidance of teaching strong mathematical content and affect students' attitudes and behaviors (Amato, 2004; Leonard & Evans, 2007). Additionally, poor attitudes toward teaching are directly related to teacher retention issues (Costigan, 2004), and self-efficacy is an important component for successful teaching since self-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).

Alternative pathways programs are a response to teacher shortages (Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2007; Clewell & Forcier, 2000), which are especially acute in mathematics and science in urban areas (Clewell & Forcier, 2000). Given the lack of highly qualified and certified mathematics and science teachers, districts are forced to employ teachers certified in other subject areas to teach mathematics and science, which is especially prevalent in high need urban schools. It has been found that up to a quarter of all mathematics teachers in these schools are not certified in mathematics, but rather in different subject areas (Clewell & Forcier, 2000).

Backgrounds on the NYCTF and TFA Programs

Traditionally teachers are prepared in schools of education in either baccalaureate or graduate degree programs with a focus on pedagogy, content, and liberal arts. These teacher candidates take part in field experiences in the classrooms while earning their degrees and teacher certifications, culminating in the student teaching experience. However, recently up to one third of teachers had been prepared in alternative pathways to certification programs (Feistritzer & Chester, 2002), which often attract individuals who did not major in education, and decided after completing college that teaching would be a desirable profession. Some had just recently graduated from college, while others are later career changers. Teachers in alternative certification programs begin graduate coursework during the summer before they begin teaching, and after several summer courses and a brief experience of student teaching, these new teachers start teaching in September while continuing their graduate coursework.

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 (NYCTF, 2008; Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 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 predicated 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 teachers to obtain temporary teaching licenses to help fill the teacher shortage. 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, Lankford, Loeb, Rockoff, & Wyckoff, 2007, p. 10). Teaching Fellows represent 11 percent of all New York City public school teachers, and 26 percent of all

mathematics teachers (NYCTF, 2010). NYCTF is the largest alternative certification program in New York City (Kane, Rockoff, & Staiger, 2006).

TFA is a non-profit organization formed in 1990 with the intention of sending college graduates to low-income schools to make a positive 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 top U.S. 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.

Literature Review

There have been several studies that compared different pathways to teacher certification with the primary focus on student achievement and teacher retention as measures of success (Boyd, Grossman, Lankford, Loeb, Michelli, & Wyckoff, 2006; Constantine et al., 2009; Rochkind, Ott, Immerwahr, Doble, & Johnson, 2007). Rochkind et al. (2007) documented teacher experiences from TFA, Troops to Teachers, and the New Teacher Project in Baltimore, who described their first year of teaching. However, this study was limited in scope. Recently the National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, through the U.S. Department of Education, conducted a comparison study of various pathways to teacher certification in elementary reading and mathematics (Constantine et al., 2009). Constantine et al. claimed that despite the rapid growth in alternative certification

programs, little evidence has been gathered to determine their effectiveness. Constantine et al. found that alternatively and traditionally prepared teachers did not have statistically significant content knowledge differences, or statistically significant differences in student achievement levels. The latter finding is in contrast to previous research in which differences were found (Boyd, Grossman, Lankford, Loeb, Michelli, & Wyckoff, 2006; Darling-Hammond, 1994, 1997; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Laczko-Kerr & Berliner, 2002). Previous studies had indicated that teachers in alternative certification programs had students who scored about as well as, if not better than, students of traditionally prepared teachers in achievement examinations after the initial certification process (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006; Kane et al., 2006).

Boyd, Grossman, Lankford, Loeb, Michelli, and Wyckoff (2006) found that in the first year of teaching, teachers prepared through the alternative certification programs had students with slightly smaller achievement gains in mathematics as compared with traditionally prepared teachers. For elementary teachers there were no differences found by the second year between alternatively and traditionally prepared teachers. Middle school students of Teaching Fellows performed just as well as the students of traditionally prepared teachers. By the third year of teaching, students of Teaching Fellows outperformed students of traditionally prepared teachers. Furthermore, TFA teachers had significantly higher student achievement in mathematics when compared to certified teachers in grades 4 to 8. However, Boyd et al. examined student data in grades 3 to 8, which makes the study limited to the elementary and middle school years.

There have been several prominent studies conducted with TFA teachers in the elementary schools specifically (Darling-Hammond, 1994, 1997; Darling-Hammond et al., 2005; Laczko-Kerr & Berliner, 2002), but not at the secondary level (Xu, Hannaway, & Taylor, 2008).

Generally, findings on the effectiveness of TFA teachers in the classroom have been mixed. Previous studies had 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 fully certified teachers in the field. However, Darling-Hammond et al. caution that upon becoming certified, many TFA teachers leave teaching.

Xu et al. (2008) focused on secondary mathematics and science teachers, and found that contrary to some other reports on TFA teachers, these uncertified teachers were found to be more effective, as measured by student achievement, than traditionally certified teachers, including more experienced traditionally certified teachers. Xu et al. claimed that even though they lacked experience, TFA teachers had students with higher achievement. Xu et al. concluded that perhaps TFA teachers were able to offset this lack of experience through better academic preparation or motivation. TFA “recruits and selects graduates from some of the most selective colleges and universities across the country” (Xu et al., 2008, p. 2), and 62% of TFA teachers were educated at “most selective” and “very selective” higher education institutions, while only 22% of non-TFA teachers were. TFA had claimed that 70% of TFA teachers came from such institutions (TFA, 2010). Further, TFA teachers had higher standardized test scores than did non-TFA teachers, and “disparities do exist between TFA and non-TFA teachers in terms of their academic preparation” (Xu et al., 2008, p. 17). Finally, it might be that TFA teachers are exceptionally motivated given TFA’s emphasis on concern for student equity issues (TFA, 2008).

Humphrey and Wechsler (2007) called for more research into alternative certification pathways and 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). Studies that compared alternative certification programs have been limited, and this is especially acute at the secondary level and in mathematics. It would be useful for researchers, professors of education, principals, and policy-makers to know which alternative pathway programs are most effective. Plumer (2010) concluded that while alternative certification teachers appeared to be slightly more successful in mathematics and science than in reading, the research had come to conflicting and mixed conclusions on the impact of alternative certification teachers. In New York the NYCTF and TFA programs are two large alternative pathways programs, and this study compared the mathematics content knowledge, attitudes toward mathematics, and concepts of self-efficacy held by teachers in these two programs.

Theoretical Framework

Aiken (1970, 1974, 1976) was an early pioneer to examine the relationship between mathematical achievement and attitudes toward mathematics, and showed that attitudes and achievement in mathematics are reciprocal. Like Aiken, Ma and Kishor (1997) found a small but positive significant relationship between achievement and attitudes through meta-analysis. This relationship, along with Ball et al.’s (2005) emphasis on the importance of content knowledge for teachers, formed the framework of this study. Ball et al. said, “How well teachers know mathematics is central to their capacity to use instructional materials wisely, to assess students’ progress, and to make sound judgments about presentation, emphasis, and sequencing” (p. 14). Further, Ball et al. suggested that teachers with high content knowledge could help

narrow the achievement gap in urban schools. Teaching Fellows and TFA teachers are placed in high need urban schools in New York City.

Additionally, Bandura's (1986) construct of self-efficacy theory framed this study's focus on self-efficacy in Teaching Fellows and TFA teachers. Bandura found that teacher self-efficacy can be subdivided into a teacher's belief in his or her ability to teach well, and his or her belief to affect student learning outcomes. Teachers who feel that they cannot effectively teach mathematics and affect student learning are more likely to avoid teaching from an inquiry and student-centered approach with real conceptual understanding (Swars, Daane, & Giesen, 2006).

This current study was grounded in this literature (Aiken, 1970, 1974, 1976; Ball et al., 2005; Bandura, 1986; Ma & Kishor, 1997; Swars et al., 2006) since these three constructs are integral to the teaching and learning process for teachers and their students. Teachers with higher levels of content knowledge, attitudes toward mathematics, and self-efficacy are better able to produce higher student achievement than are teachers with lower levels. This study expands upon the literature by examining the three constructs between new in-service teachers in two large alternative certification programs, while previous studies focused only on student achievement and teacher retention.

Research Questions

1. What differences existed between Teaching Fellows and TFA mathematical content knowledge both at the beginning and end of a mathematics methods course?
2. What differences existed between Teaching Fellows and TFA attitudes toward mathematics both at the beginning and end of a mathematics methods course?
3. What differences existed between Teaching Fellows and TFA concepts of teaching self-efficacy?

4. What differences existed between Teaching Fellows and TFA attitudes as measured by learning and teaching journals?

Methodology

The study used both quantitative and qualitative methods, and participants consisted of 42 Teaching Fellows and 22 TFA teachers at the partnering university, a medium-sized urban university located in New York City. Both groups constituted a large part of the adolescent mathematics graduate degree students at the partnering university in which this study took place. Teaching Fellows and TFA teachers were both at the beginning of their teaching careers teaching middle and high school mathematics while taking graduate education courses. For mathematical content knowledge, attitudes toward mathematics, and learning and teaching journals, the sample for TFA is the entire 22 teachers. However, for self-efficacy the sample is reduced to 19 participants because two teachers did not return their self-efficacy instruments, and one teacher left teaching, the partnering university, and the TFA program all together in the second year. All 42 Teaching Fellows were available for all measurements.

The teachers were enrolled in a mathematics methods course that was based upon reformed-based methods and addressed both pedagogy and content from a problem solving perspective consistent with National Council of Teachers of Mathematics (NCTM) (2000) *Principles and Standards for School Mathematics*. The course was one semester for Teaching Fellows, but it was a year long course for TFA. However, the same content and same amount of time was devoted to the mathematics content and methods in both programs. It was a year long course for TFA teachers because the course was combined with two other courses: assessment and literacy.

Both Teaching Fellows and TFA teachers took the New York State Content Specialty Test (CST) the summer before they began their program, which is required by the State of New York for teacher certification. This test assesses mathematical content knowledge for teacher certification and the scores range from 100 to 300 with a minimum passing score of 220. It consists of multiple choice items and a written assignment, and has six sub-areas: Mathematical Reasoning and Communication; Algebra; Trigonometry and Calculus; Measurement and Geometry; Data Analysis, Probability, Statistics and Discrete Mathematics; and Algebra Constructed Response. Further, both Teaching Fellows and TFA teachers took a mathematics content test at the beginning and end of their mathematics methods course. The mathematics content test consisted of 25 free response items ranging from algebra to calculus, and the test taken at the end of the course was similar in form and content to the one taken at the beginning.

Additionally, both Teaching Fellows and TFA teachers were given a survey instrument that measured attitudes toward mathematics at the beginning and end of the mathematics methods course. The attitudinal questionnaire was adapted from Tapia (1996) and had 39 items that measured attitudes toward mathematics including self-confidence, value, enjoyment, and motivation in mathematics. The instrument used a 5-point Likert scale with items strongly agree, agree, neutral, disagree, and strongly disagree.

Teaching Fellows were given self-efficacy surveys at the beginning and end of their mathematics methods course. However, TFA teachers were given the self-efficacy survey only once in their second year of teaching and enrollment in the graduate education program. The self-efficacy instrument was adapted from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs et al. (2000), and measured concepts of self-efficacy. The MTEBI is a 21-item five-point Likert scale instrument with choices of strongly agree, agree,

uncertain, disagree, and strongly disagree, and is grounded in the theoretical framework of Bandura's (1986) self-efficacy theory. Based on the Science Teaching Efficacy Belief Instrument (STEBI-B) developed by Enochs and Riggs (1990), the MTEBI contains two subscales: Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE) with 13 and 8 items, respectively. Possible scores range 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.

Finally, Teaching Fellows and TFA teachers were required to keep reflective journals on their learning and teaching over the course of the methods course, which provided qualitative data of their attitudes toward learning and teaching mathematics. 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? 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?

Limitations

The major limitation was the small sample size in this study: $N = 42$ for NYCTF and $N = 22$ for TFA ($N = 19$ for TFA self-efficacy). This small sample was a convenience sample, and thus restricted the generalizability of this study. Further, a limitation was the imbalance between NYCTF and TFA sample sizes, and this problem is due to availability. This study should be

replicated with larger sample sizes, but the researcher in this study did not believe that this imbalance invalidated the findings since both samples were sufficiently large for analysis.

Another limitation was the imbalance in the methods course between the two programs. For NYCTF the methods course was a single semester in length, and for TFA the methods course lasted the entire academic year. However, since the same amount of material was covered and the same amount of time dedicated to the course, this did not have a major impact on the validity of this study. While the self-efficacy instrument was administered during the methods course for Teaching Fellows, it was given to TFA teachers at the beginning of their second year.

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

Results

Research questions one, two, and three were answered using independent samples *t*-tests with significance levels taken at the 0.05 level. For research question one, both pre- and post-mathematics content test scores and mathematics CST scores were used to determine if there were any significant differences between NYCTF and TFA teacher content knowledge. For research question two, both pre- and post- attitudes toward mathematics findings were used to determine if there were any significant differences between NYCTF and TFA teacher attitudes toward mathematics. Finally, for research question three, both pre- and post- MTEBI scores, separated for both PMTE and MTOE subscales, for Teaching Fellows were used with MTEBI

scores for TFA teachers to determine if differences existed in teacher self-efficacy between the two programs.

Findings revealed no statistically significant differences between Teaching Fellows and TFA teachers on the mathematical content test, CST scores, attitudes toward mathematics instrument, and the MTEBI for both subscales: PMTE and MTOE. This means there are no differences between NYCTF and TFA mathematics content knowledge, attitudes toward mathematics, and concepts of teaching self-efficacy as measured by the instruments used in this study.

Analysis of the learning and teaching journals revealed similarities and differences between the two programs. For the learning journals it was found that both groups cited problem solving and numeracy in the methods course frequently. Numeracy can be defined as mathematical literacy, and in both programs teachers read *Innumeracy: Mathematical Illiteracy and its Consequences* (Paulos, 1990). Techniques for motivating student learning were discussed in both NYCTF and TFA journals. Both Teaching Fellows and TFA teachers cited reflective teaching and literature critique reviews least often. While social justice was cited most frequently by TFA teachers, it was mentioned very infrequently by Teaching Fellows. While microteaching and learning about motivation techniques were two categories frequently mentioned by Teaching Fellows, TFA teachers rarely mentioned these. In both NYCTF and TFA methods classes teachers were expected to present a brief microlesson, one that contained a motivator for the lesson, to their classmates.

For the teaching journals both Teaching Fellows and TFA teachers cited classroom management as the most frequently cited concern. However, it should be noted that while every TFA teacher reference to classroom management was citing a problem with classroom

management, several Teaching Fellows mentioned classroom management as not being as problematic as they thought it would be. Also frequently referenced in both NYCTF and TFA journals were student motivation for learning, student attendance, and standardized state examination preparation as emphasized by their administrations. TFA cited unsupportive administration frequently as a concern, whereas NYCTF did not.

Discussion

No statistically significant differences were found between NYCTF and TFA on mathematics content knowledge, attitudes toward mathematics, and concepts of self-efficacy. It is commonly claimed by TFA that their candidates come from the most highly ranked and selective universities in the United States (TFA, 2010; Xu et al., 2008), and the implication is that those among America's brightest become TFA teachers. However, the findings in this study indicated that NYCTF and TFA teachers are statistically similar in terms of content knowledge, attitudes, and beliefs. These results are quite 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 as Teaching Fellows, do however have stronger mathematics content knowledge. Moreover, Constantine et al. (2009) claimed that of the various alternative pathways programs, NYCTF and TFA are the more selective of the other alternative pathways program in candidate selection. In 2008 only about 15 percent of NYCTF program applicants were accepted into the program, and over 8 percent of NYCTF applicants actually entered training in the summer before teaching with an additional 1 percent beginning early in the 2007/2008 academic year (NYCTF, 2008). In 2008 approximately 20 percent of TFA applicants were accepted into the program with about 15 percent of applicants actually starting the program (TFA, 2008). The mean grade point average in 2008 for new Teaching Fellows was 3.3

(NYCTF, 2008), while the mean grade point average for new TFA teachers was 3.6 (TFA, 2010). Statistical differences in grade point averages had not been examined.

Since the results of this study indicate there are no differences found in several variables that measured teacher quality between the two programs, the implication is that it should not matter in which program teachers are selected based upon content knowledge, attitudes toward mathematics, and concepts of self-efficacy. However, given results from prior studies that focused on teacher retention, perhaps NYCTF maintains an advantage over TFA using retention, a variable important in student success, as an important criterion for success. Sipe and D'Angelo (2006) found when surveying Teaching Fellows that about 70 percent of them intended to stay in education. NYCTF reports that 92 percent of Teaching Fellows 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, 2010). Boyd, Grossman, Lankford, Michelli, Loeb, and Wyckoff (2006) reported that about 46 percent of Teaching Fellows stayed in teaching after four years as compared to 55 to 63 percent of traditionally prepared teachers. Further, Kane et al. (2006) found that Teaching Fellows and traditionally prepared teachers had similar retention rates. However, Darling-Hammond et al. (2005) reported that upon becoming certified many TFA teachers leaving teaching. This is in contrast to TFA's own report of teacher retention. TFA claimed that about two-thirds of TFA teachers stayed in the field upon completing their time in the program, and half of those remained in teaching (TFA, 2008). This means that about one third stayed in the classroom upon fulfilling their commitment, which generally lasts several years. Another one third maintained non-teaching roles in education, such as in administration or advocacy (TFA, 2008). Lassonde (2010) claimed that only 11 percent of TFA teachers reported planning to teach 10 years or more. As of 2010 there were 17,000 TFA alumni (TFA,

2010), and according to TFA, over 5600 remained teaching in the classroom after their commitment ended (TFA, 2009). These findings indicate that approximately more than twice the percentage of Teaching Fellows stayed in the classroom compared to TFA teachers over a similar time period of several years. However, no statistical analysis had been conducted to determine significance.

In the learning journals teachers in both programs cited problem solving and numeracy frequently. However, more interestingly, social justice was cited most frequently by TFA teachers, but it was mentioned very infrequently by Teaching Fellows. This is an interesting finding given the emphasis on social justice in the school of education where this study took place. If social justice issues in the classroom are of high concern, then perhaps TFA teachers have an advantage over Teaching Fellows, in this respect. This should be further investigated.

In the teaching journals teachers in both programs cited, unsurprisingly, classroom management issues as the most frequently cited concern for new teachers, as documented in the literature (Cruickshank, Jenkins, & Metcalf, 2006; Veenman, 1984). It was surprising, however, that NYCTF teachers found classroom management to not be as much an issue, but TFA teachers found classroom management exclusively problematic.

An interesting finding was that Teaching Fellows cited learning about motivation techniques often in their learning journals, while TFA teachers did not, especially since both groups frequently mentioned student motivation in their teaching journals, a concept related to their microteaching.

Both Teaching Fellows and TFA teachers cited time needed for, and administrative emphasis on, standardized state testing. In the time of No Child Left Behind (NCLB, 2001) much emphasis on accountability means that schools and principals must ensure that teachers are

raising standardized state test scores. It is no surprise that both NYCTF and TFA teachers rank this highly among their concerns.

The major implication from this study is that TFA is not stronger than NYCTF in content knowledge, attitudes, or in their confidence of their own teaching efficacy, as is often assumed given the reputation of TFA and caliber of college and university pursued by TFA in candidate recruitment, and it is hoped that this study changes this perception. From the literature it appeared that Teaching Fellows had an advantage in terms of teacher retention, but the results of this study indicated that TFA teachers had an advantage with concern for social justice in the classroom. However, more confirmatory research is needed. Further studies should compare differences between Teaching Fellows and TFA teachers in actual classroom practice in secondary mathematics teaching specifically, given the size of the programs. How does student achievement compare for the two groups among high need students? This study found no differences in content knowledge and beliefs for the two groups of teachers, but it would be beneficial to understand NYCTF and TFA direct impact in urban classrooms.

Educational researchers must continue to investigate the quality of alternative certification programs. Since students in high need urban schools are often the ones who receive alternative certification teachers, it is imperative that educational researchers, professors of education, administrators, and policy makers ensure that these students are getting the highest level quality teachers they deserve. The question posed to administrators and policy makers is: Would you accept an alternative certification teacher in your own child's classroom? We must continue to understand and improve alternative certification until the answer is a resounding "yes."

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