
Content Knowledge, Attitudes, and
Self-Efficacy in the Mathematics
New York City Teaching
Fellows Program

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Purpose

The purpose of this study was to understand the mathematical content knowledge new teachers have both before and after taking a mathematics methods course in the New York City Teaching Fellows (NYCTF) program. Further, the purpose was to understand attitudes toward mathematics and teacher self-efficacy that Teaching Fellows have over the course of the semester.

New York City Teaching Fellows

- 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).
- 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.

New York City Teaching Fellows

- 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).
- Teaching Fellows grew from around 1 percent of all newly hired teachers from its beginning in 2000 to 33 percent of all new teachers by 2005 (Boyd, Loeb, Lankford, Rockoff, & Wyckoff, 2007).

Literature Review Summary

Recently there has been an interest in studying the effects of alternative teacher certification programs in America's classrooms with a particular interest in teacher quality issues (Darling-Hammond, 1994, 1997; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Decker, Mayer, & Glazerman, 2004; Humphrey & Wechsler, 2007; Laczko-Kerr & Berliner, 2002; Raymond, Fletcher, & Luque, 2001).

Literature Review Summary

Further, there has been interest in Teaching Fellows in New York City schools in particular (Boyd, Grossman, Lankford, Loeb, Michelli, & Wyckoff, 2006; Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006; Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2007; Cicchelli & Cho, 2007; Costigan, 2004; Kane, Rockoff, & Staiger, 2006; Stein 2002).

Literature Review Summary

Most studies investigated teacher retention and student achievement as the variables used to determine success. Naturally these are two of the most important variables, but the intention of this present study was to further investigate other variables related to success, such as teacher content knowledge, attitudes toward mathematics, and teacher self-efficacy. Details about content knowledge have been sparse and there has been a lack of concentrated focus on mathematics teachers specifically in previous research.

Theoretical Framework

Ma and Kishor (1997) found a positive relationship between achievement and attitudes in mathematics. This relationship, along with Ball, Hill, and Bass' (2005) emphasis on the importance of content knowledge for teachers, forms the framework of this study. Additionally, Bandura's (1986) construct of self-efficacy theory framed this study's focus on self-efficacy. 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 in a student's capacity to learn well from the teacher.

Research Questions

1. What differences existed between Teaching Fellows' mathematical content knowledge before and after a mathematics methods course?
2. What differences existed between Teaching Fellows' attitudes toward mathematics before and after a mathematics methods course? Further, were Teaching Fellows' attitudes toward mathematics significantly higher than neutral responses at the end of the semester?
3. What differences existed between Teaching Fellows' concepts of self-efficacy before and after a mathematics methods course? Further, were Teaching Fellows' concepts of self-efficacy significantly higher than neutral responses at the end of the semester?

Research Questions

4. Was there a relationship between Teaching Fellows' attitudes toward mathematics and concepts of self-efficacy?
5. What level of content knowledge did Teaching Fellows possess?
6. What were Teaching Fellows' attitudes toward teaching and learning mathematics?

Methodology

Sample: 42 New York City Teaching Fellows in mathematics methods course

Instruments:

- Mathematics Content Test
- New York State Content Specialty Test (CST)
- Sample CST
- Attitudes Toward Mathematics Inventory
- Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)

Methodology

Quantitative methods:

- Paired Samples *t*-test
- Independent Samples *t*-test
- Pearson Correlations

Qualitative methods:

- Analysis of Reflective Teaching and Learning Journals
- Final question on final examination requiring teachers to justify their teaching philosophy (traditional or reformed-based)

Methodology

Instruments:

- Mathematics Content Test: Measured mathematical content proficiency ranging from algebra to calculus through open response items.
- Attitudes Toward Mathematics Instrument (Tapia, 1996): Measured attitudes toward mathematics including self-confidence, value, enjoyment, and motivation in mathematics using Likert scale ranging from SD to SA.

Mathematics Teaching Efficacy Beliefs Instrument (MTEBI)

Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) two subscales:

- Personal Mathematics Teaching Efficacy (PMTE) specifically measured a teacher's self-concept of his or her ability to effectively teach mathematics.
- Mathematics Teaching Outcome Expectancy (MTOE) specifically measured a teacher's belief in his or her ability to directly affect student learning outcomes.

Results Research Question 1

The results of the paired samples t -test (two-tailed) revealed a statistically significant difference between pretest scores ($M = 74.79$, $SD = 17.605$) and posttest scores ($M = 84.48$, $SD = 14.225$) for the mathematics content test with $t(41) = -6.002$, $p = 0.000$, $d = 0.86$. This means there was a statistically significant increase in content knowledge as measured by the mathematics content test over the course of the semester. Additionally, there was a large effect size.

Results Research Question 2 Part 1

The results of the paired samples t -test (two-tailed) revealed a statistically significant difference between pretest scores ($M = 3.25$, $SD = 0.373$) and posttest scores ($M = 3.33$, $SD = 0.410$) for the attitudinal test with $t(41) = -2.041$, $p = 0.048$, $d = 0.20$. This means there was a statistically significant increase in positive attitudes toward mathematics over the course of the semester. However, the effect size was small.

Results Research Question 2 Part 2

The results of the independent samples t -test (two-tailed) revealed a statistically significant difference between attitudinal scores ($M = 3.33$, $SD = 0.410$) and neutral scores ($M = 2.00$, $SD = 0.000$) with $t(41) = 21.109$, $p = 0.000$ (equal variance not assumed), $d = 4.89$. This means that the participants had statistically significant better attitudes toward mathematics than a neutral value of “2”, and the effect size was very large.

Results Research Question 3 Part 1

The results of the paired samples t -test (two-tailed) revealed no statistically significant difference between pretest scores ($M = 2.90$, $SD = 0.435$) and posttest scores ($M = 2.94$, $SD = 0.486$) for the PMTE with $t(41) = -0.551$, $p = 0.584$. This means there was no increase in belief in self-efficacy toward teaching as measured by the PMTE over the course of the semester. Further, the results of a second paired samples t -test (two-tailed) revealed no statistically significant difference between pretest scores ($M = 2.73$, $SD = 0.481$) and posttest scores ($M = 2.74$, $SD = 0.505$) for the MTOE with $t(41) = -0.170$, $p = 0.866$. This means there was no increase in belief in affecting student outcomes as measured by the MTOE over the course of the semester.

Results Research Question 3 Part 2

For the PMTE the results of an independent samples *t*-test (two-tailed) revealed a statistically significant difference between PMTE scores ($M = 2.94$, $SD = 0.486$) and neutral scores ($M = 2.00$, $SD = 0.000$) with $t(41) = 12.565$, $p = 0.000$ (equal variance not assumed), $d = 2.73$. This means that the participants had statistically significant better attitudes toward mathematics than a neutral value of “2”, and the effect size was very large.

Results Research Question 3 Part 2

For the MTOE the results of an independent samples *t*-test (two-tailed) revealed a statistically significant difference between MTOE scores ($M = 2.74$, $SD = 0.505$) and neutral scores ($M = 2.00$, $SD = 0.000$) with $t(41) = 9.513$, $p = 0.000$ (equal variance not assumed), $d = 2.07$. This means that the participants had statistically significant better attitudes toward mathematics than a neutral value of “2”, and the effect size was very large.

Results Research Question 4

It was found that there was a statistically significant correlation between pretest mathematics attitude scores ($M = 3.25$, $SD = 0.373$) and pretest PMTE scores ($M = 2.90$, $SD = 0.435$) with $r = 0.690$, $n = 42$, and $p = 0.000$. Additionally, it was found that there was a statistically significant correlation between posttest mathematics attitude scores ($M = 3.33$, $SD = 0.410$) and posttest PMTE scores ($M = 2.94$, $SD = 0.486$) with $r = 0.491$, $n = 42$, and $p = 0.001$. No correlations were found between mathematics attitude scores and MTOE scores.

Results Research Question 5

On the 15-item sample CST the mean score was 10.38 and standard deviation was 3.012. The potential range of scores is 0 to 15. The mean score for actual CST scores was 260.62 and standard deviation was 20.184. The passing score required in New York State for the CST is 220 and the highest possible score is 300. A statistically significant correlation was found between the two examinations with $r = 0.529$, $n = 42$, $p = 0.000$. This means that the sample CST test given at the beginning of the semester was directly related to the CST taken previous to beginning the course.

Results Research Question 6

The sixth research question was answered using Teaching Fellows' teaching and learning journals (see Tables 1 and 2) and their responses to the final item on the final examination that required them to state and justify their own position toward teaching mathematics from a traditional back to the basics approach or from a reform constructivist approach.

The number of Teaching Fellows who had traditional views toward teaching was five; the number who had moderate views was 23; and the number who had reform views was 14.

Table 1: Analysis of Teaching Journals

Topic	Freq.
Classroom Management Issues	28
Student Motivation for Learning and Attendance	14
Standardized State Exams	12
Lack of Basic Skills	9
Collaborative Learning	8
Time Management Issues	8
Lack of Student Conceptual Understanding	7
Homework issues	5
Unsupportive Administration	5
Constructivism	5
Math Anxiety	2

Table 2: Analysis of Learning Journals

Topic	Freq.
Problem Solving	27
Numeracy	25
Microteaching	23
Motivation Techniques	21
Technology and Manipulatives	18
Differentiation in Teaching	14
Standards	13
Questioning Techniques	9
Assessment	9
Real World Connections	8
Literacy in Mathematics	5
Reflective Teaching	5
Social Justice	3
Conceptual Mathematical Understanding	3
Literature Critiques	1

Discussion

- It was found that Teaching Fellows increased their mathematical content knowledge over the course of the semester.
- It was found that Teaching Fellows had an increase in positive attitudes toward mathematics over the course of the semester.
- It was found that at the end of the semester Teaching Fellows generally held positive attitudes toward mathematics.

Discussion

- It was found that at the end of the semester Teaching Fellows generally had high concepts of self-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).
- A positive correlation was found between Teaching Fellows' attitudes toward mathematics and PMTE scores for both pre and posttests.
- It was found that Teaching Fellows generally found that classroom management was the biggest issue in their teaching, and that problem solving and numeracy were the most important issues addressed in the methods course.

Discussion

There is concern about the lack of content knowledge held by alternative certification teachers since many did not study mathematics extensively as undergraduates like many traditionally prepared teachers did. The findings in this study suggest that teachers improved their content knowledge and attitudes toward the subject after taking a reformed-based mathematics methods course. This has implications for the future preparation of alternatively certified teachers since it showed that despite not having an undergraduate degree in mathematics, a reformed-based methods course coupled with in-service teaching can have a significant impact on content knowledge and attitudes toward mathematics. It is suggested that more mathematics and/or methods courses be included in teacher preparation programs for alternative certification teachers.

Discussion

Considering the ever increasing pool of New York City mathematics teachers who enter the profession through the Teaching Fellows program, it is imperative to understand their mathematics content knowledge, attitudes toward mathematics, and their concepts of self-efficacy. Further, considering the rise in alternative certification programs throughout the United States, studying these three areas of concern for new teachers is of great importance. This has a direct impact on the many urban students who receive these new teachers in their classrooms. Future studies should focus on student achievement in the classroom. Given the field's rhetoric regarding equity and social justice, more studies are necessary on this unique group of teachers who often teach urban students.