Determining Quality Teachers: Mathematical Content Knowledge, Perceptions of Teaching Self-Efficacy, and Attitudes toward Mathematics among a Teach for America Cohort

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The purpose of this study was to understand the relationships between mathematical content knowledge, perceptions of teaching self-efficacy, and attitudes toward mathematics in one cohort of Teach for America teachers who took the New York State Content Special Test in mathematics at the start of their program, and a mathematics attitude instrument taken before and after their first year teaching while taking graduate courses in a teacher education program. Additionally, teachers completed a self-efficacy instrument in their second year of teaching and graduate coursework. The major finding revealed that mathematical content knowledge was related to attitudes toward mathematics, and attitudes toward mathematics were related to perceptions of self-efficacy. It was found that teachers with mathematics related majors had higher mathematical content knowledge than did business majors, but similar levels of self-efficacy. Liberal arts majors had similar content knowledge and levels of self-efficacy as did mathematics related majors.

***Keywords**: alternative certification, math content knowledge, Teach for America, middle school teachers, high school teachers, self-efficacy*

Summary of Initial Research Study

This research is a follow-up study to an initial study conducted with first year Teach for America (TFA) teachers in New York (Evans, 2009). The purpose of the initial study was to understand the mathematical content knowledge held by a cohort of middle and high school teachers before and after their first year of teaching and taking graduate coursework in the TFA program, as well as what attitudes toward mathematics TFA teachers held over their first year. A significant increase in both mathematical content knowledge and positive attitudes toward mathematics occurred over the TFA teachers' first year of teaching. Teachers' reflective journals revealed that they generally believed an emphasis on social justice in their coursework was of greatest benefit to them, and that classroom management was the biggest problem faced in their teaching. Additionally, it was found that mathematics related majors had significantly

better content knowledge scores on the pre- and posttests and better attitudes toward mathematics on a pretest than did business majors.

Follow-up to Initial Research Study

The purpose of this study was to understand the relationships between mathematical content knowledge, perceptions of teaching self-efficacy, and attitudes toward mathematics held by a cohort of teachers in the TFA program. This study revisited a cohort of TFA teachers in their second year of teaching and taking graduate education courses at Pace University in New York. In this study, teachers' mathematical content knowledge was further measured through the collection of scores on the New York State Content Specialty Test (CST), a standardized mathematics certification examination required by New York State. Additionally, teachers were given the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI), a teaching self-efficacy survey used to determine their perceptions of their ability to effectively teach mathematics and their beliefs in their ability to directly affect student learning outcomes despite external factors.

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 underserved students. Its founder, Wendy Kopp, was herself a new graduate of Princeton University who was looking to do something more with her life after graduation (Kopp, 2003). She considered that many recent college graduates at top universities in the United States 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 employment sectors while remaining 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.

Need for the Study

Many studies have been conducted on TFA teachers at the elementary level (Darling-Hammond, 1994, 1997; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005; Laczko-Kerr & Berliner, 2002), but not as many at the secondary level (Evans, 2009; Xu, Hannaway, & Taylor, 2008). Further, most studies have focused primarily on student achievement and teacher retention, which are two of the most important variables. However, examining only these variables is not sufficient if the goal is to increase teacher quality. Suell and Piotrowski (2007) called for a strong academic coursework component for alternative pathways teachers, which makes determining what constitutes 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 and have stated "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 say that more research is needed on teacher backgrounds.

Review of the Literature

Darling-Hammond et al. (2005) found that certified teachers consistently produced significantly higher student achievement gains as compared to uncertified teachers, including typically uncertified TFA teachers. Laczko-Kerr and Berliner (2002) found that students of TFA teachers performed more poorly than students of equally inexperienced, but fully certified, teachers. However, students of uncertified TFA teachers performed the same as students of other uncertified teachers (Darling-Hammond et al., 2005; Laczko-Kerr & Berliner, 2002). Certified TFA teachers, after two to three years of teaching and enrolling in a teacher preparation program, performed just as well as other certified teachers in the field. Darling-Hammond et al. cautioned that, upon becoming certified, many TFA teachers leave teaching. TFA claimed that about two-thirds of all TFA teachers stayed in education upon completing their time in the program, and half of those remained in teaching, which means that about one-third of all TFA alumni stayed in the classroom upon fulfilling their commitment, and another one-third maintained non-teaching roles in education, such as in administration or advocacy (Teach for America, 2010a). As of 2009, TFA had approximately 17,000 alumni (Teach for America, 2010a).

Xu et al. (2008) focused their study on secondary mathematics and science teachers, and found that, contrary to some other reports on TFA teachers, these uncertified TFA teachers were 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 scores on end-of-course standardized tests. Xu et al. concluded that perhaps TFA teachers were able to offset their lack of experience through better academic preparation or motivation. The authors stated that TFA "recruits and selects graduates from some of the most selective colleges and universities across the country" (p. 2), and that 62% of TFA teachers were educated at "most selective" and "very selective" higher education institutions while only 22% of non-TFA teachers were educated at these institutions. Further, TFA teachers had higher standardized tests 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 (Teach for America, 2010b).

Few studies have addressed mathematical content knowledge with teacher perceptions of self-efficacy (Jones Newton, Leonard, Evans, & Eastburn (in press); Swars, Daane, & Giesen, 2006; Swars, Hart, Smith, Smith, & Tolar, 2007), and no known studies have addressed this issue in alternative certification. Jones Newton et al. found a relationship between mathematics content knowledge and perceptions of self-efficacy for elementary preservice teachers taking a mathematics methods course. Swars et al. (2006) examined the relationship between mathematics anxiety and teacher efficacy, and found that lower mathematics anxiety was related to higher perceptions of self-efficacy. Further, Swars et al. (2007) found an increase in teacher self-efficacy over the course of an elementary mathematics methods class. It is possible that beliefs about self-efficacy may be a greater variable in quality teaching than content knowledge

alone (Bandura, 1986; Ernest, 1989). No studies are known that address teachers' perceptions of self-efficacy among middle or secondary teachers in alternative certification programs such as TFA.

Theoretical Framework

Aiken (1970, 1974, 1976) was one of the early researchers who examined the relationship between mathematical achievement and attitudes toward mathematics. Aiken (1970) showed that attitudes and achievement in mathematics are reciprocal. Ma and Kishor (1997) found a small but positive significant relationship between achievement and attitudes through meta-analysis. This relationship, along with the work of Ball, Hill, and Bass (2005), with an emphasis on the importance of content knowledge for teachers, formed the framework of this study. Ball et al. concluded that "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); found that teachers who teach students of low socio-economic status were less likely to have stronger content knowledge than teachers who did not teach students of low socio-economic status; and found that teachers with stronger content knowledge had higher achieving students. Additionally, the gains in achievement for students of higher content knowledge teachers were similar to the differences between students of different socio-economic status. This led the authors to suggest that teachers with high content knowledge could help narrow the achievement gap in urban schools. In New York City in particular, and throughout the United States in general, TFA teachers are often placed in high need urban schools (Teach for America, 2010b).

Additionally, Bandura's (1986) construct of self-efficacy theory framed this study's focus on self-efficacy in TFA teachers. Bandura found that teacher self-efficacy can be subdivided into a teacher's belief in his or her ability to teach effectively and affect student learning outcomes despite external factors. 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 understanding (Swars et al., 2006).

This current study was grounded in this literature (Aiken, 1970, 1974, 1976; Ball et al., 2005; Bandura, 1986; Ma & Kishor, 1997) since the three constructs are integral to the teaching and learning process for teachers and their students. Teachers with higher levels of content knowledge, self-efficacy, and attitudes toward mathematics are better able to produce high student achievement than are teachers with lower levels of these three constructs. This study expands upon the literature by examining these three constructs among a cohort of new in-service TFA teachers.

Research Questions

1. Does a relationship exist between TFA teachers' mathematical knowledge and attitudes toward mathematics?
2. Does a relationship exist between TFA teachers' attitudes toward mathematics and perceptions of self-efficacy?
3. What level of self-efficacy do TFA teachers possess?

4. Does a difference exist in mathematical knowledge between undergraduate majors for TFA teachers?
5. Does a difference exist in perceptions of self-efficacy between undergraduate majors for TFA teachers?

Methodology

The methodology of this study was quantitative. The sample in this study consisted of 22 middle and high school TFA mathematics teachers in their second year of teaching and enrollment in a graduate teacher education program at Pace University in New York. The initial study on this group of teachers began with teachers in their first year of the program (Evans, 2009), and this study continued during their second year of teaching while completing their graduate teacher education program at Pace University. Half the teachers in this study were male and half were female. Undergraduate majors for teachers consisted of liberal arts ($N = 8$), business ($N = 9$), and mathematics related majors ($N = 5$).

During the summer prior to their first year of teaching, the participants in this study took graduate education courses at Pace University that were taught by University faculty. The TFA teachers took the state required New York State Content Specialty Test (CST) the summer before they began their program. The range of possible scores on the CST is 100 to 300, and the minimum passing score is 220. The Transitional B license, issued by the state of New York, is used for alternative certification teachers, including TFA teachers, while they are in their programs. Such a license is valid for three years and leads to initial certification.upon successful completion of the program.

For mathematical content knowledge and attitudes toward mathematics, the sample was the entire group of 22 teachers. However, when self-efficacy was examined during their second year of teaching and graduate education, the sample was reduced to 19 teachers because two teachers who agreed to participate in the study did not return their self-efficacy instruments, and one teacher left the TFA program and teaching in the second year. The self-efficacy instrument was adapted from the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) developed by Enochs, Smith, and Huinker (2000), and measured perceptions of self-efficacy. The MTEBI is a 21-item, 5-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 self-efficacy theory (1986). 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 measures a teacher's self-concept of his or her ability to effectively teach mathematics. The MTOE specifically measures a teacher's belief in his or her ability to directly affect student learning outcomes despite external factors. Enochs et al. (2000) found the PMTE and MTOE had Cronbach alpha coefficients of 0.88 and 0.77, respectively.

Data on attitudes toward mathematics were collected in the initial study conducted with this cohort of participants in their first year (Evans, 2009). The questionnaire used in the initial

study 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 uses a 5-point Likert scale with choices "strongly agree", "agree", "neutral", "disagree", and "strongly disagree". This was administered at the beginning and end of the teachers' first year in the initial study (Evans, 2009). These data were used in this current study to answer the first and second research questions.

The quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 16.0, and utilized Pearson correlations, independent samples *t*-tests, and one-way ANOVA. All significance levels were taken at the 0.05 level. Research questions one and two were answered using Pearson correlations with data collected from the attitudes toward mathematics survey instrument in the first year. Research question one was also answered using data collected from CST scores, and research question two was also answered using data collected from the MTEBI in the second year. Independent samples *t*-tests were used to answer research question three using data collected from the MTEBI. One-way ANOVA was used to answer research questions four and five using data collected from the CST scores and the MTEBI, respectively.

For research questions four and five, TFA teachers were divided into three categories based upon their undergraduate college majors: liberal arts, business, and mathematics related majors. Liberal arts majors consisted of history, music, political science, psychology, public policy, sociology, and Spanish majors. Business majors consisted of accounting, economics, general business, and marketing majors. Mathematics related majors consisted of mathematics and engineering majors. TFA teachers were grouped as liberal arts, business, or mathematics related majors because all teachers in this study could conveniently and reasonably be placed in one of those three categories. TFA mathematics teachers come to the program with various undergraduate degrees and many of these degrees are unrelated to mathematics. The concern that teachers coming from backgrounds other than mathematics fields do not have enough mathematics content knowledge to effectively teach this subject was explored in this study.

Limitations

A major limitation of this study was the small sample size ($N = 22$ for mathematical content knowledge and attitudes toward mathematics and $N = 19$ for self-efficacy). Only one class of TFA teachers was available due to the small number of middle and high school TFA teachers available at Pace University, and it is recommended that this study be replicated with a larger sample size when possible. Although the sample size was small, this was an exploratory study that should be a catalyst for further investigation of the variables examined. Moreover, the small sample size is statistically adequate for the statistical tests used to answer the research questions in this study, but generalizability remains an issue. However, the interest in this study was not to examine mathematics teachers in the TFA program in general, but rather to examine the relationships of content knowledge, self-efficacy, and attitudes of one particular cohort of TFA teachers. Since this study is exploratory, general conclusions from the data collected should be interpreted with caution. This is further addressed in the discussion section.

Secondly, a limitation in this study is the role of the teacher-researcher. The instructor in the mathematics methods course taken in the first year of teaching 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 for this study. As in all survey research, internal validity issues are a concern due to student self-report.

Results

Research question one was answered using Pearson correlations (see Table 1). A statistically significant correlation between CST mathematics scores and pretest attitudinal scores was found. However, no correlation was found between CST scores and posttest attitudinal scores.

Table 1

Pearson Correlation between CST Scores and Attitudinal Scores

Assessment	Mean	SD	*r*-value
CST	268.41	21.407	0.538*
Pretest Attitudinal Test	4.06	0.451	

$N = 22$, $df = 21$
* $p < 0.05$

Pearson correlations were also used to answer research question two (see Table 2). Statistically significant correlations were found between attitudinal scores on the pretest and PMTE and MTOE scores, respectively. Further, there was a statistically significant correlation between attitudinal scores on the posttest and PMTE scores. However, no statistically significant correlation was found between attitudinal scores on the posttest and MTOE scores.

Table 2

Pearson Correlations between Attitudinal Scores and MTEBI (PMTE and MTOE) Scores

Assessment	Mean	SD	*r*-value
Pretest Attitudinal Test	3.14	0.428	0.598**
PMTE	3.01	0.320	
Pretest Attitudinal Test	3.14	0.428	0.479*
MTOE	2.86	0.394	
Posttest Attitudinal Test	3.40	0.334	0.701**
PMTE	3.01	0.320	

$N = 19$, $df = 18$
** $p < 0.01$
* $p < 0.05$

Research question three was answered using independent samples *t*-tests (see Table 3). TFA teachers had statistically significant higher scores on both the PMTE and MTOE than neutral values coded as "2" in the data. Further, the effect sizes for both PMTE and MTOE were very large, and this means that TFA teachers had high levels of self-efficacy. It should be noted, however, that comparing actual self-efficacy scores with neutral responses should be interpreted with caution.

Table 3

Independent Samples t-Test Results on MTEBI (PMTE and MTOE) Scores

Assessment	Mean	SD	*t*-value	*d*-value
PMTE Actual Scores	3.01	0.320	-13.725**	4.47
Neutral Scores	2.00	0.000		
MTOE Actual Scores	2.85	0.394	-9.381**	3.05
Neutral Scores	2.00	0.000		

$N = 19$, $df = 18$, two-tailed
Equal variances not assumed.
** $p < 0.01$

Research question four was answered using a one-way ANOVA (see Tables 4 and 5). TFA teachers were grouped into three categories according to their undergraduate college majors: social science ($N = 8$), business ($N = 9$), and mathematics related ($N = 5$). For mathematical content knowledge, the one-way ANOVA revealed a statistically significant difference with large effect size. A post hoc test (Tukey HSD) was performed to determine exactly where the means differed and revealed that mathematics related majors had significantly higher mathematical content knowledge as measured by the CST than did business related majors, $p < 0.05$. There were no other statistically significant differences.

Table 4

Means and Standard Deviations on Mathematical Knowledge (CST Scores)

CST Scores	Mean	SD
Content Proficiency Pre Test		
Liberal Arts ($N = 8$)	272.88	14.177
Business ($N = 9$)	255.22	20.891
Mathematics ($N = 5$)	285.00	20.149
Total ($N = 22$)	268.41	21.407

Table 5

ANOVA Results on Mathematical Knowledge (CST Scores) for Major

Variation	Sum of Squares	*df*	Mean Square	*F*	η^2
Between Groups	3100.888	2	1550.444	4.516*	0.32
Within Groups	6522.431	19	343.286		
Total	9623.318	21			

* $p < 0.05$

Research question five was answered using a one-way ANOVA. No statistically significant differences were found between the various undergraduate college majors and perceptions of self-efficacy as measured by the MTEBI with two subscales: PMTE and MTOE. This means there were no differences between college major and perceptions of self-efficacy.

Discussion

Mathematics CST scores were found to be directly related to attitudes toward mathematics on the attitudinal pretest. This relationship was not surprising, and it confirmed a relationship widely found in the literature (Aiken, 1970, 1974, 1976; Ma & Kishor, 1997). This finding is a significant contribution to the literature precisely because it was found for TFA teachers in particular, compared to mathematics teachers in general. This finding strengthens the argument for strong content knowledge for teachers since there is a direct relationship between content knowledge and attitudes. Further, teachers' attitudes could have a direct impact on the quality of their teaching. The correlation of variables related to quality instruction, such as content knowledge and attitudes, needs to be better understood in the literature for alternatively certified teachers (Humphrey & Wechsler, 2007). No relationship was found between CST scores and attitudes toward mathematics on the posttest. It is believed this is a type II statistical error related to the small sample size and should be examined in future research.

Attitudes toward mathematics were found to be related to perceptions of self-efficacy, which is partially consistent with the literature when comparing mathematics anxiety with self-efficacy using the MTEBI (Swars et al., 2006). Swars et al. found that mathematics anxiety was related to PMTE scores, but not MTOE scores. In this present study, attitudes toward mathematics on the pretest were related to both PMTE and MTOE scores. However, on the posttest, attitudes toward mathematics were related only to PMTE scores and not to MTOE scores. Further, mathematics anxiety has been shown to be related to attitudes toward mathematics (Ma, 1999). It appears that the significant relationship found between pretest attitude scores and MTOE scores may have been a type I statistical error because it is inconsistent with the literature and only occurred for the attitudes pretest only. Further, the significance level was at the 0.05 level for the MTOE, whereas the significance levels for the PMTE were at the 0.01 level. Thus, this false positive may be related to the small sample size in this study. Additionally, it would be appropriate to consider posttest attitudinal scores more seriously since the MTOE was administered in the second year, a time period closer to the attitudinal posttest at the end of the first year. When teachers took the pretest they had just

begun teaching in the classroom. Perhaps the reality of the classroom had not yet been perceived by these teachers. As previously stated, 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 understanding (Swars et al., 2006). The implication is that perhaps fostering a better appreciation for mathematics may be useful since attitudes toward the subject are related to one's perceptions of self-efficacy in teaching the subject. This has implications for professional development for in-service TFA teachers.

Future research should examine the nature of the relationship between self-efficacy and other variables, such as content knowledge and attitudes toward mathematics. This might be best done through qualitative research.

It was found that TFA teachers had high levels of teaching self-efficacy, which means that they had strong beliefs in their ability to teach effectively and affect student learning outcomes. This finding has particularly interesting implications since the literature shows teachers tend to have high levels of student outcome expectancy while they were pre-service teachers (Swars et al., 2007). However, outcome expectancy generally declines when the teachers become in-service teachers and the realities of the classroom are encountered (Swars et al., 2007). Teachers in this study had high levels of outcome expectancy despite being in-service teachers. The implication is that the reality of the classroom did not diminish TFA teachers' perceptions of teaching efficacy. It is possible that TFA teachers are a unique group with higher than usual confidence in their teaching due to the highly selective nature of the TFA program and the large number of TFA teachers coming from selective universities (Xu et al., 2008). This finding provides support for the potential positive impact of the TFA program. This should be further investigated in future research for alternative certification in-service teachers from different programs. Comparisons of self-efficacy should be made between TFA teachers and other categories of teachers, such as traditional teachers.

Mathematics related majors had higher mathematical knowledge than did business majors as measured by the CST. This was consistent with the results found in the initial study conducted on this cohort using a different content knowledge measurement (Evans, 2009). Similarly, in the initial study no differences were found between mathematics related majors and liberal arts majors. A possible explanation is that mathematics taught to business majors may be different from mathematics taught to liberal arts and mathematics majors. Mathematics in liberal arts and mathematics programs may be more traditionally academic and aligned with the content taught in middle and high school, whereas business mathematics may be taught from an applications perspective. Given the importance of strong mathematics content knowledge for teachers (Ball et al., 2005), the implication of this finding is that perhaps a liberal arts background for TFA teachers provides adequate background in mathematics. However, considering that only mathematics related majors showed significantly higher content knowledge than did business majors, possible differences not found in this study between mathematics and liberal arts backgrounds should be investigated in future studies with larger sample sizes.

Two major implications arise from the results of this study. First, although mathematics related majors had higher mathematical content knowledge than did business majors, no differences were found in their perceptions of their ability to effectively teach mathematics or

their beliefs in their abilities to directly affect student learning outcomes. This is interesting because, despite mathematics related majors having higher mathematical ability than business majors, it appears that there is no effect on their perceptions of their ability to teach mathematics effectively and for their students to learn well from them. As previously stated, there is a concern that teachers from non-mathematics fields do not have enough content knowledge to effectively teach mathematics. The findings of this study showed that even though a difference was found for content knowledge between the two majors, perceptions of teaching ability were not found to be different. This is significant since self-efficacy is an important variable in quality teaching and it is possible that beliefs about self-efficacy may be a greater variable than content knowledge alone (Bandura, 1986; Ernest, 1989). Future research should investigate what effect this has on student achievement.

Second, no differences in mathematical ability or perceptions of self-efficacy were found between mathematics related majors and liberal arts majors. The implication is that one does not need to have a mathematics related undergraduate major in order to have sufficient content knowledge and self-perception of one's ability to effectively teach mathematics. This indicates that, for the TFA teachers who participated in this study, whether they were mathematics or engineering majors, or history, music, political science, psychology, public policy, sociology, or Spanish majors did not matter. This could have significant implications for future selection of TFA candidates as well as selection of candidates from other alternative certification programs. However, while teachers with mathematics related majors had significantly higher levels of content knowledge than did those with business majors, no difference in levels of content knowledge was found between those with liberal arts and business majors. This is an important finding and should be further investigated. Additionally, future research should investigate how student achievement compares between students of teachers from both liberal arts and mathematics backgrounds.

As indicated earlier, a major limitation of this study is the small sample size used to gather data. However, as previously stated, this is an exploratory study with the intention of examining one particular cohort of TFA teachers. The results of this study give researchers an indication of the relationships between content knowledge, self-efficacy, and attitudes of one cohort of TFA teachers. This study should be replicated on a larger scale to verify the results found and explore the variables more deeply. The biggest value in this study is the implication that a mathematics background may not be necessary for sufficient mathematics content knowledge or perceptions of teaching ability.

To further validate the findings of this study, due to the small sample size available, another study conducted by the researcher is referenced here (Evans, in press). More teachers were available for study in a different highly selective alternative certification program with $N = 42$. Similar results were found with these teachers as were found with TFA teachers. Significant correlations were found between attitudes toward mathematics and PMTE scores. Consistent with the literature (Swars et al., 2007), no relationship was found between attitudes toward mathematics and MTOE scores. This provides evidence that the significant relationship found between attitudes toward mathematics and pretest MTOE scores for TFA teachers was likely a type I statistical error as suggested. Teachers in the other study were found to have high levels of teaching efficacy and outcome expectancy, with the last finding also contrary to the literature,

as was found with TFA teachers in this study. Mathematics related majors also had higher content knowledge than did business majors, but both groups had similar levels of self-efficacy, as was found with TFA teachers. The relationship between content knowledge and attitudes toward mathematics was not examined.

Given the need for high quality mathematics teachers, particularly in high need urban schools, it is imperative that students in these schools are getting the quality education they deserve. To ensure that all children have the highest quality teachers, teacher quality in teacher preparation programs, especially alternative pathways programs, must continually be examined.

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