Increasing the Self-Efficacy of Inservice Teachers through Content Knowledge

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A teacher's sense of self-efficacy has been consistently recognized as an important attribute of effective teaching and has been positively correlated to teacher and student outcomes (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). A number of studies show the impact of teachers with high levels of efficacy. Students of these teachers have outperformed students who had teachers with lower levels of efficacy on the mathematics section of the Iowa Test of Basic Skills (Moore & Esselman, 1992). Greater achievement was also found in rural, urban, majority Black, and majority White schools for students who had teachers with high levels of self-efficacy (Watson, 1991). In addition, studies have shown that teachers with high levels of efficacy have demonstrated different characteristics related to work ethic and pedagogical practice than teachers with low levels of self-efficacy. For example, studies have shown that teachers with high levels of self-efficacy work longer with students that struggle, recognize student errors, and attempt

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new teaching methods that support students (Gibson & Dembo, 1984; Ashton & Webb, 1986; Guskey, 1988). Czernaik (1990) found that highly efficacious teachers were more likely to use "reform-based" teaching methods, such as inquiry-based and student-centered approaches, while teachers with low levels of self-efficacy used more teacher-directed methods, such as lecturing and textbook reading.

The benefits of having high levels of efficacy have been firmly established; therefore, many researchers have explored methods of increasing levels of efficacy in preservice teachers (see Swars, 2005; Palmer, 2006; Utley, Bryant, & Moseley, 2005); but few studies have explored the concept of raising inservice teachers' efficacy levels. This is partly due to the fact that the concept of self-efficacy, as developed by Bandura (1993), has been thought to impact novice individuals early in the context of new learning, thus limiting the studies of practicing or in-service teachers. In this article, we examine teachers' self-efficacy and change over time. In the following section we detail self-efficacy and the ways that self-efficacy can impact teaching.

Self-efficacy has been defined by Bandura (1997) as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Self-efficacy is context specific, meaning the level of perceived ability changes for each person depending upon the situation or task (Tschannen-Moran, et. al., 1998). Thus professional development or further education that impacts a teacher's understanding of their craft can affect the teacher's perceived ability level and therefore self-efficacy.

Bandura's theory of self-efficacy contains two expectancies, self-efficacy and outcome efficacy. Self-efficacy expectation provides individuals a way to decide whether they have the ability to perform the required task at the desired level of competency, while outcome expectancy provides individuals a way to decide if they have accomplished a task at a desired level (Tschannen-Moran, et. al.). Researchers have used Bandura's theory in the field of education in order to study teacher self-efficacy; and two dimensions of teacher efficacy consistently have been found to be independent measures: *personal teaching efficacy* and *general teaching efficacy*, sometimes referred to as *outcome efficacy* (Woolfolk-Hoy & Burke-Spero, 2005). Personal teacher efficacy is generally defined as a teacher's belief in his or her skills and abilities to positively impact student achievement, while general (outcome) teaching efficacy has been defined as a teacher's belief that the educational system can work for all students, regardless of outside influences such as socio-economic status and parental influence.

In considering the context of an inservice teacher with lower levels of specific content knowledge, we posit that content courses which are designed to support a teacher's development of content knowledge and pedagogy can be a valuable way to increase levels of self-efficacy. This hypothesis is supported through the work of Ma (1999) and her idea of "profound understanding of fundamental mathematics," which argues that teachers need to have mathematical knowledge that is connected, grounded in curriculum, and longitudinally coherent. The work of Ball, Hill, and

Bass (2005) and Hill and Ball (2004) also tentatively demonstrate that math teachers need specialized knowledge that goes beyond the common knowledge held by most adults. This is consistent with studies that have shown that content courses that focus on how to teach the content have been successful in raising preservice teachers' efficacy levels (Appleton, 1995; Palmer, 2001). The purpose of the present study was to investigate whether inservice teachers' levels of personal efficacy and/or outcome efficacy changed as a result of completing courses in mathematics and/or science that intertwined content acquisition with pedagogy. In addition, we were interested in the reasons teachers participated in content courses and if this information helped identify characteristics of teachers with high levels of efficacy.

Method

Context and Participants

The RM-MSMSP is a National Science Foundation-funded, 5-year project that targets middle school teachers and students in seven Denver-area school districts. The project includes seven partner school districts and faculty from four universities. The primary goal is to increase the subject-matter content and pedagogical content knowledge of middle school teachers. In its infancy this project aimed at increasing the number of highly qualified teachers as defined by the No Child Left Behind legislation. In the state of Colorado, highly qualified status can be obtained by completion of 24 content hours of college level coursework in the field of study. The project's primary goal was to provide math and science content courses to all middle level teachers, but high school and elementary teachers have also benefited from the additional coursework.

Since the project's inception in 2004, 17 content-based math and science courses have been developed and cotaught by faculty from the natural sciences and mathematics, math and science education (across universities), and K-12 partners. This instructional method was deemed important by the principal writers of the grant for several reasons. First that the tripartite group would learn from each other; and, second, K-12 faculty would learn more about the culture and expertise of university faculty and would come to understand more fully the theoretical underpinnings of instructional practice and math and science content. Education faculty would have an opportunity to learn more about the issues of K-12 education and develop a different sense of content expertise and research from math and science faculty. And finally, math and science faculty would learn more about pedagogy and student learning from both K-12 and education faculty. In the end, the primary beneficiaries were the teacher participants because the summer academy courses, while taught with a focus on content, also emphasized the pedagogical perspective. Through qualitative observations, we have found that instructors often interpret for each other by interjecting remarks like, "so this is what it means in the classroom," or "here's how it matches with the standards," or "here's a way to do this with your students." In the structured follow-up courses, the reverse was also true. While teacher participants were learning more about how to differentiate instruction and adapt instruction for second-language learners, and learning new instructional and assessment strategies, the content expert was there to ensure that conceptions of the content were clear and that new questions that were raised were answered. One educational instructor told us, "I'm always glad [the content instructor] is there because with new self-confidence and a trusting environment, comes more questions—complex questions that I'm not sure I could answer satisfactorily."

Over the past four years, 277 teachers have taken at least one of the15 courses. Every participating teacher is given a unique teacher identifier number, which allows for confidential examination of demographic and survey information. Each of these teachers, at various stages of the project, received an email requesting that he or she participate in an online survey that would measure his or her sense of self-efficacy. A reminder email was sent two weeks later to any teachers who had not responded at that point in time. The survey link closed two weeks after the reminder email. Ninety-five teachers (32%) responded to the self-efficacy survey. Seven of these responses were eliminated from the analysis due to missing data, resulting in a final pool of 88 participants. The participating teachers also were invited to submit to an online postcourse survey, which allowed them to respond to any perceived positive and negative aspects of the provided courses.

Survey Instrument and Interview Questionnaire

The survey instrument selected to measure teachers' self-efficacy was the Science Teaching Efficacy Belief Instrument (STEBI-B). This instrument was developed by Riggs and Enochs (1990) and was based upon Bandura's self-efficacy theory discussed above. The STEBI-B was built upon the Gibson and Dembo (1984) Teacher Efficacy Scale in order to more accurately measure science teachers' self-efficacy. It consists of 23 items and is broken down into two scales—Personal Teaching Efficacy (PTE) and Teaching Outcome Expectancy (TOE). Again, PTE is a teacher's belief in his or her skills and abilities to positively impact student achievement, while TOE is a teacher's belief that the educational system can work for all students, regardless of outside influences such as socio-economic status and parental influence. The PTE scale consists of 13 statements that respondents answer from strongly agree, agree, uncertain, disagree, and strongly disagree. The OTE scale has 10 statements with the same scoring pattern. Each statement was scored according to the recommendations by Riggs and Enochs (1990): strongly agree = 5, agree = 4, uncertain = 3, disagree = 2, and strongly disagree = 1. Reverse scoring was utilized for the 10 negatively worded items. The authors of this scale did not provide guidance for establishing what level of score corresponds to high, medium, or low levels of efficacy. In reviewing the literature, some researchers used a score of 3.0 to reflect a neutral response and scores of one standard deviation above and below this mark to indicate high and low levels of efficacy (Palmer, 2006). Those benchmarks were determined to be suitable measures for this study. The STEBI-B has been used in numerous studies, and the data has consistently been found to be reliable and valid (Bleicher, 2004).

In this study, the STEBI-B was modified to include math as well as science. The research team also added six questions to the survey in order to answer research questions regarding whether low motivation in students can affect teacher's self-efficacy, and whether working with English as Second Language (ESL) students affects self-efficacy. The final version with 29 questions is provided in the Appendix.

A postcourse survey instrument was developed by the research team in order to analyze the effectiveness of the provided courses. This instrument was examined as a source of qualitative information about the participating teachers' perceived benefits of the coursework. The survey consisted of 25 questions, but only 4 that required extensive written responses. Two of the four written response items provided relevant information for this study, and these two were selected to be analyzed in order to explore the characteristics of those participating teachers who scored high in efficacy. These two selected questions are: (a) I chose to enroll in this RM-MSMSP course because…, and (b) the most valuable aspects of this course were.

Analysis

The first step in the analysis was to determine the reliability and validity of the data that had been produced from the self-efficacy survey instrument. Principal factor analysis was conducted on the data to ensure that the data produced the two subconstructs of PTE and TOE. Cronbach's alpha was computed on both subconstructs in order to determine if the factors formed a reliable scale.

In order to determine whether teachers who had taken a high number of courses differed from teachers who had taken a low number of courses on their levels of PTE and/or TOE, independent samples *t*-tests were conducted. The independent samples *t*-test statistic is appropriate when investigating the difference between two unrelated or independent groups on an approximately normally distributed dependent variable. The assumptions for this statistic include: (a) the variances of the dependent variable in the two populations are equal, (b) the dependent variable is normally distributed within each population, and (c) the data are independent. The first assumption was checked by examining the Levene test for equal variances. The second assumption was checked by using the Explore function in the Statistical Package for the Social Sciences (SPSS) and examining the skewness of the dependent variable. The last assumption was considered when collecting the data, and this set of data was independently collected.

The second research question regarding the characteristics of teachers who scored high in efficacy was explored through qualitative methods. The analysis consisted of examining the two selected questions from the postcourse survey. This data was coded using constant comparative analysis. This method of analysis is appropriate when the researcher is attempting to gain an overall understanding of the data and wishes to develop a possible theme based on the data. The analysis began with examining the data line by line to develop an *in vivo* code that might be reused in later text. After all coding was completed, the codes were grouped into categories that were determined from examining the data. These groupings were then broken into subgroups that allowed for the production of themes from the data. This process will be explained fully in the following results section.

Results

Reliability Analysis

Using SPSS, a principle factor analysis with varimax rotation was conducted on the data to assess the underlying structure for 18 of the items on the original STEBI-B. The six added questions were eliminated from the analysis, as the reliability is still being examined. Questions 3, 11, 13, 14, and 20 were also eliminated due to wording and multicollinearity issues. Assumptions were checked and met. Two factors were requested, based upon the fact that the items were designed to index two constructs: PTE and TOE. After rotation, the first factor accounted for 21.8% of the variance, and the second factor accounted for 16.7% of the variance. Table 1 displays the items and factor loadings for the rotated factors. The results compare favorably with the

Table 1
Factor Loadings for the Rotated Factors

Item	Factor Loading		
	1	2	Communality
Q2: extra effort		.56	.31
Q5: effective teaching		.59	.35
Q6: know steps	.59		.36
Q8: underachieve		.62	.39
Q10: background		.54	.30
Q12: extra attention		.72	.52
Q15: teacher responsible		.62	.38
Q16: teacher effective			
Q17: student interest		.35	.19
Q19: answer questions	.48		.24
Q24: questions	.59		.36
Q4R: teach well	.61		.37
Q7R: effective experiments	.62		.38
Q9R: ineffective	.52		.27
Q18R: answer	.76		.58
Q22R: principal visit	.54		.29
Q23R: loss at how to help	.77		.60
Q25R: turn on students	.49		.25
Eigenvalues	3.74	3.00	
% of variance	20.75	16.68	

two previously conducted STEBI-B reliability studies (Riggs & Enochs, 1990; Bleicher, 2004).

The first factor, which measures PTE, loaded strongly on all 10 questions, with questions 18 (I find it difficult to explain to students why math/science experiments work) and 23 (When a student has difficulty understanding a math/science concept, I am usually at a loss as to how to help the student understand it better) being the strongest. The second factor, which measures TOE, also loaded strongly on all eight items, with question 12 (When a low achieving child progresses in math/science, it is usually due to extra attention given by the teacher) being the strongest. The indication of the presence of the two factors PTE and TOE suggests the data was reliable for determining the teachers' efficacy scores in the two categories. To assess whether the items included in the two factors formed a reliable scale, Cronbach's alpha was computed. The alpha for the PTE items was .84 and the alpha for the TOE items was .81, which indicates that the items form a scale that has good internal consistency reliability.

Content Courses and Self-Efficacy

The next step was to determine if the courses were contributing any significant difference to the existing levels of PTE and/or TOE on the STEBI-B. Independent samples *t*-tests were conducted to explore the relationship between the number of courses taken on each subscale. The participating teachers were divided into two groups: teachers who had taken four or more courses, and teachers who had taken one to three courses. We selected these two groups because the average number of courses taken was between 3 and 4. In addition, most teachers that were not highly qualified needed at least four classes to meet that standard. Assumptions were checked and the assumption of equal variances was not met on the TOE comparison, thus the *t* score and degrees of freedom were adjusted accordingly (Morgan, Leech, Gloeckner, & Barrett, 2004). Table 2 shows the mean of teachers who had taken four or more courses (3.70) was significantly higher, t=-2.63, p=.01,

Table 2
Comparison of Teachers Taking High Number of Courses [N=41] with Teachers Taking Low Number of Courses [N=47] on PTE and TOE

Variable	M	SD	t	df	p
PTE Average					
High courses	4.12	.42	-.004	86	.99
Low courses	4.11	.49			
TOE Average					
High courses	3.70	.39	-2.63	78.82[a]	.01
Low courses	3.40	.65			

[a] The **t** and **df** were adjusted because variances were not equal.

on TOE than the mean score of teachers who had taken one to three courses (3.40). Using the neutral score of 3.0 and the overall TOE standard deviation of .56, the threshold for teachers showing high levels of efficacy was 3.56. This threshold was met by the teachers who had taken four or more courses, but not by the teachers who had taken one to three courses. The effect size, *d,* is approximately .54, which is medium for this area of study. There was no significant difference between the groups on PTE scores, t=-.004, p=.99.

Common Characteristics of High Efficacy Teachers

Since the results indicated that teachers who took a high number of courses had significantly higher levels of TOE, the second research question—What are some common characteristics of teachers who score high in efficacy?—was examined. The 88 participating teachers were grouped according to number of content courses taken and level of TOE. Only TOE was examined, since there were no significant differences in groups on the PTE scale. Table 3 describes the matrix design used to categorize the 88 teachers in order to examine the additional survey data from the selected groups of teachers. Again, using the neutral score of 3.00 and adding the standard deviation of .56, the threshold for high levels of efficacy was determined to be 3.56.

A chi-square statistic was used to corroborate the findings that a significant difference existed between the high number of courses group and the low number of courses group. Table 4 shows the Pearson chi-square results and indicates that the two groups are significantly different on level of TOE (x^2=4.61, df=1, N=88, p=.032). The teachers who had taken four or more courses were more likely than the teachers who had taken one to three courses to have high levels of TOE. Phi, which indicates the strength of the association between the two variables, is .229 which indicates a medium effect size.

Constant comparative analysis was used to code the qualitative data provided from the postcourse survey. This analysis process is described in detail below. Only 13 responses were available for the high efficacy/low courses group; thus, in order to have equal weight in the comparison, 13 responses were randomly selected from the available group of high efficacy/high courses teachers. A selection of the available data is presented in Table 5. This selection includes representative quotes from teachers with high efficacy.

Table 3
Matrix Design for Categorization of Teacher Participants

	Number of Content Courses Taken		
Teacher		High (4+)	Low (1-3)
Outcome Efficacy	High (>3.56)	29	24
Score	Avg/Low (<3.56)	11	24

When conducting constant comparative analysis on this set of data, the data from the two postcourse survey questions were initially shrunk into meaningful chunks that allowed each line to be examined independently and coded accordingly. Each line was given a new *in vivo* code except when a previous *in vivo* code worked with a particular line. Table 6 shows a selection of this process of shrinking the data and the coding process for the first question (I chose to enroll in this RMMSMSP course because…).

Table 4
Chi-square Analysis of Likelihood of High TOE Score

Variable	n	Low TOE	High TOE	x^2	p
Courses Taken				4.61	.032
1 – 3	48	24	24		
4 or more	40	11	29		
Totals	88	35	53		

Table 5
Qualitative Data from Two High Efficacy Groups

High Efficacy/High Courses Group:

Being an effective highly-trained teacher is important. I want to be able to provide strong effective math instruction to my fifth graders.

I wanted to strengthen my skills in calculus, have a clearer understanding of what I needed to prepare my middle schoolers for and possibly gain new instructional techniques from my peers and instructors.

High Efficacy/Low Courses Group:

I wanted to update my content knowledge of calculus

I wanted to further my knowledge in the area of Math...specifically Geometry

Table 6
Example of Constant Comparative Analysis Chunking and Coding

Original Text—Chunked	Coding for Each Chunk
The content sounded interesting.	Content interesting
I enjoy the higher learning I receive as an adult.	Intrinsic value of education
I wanted to strengthen my skills in calculus, have a clearer understanding of what I needed to	strengthen skills increase content knowledge
prepare my middle schoolers for	prepare students
and possibly gain new instructional techniques from	new instructional techniques

The codes for each question within each group were then grouped into broad categories that captured the essence of the codes. Next, the codes within each of these broad categories were broken into subcategories that helped to explain the data and prepare for a possible theme. Table 7 shows a portion of the axial coding used for one of the categories from the first question. The individual codes presented were first grouped into the category *professional needs*. This broad category was then broken into the two subcategories of *intrinsic motivation* and *extrinsic motivation*. A theme was then produced by using the categories and subcategories to represent the group responses.

High/High Theme —Motivation for Taking the Course. Regarding the reason for taking the courses, the high-efficacy, high-number-of-courses group produced the following theme: *professional and personal motivation*. Professionally, they were motivated both intrinsically and extrinsically. They were intrinsically motivated to become an effective, highly trained teacher with new skills, instructional techniques, and an increased content knowledge base. They were extrinsically motivated to complete an added endorsement or become highly qualified in either math or science and to become knowledgeable in the required state or district standards. These teachers were also personally motivated by the intrinsic value of education, their past positive experiences with coursework that met their needs, and by the monetary value of these credit hours. This broad theme is supported in the data by the following quotes: "Being an effective, highly-trained teacher is important. I want to be able to provide strong effective math instruction to my fifth graders," and "I enjoy the higher learning I receive as an adult."

High/Low Theme —Motivation for Taking the Course. The theme produced from the high-efficacy, low-number-of-courses group on why they took the courses was: *professional, internal needs*. These teachers wanted to take the courses in order to increase their content knowledge of the relevant material, to become better teachers by watching other teachers, to gain new insights into their own teaching, and to learn some new classroom activities. They were also slightly externally motivated to become highly qualified or certified in their desired subject area. They were only slightly personally motivated by the monetary value of the courses and by the positive

Table 7
Axial Coding Selection

- Professional Needs
  - Intrinsic Motivation
    - Effective, highly trained teacher
    - Effective math instructor
    - Increase content knowledge (4)
    - Strengthen skills
  - Extrinsic Motivation
    - Completing endorsement—math/science
    - Highly qualified status

feedback they had experienced regarding these courses. This theme is supported in the data by the following quotes: "I enrolled in this course because I wanted to expand my math background," and "I wanted to become highly qualified in mathematics."

High/High Theme: Valuable Aspects of Course. When asked to describe the most valuable aspects of the courses, the theme produced for the high-efficacy, high-number-of-courses group was: *appreciation for the enriching, student-centered aspects of the courses, along with the practical resources made available*. These teachers felt enriched by the increased content and conceptual understanding of the material through the use of lab exercises, peer interaction, differing approaches to problem solving, and the new curriculum strategies. They also appreciated the student-centered learning they gained through classroom activities and labs that would help them increase student understanding. The teachers described the methods employed by the instructors as well delivered, hands-on, and in situ. Finally, these teachers appreciated the technological, Internet, and curriculum resources provided. This theme is supported in the data by the following quotes:

> The instructors used the inquiry based/ hands on approach to teach us. It allowed for a more thorough understanding of the concepts taught.

> Learning the different ways to reach or confirm answers to the problems. I also realized to a larger extent the value of cooperative learning strategies and ways to implement the ideas into my classroom instruction.

High/Low Theme: Valuable Aspects of Course. The theme produced for the high-efficacy, low-number-of-courses group on the most valuable aspects of the courses was: *appreciation for the instructors, the activities, and the professional aspects*. These teachers felt that the instructors of the courses modeled good teaching methods and used activities, lectures, and strategies that encouraged alternative thinking. They appreciated the hands-on activities and the content-specific handouts they could use in the classroom, along with the CSAP tips, the graphing calculator instruction, and the tips on integrating their curriculum. They appreciated the chance to increase their content knowledge and to engage in peer interaction. This theme is supported in the data by the following quotes:

> The strategies the instructors used to force participants to think. This thinking was very much outside of the box.

> The engaging activities, experiments, demos, evaluations, and other materials that I can do in my classroom.

Discussion

Findings

This study was designed to explore the impact of content courses that also emphasize pedagogy on the self-efficacy levels of in-service teachers with lower levels of content knowledge in math or science. Previous studies have explored the impact of levels of efficacy on teacher effectiveness and have concluded that self-efficacy is a critical component of effective teaching and can increase student achievement (Tschannen-Moran etal; Gibson & Dembo, 1984). Other studies have explored ways of increasing preservice teachers' levels of efficacy (Swars, 2005; Palmer, 2006), but few studies exist on increasing levels of inservice teachers' efficacy.

This study explored the concept that inservice teachers' efficacy levels can be positively impacted by an increase in content-specific knowledge with a pedagogical emphasis. Ball, Hill, and Bass (2005) assert that a teacher's mathematical knowledge is central to how well the teacher can use curriculum materials, assess student progress, and judge how to present, emphasize, and sequence the material. The results of this study demonstrated that in-service teachers' outcome efficacy was higher in teachers who have taken four or more math or science content courses. Why would content courses increase a teacher's level of outcome efficacy and not affect personal efficacy? We believe the answer lies in the group of teachers examined in this study. These teachers were mostly experienced teachers (some with 15 or more years of experience), who lacked the content knowledge required for highly qualified status. It was not surprising that the level of personal efficacy exhibited by these teachers was high (mean of 4.10); however, they lacked the belief in their ability to reach all students due to their level of content knowledge. Increasing the level of content knowledge and demonstrating teaching methods appropriate for conveying this knowledge to a diverse group of students, contributed to an increase in the levels of outcome efficacy. In support of this conclusion, we asked participants to relate their classroom "success stories" after participation in the courses. We received over one hundred responses within two days and the following two quotes are representative of the typical response:

> My content knowledge has gone from that of an inexperienced and undereducated elementary school teacher to that of a confident science teacher ready to jump in to the middle school classroom. I feel confident in adapting my districts curriculum to better fit in with the principles of the learning cycle.
>
> As a result of the RM-MSMSP grant, I have been able to include a variety of hands-on, inquiry-based activities to supplement an otherwise uninteresting curriculum. In addition, I have gained additional content knowledge in areas of math and science, thus giving me more confidence to teach these subjects accurately from day to day.

The findings were also supported by the themes developed from the qualitative analysis of the teacher responses to the questions, "I chose to enroll in this RM-MSMSP course because…," and "The most valuable aspects of this course were…." The teachers in the high- efficacy, high-number-of-courses group were more likely to enroll in the courses due to intrinsic and personal motivations to become effective teachers who valued education. They valued the courses for the increased content and conceptual understanding of the material and the enriching, student-centered aspects. This contrasts to the high-efficacy, low-courses group who were more likely to enroll in these courses for the mostly professional reason of increasing content knowledge, but were also motivated to become highly qualified or certified in their area of study. This group valued the courses for the instructors and the practical tips for the classroom. While the differences may seem slight, they do indicate that the higher-number-of courses group tended to intrinsically value education and the conceptual understanding afforded to them from these courses. This seems to correspond to an increase in the belief of the teachers that they were now able to teach a diverse group of students effectively. These findings correlate with the research of Czernaik (1990), who found that highly efficacious teachers were more interested in learning about and using "reform based" teaching methods such as inquiry-based and student-centered approaches.

Limitations and Implications for Future Research

While the methodology and analysis of these data are solid, there were some limitations to the study in the area of data collection. The study could be strengthened by using a pretest/posttest design that would allow a more definitive interpretation of the preexisting levels of each teacher's self-efficacy. Personal interviews with randomly selected teachers from each of the four categories (high efficacy/high courses; high efficacy/low courses; average-low efficacy/high courses; and, average-low efficacy/low courses) would also help to clarify the differences between these groups.

Further research is warranted to help determine the extent of the malleability of self-efficacy for all teachers in all content areas. In addition, it will also be important to correlate this data with other project data collection efforts such as observations of reformed teaching practice and actual content knowledge as measured by teacher content inventories. Additional research into the area of how content knowledge can support teacher efficacy along with increasing the knowledge of students is also indicated. With these deficiencies noted, this study does make an important contribution to the field of self-efficacy research due to the implication that changes can be made to outcome efficacy in experienced teachers through professional development or content-based mathematics or science course work that draws out the teachers' intrinsic values and interests.

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Appendix

Math/Science Teaching Efficacy Belief Instrument

Please mark the appropriate answer to each statement. We realize that you may or may not teach math or science at this time. If you do not teach one of these subjects, please respond based on the subject area of the RM-MSMSP Summer Academy Course you completed. Your answers should be consistent for either math or science throughout the survey. Note: If you do not teach math or science AND you completed both a math and a science course in summer 2006, select either math or science and complete the survey accordingly.

1. I am responding to the following statements from the perspective of a _________ teacher.
___ Math ___Science

SA – Strongly Agree; A – Agree;' U – Uncertain; D – Disagree; SD – Strongly Disagree

2. When a student does better than usual in math/science, it is often because the teacher exerted a little extra effort.
___SA ___A ___U ___D ___SD

3. I am continually finding better ways to teach math/science.
___SA ___A ___U ___D ___SD

4. Even if I try very hard, I don't teach math/science as well as I do most subjects.
___SA ___A ___U ___D ___SD

5. When the math/science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.
___SA ___A ___U ___D ___SD

6. I know the steps necessary to teach math/science concepts effectively.
___SA ___A ___U ___D ___SD

7. I am not very effective in monitoring math/science experiments.
___SA ___A ___U ___D ___SD

8. If students are underachieving in math/science, it is most likely due to ineffective math/science teaching.
___SA ___A ___U ___D ___SD

9. I generally teach math/science ineffectively.
___SA ___A ___U ___D ___SD

10. The inadequacy of a student's math/science background can be overcome by good teaching.
___SA ___A ___U ___D ___SD

11. The low math/science achievement of some students cannot generally be blamed on their teachers.
___SA ___A ___U ___D ___SD

12. When a low achieving child progresses in math/science, it is usually due to extra attention given by the teacher.
___SA ___A ___U ___D ___SD

13. I understand math/science concepts well enough to be effective in teaching middle school math/science.
___SA ___A ___U ___D ___SD

14. Increased effort in math/science teaching produces little change in some students' math/science achievement.

___SA ___A ___U ___D ___SD

15. The teacher is generally responsible for the achievement of students in math/science.

___SA ___A ___U ___D ___SD

16. Students' achievement in math/science is directly related to their teacher's effectiveness in math/science teaching.

___SA ___A ___U ___D ___SD

17. If parents comment that their child is showing more interest in math/science at school, it is probably due to the performance of the child's teacher.

___SA ___A ___U ___D ___SD

18. I find it difficult to explain to students why math/science experiments work.

___SA ___A ___U ___D ___SD

19. I am typically able to answer students' math/science questions.

___SA ___A ___U ___D ___SD

20. I wonder if I have the necessary skills to teach math/science.

___SA ___A ___U ___D ___SD

21. Effectiveness in math/science teaching has little influence on the achievement of students with low motivation.

___SA ___A ___U ___D ___SD

22. Given a choice, I would not invite the principal to evaluate my math/science teaching.

___SA ___A ___U ___D ___SD

23. When a student has difficulty understanding a math/science concept, I am usually at a loss as to how to help the student understand it better.

___SA ___A ___U ___D ___SD

24. When teaching math/science, I usually welcome student questions.

___SA ___A ___U ___D ___SD

25. I don't know what to do to turn students on to math/science.

___SA ___A ___U ___D ___SD

26. Even teachers with good math/science teaching abilities cannot help some kids learn math/science.

___SA ___A ___U ___D ___SD

27. When an English language learner does better than expected in math/science, it is often because the teacher has had relevant training or skills, for example, in sheltered instruction and/or ESL techniques.

___SA ___A ___U ___D ___SD

28. I am comfortable working with English language learners in my math/science classes.

___SA ___A ___U ___D ___SD

29. Even if I try very hard, I will not be able to help my English language learners meet or exceed math/science standards.

___SA ___A ___U ___D ___SD