2016 NCTM RESEARCH CONFERENCE
April 11-13 • San Francisco

Paper Title: **Elementary Preservice Teachers' Self-Efficacy for Teaching Mathematics and Content Knowledge**

Author(s): Rebecca M Giles, Ph.D.
Kelly O. Byrd, M.Ed.
Angelia Bendolph, M.S

Session Type: **Brief Research Report**
Presentation Date: Tuesday, April 12, 2016
Presentation Location: San Francisco, California

Elementary Preservice Teachers' Self-Efficacy for Teaching Mathematics and Content Knowledge

Rebecca M. Giles, Ph.D., Professor
rgiles@southalabama.edu
University of South Alabama
College of Education, UCOM 3100
Department of Leadership and Teacher Education
Mobile, AL 36688-0002
Phone: (251) 380-2899
Fax (251) 380-2758

Kelly O. Byrd, M.Ed., Senior Instructor
kbyrd@southalabama.edu

Angelia Bendolph, M.S.
alb1104@jagmail.southalabama.edu

Paper presented at the National Council for Teaching Mathematics 2016 Research Conference

April 12, 2016

San Francisco, CA

Abstract

Research has consistently shown that teacher efficacy is related to a variety of desirable student outcomes, thus making teacher efficacy an important factor in high-quality mathematics instruction. The possible relation between preservice teachers' mathematics content knowledge and their self-efficacy for teaching mathematics is of particular importance to teacher educators. The purpose of this study was to investigate the relationship between elementary preservice teachers' mathematics content knowledge and their self-efficacy beliefs related to teaching mathematics. Participants (n=34) were seniors seeking K-6 teaching certification from a single university. Instruments included the *Praxis*® Elementary Education Multiple Subjects Mathematics Subtest and the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI). The MTEBI, developed by Enochs, Smith, and Huinker (2000), is 21-item survey with two subscales—Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE). This one-group posttest-only study found no statistical significance for relationship between PMTE or MTOE and mathematics content knowledge.

Elementary Preservice Teachers' Self-Efficacy for Teaching Mathematics and Content Knowledge

Beginning with No Child Left Behind (2002), teachers' subject area knowledge has become a progressively more important factor in teacher preparation. Not surprisingly, there has been a substantial increase in the number of published research articles on preservice teachers' mathematical content knowledge over the past few decades (Thanheiser, et al., 2014). Further, research indicating that teachers make the defining difference in the academic success of students (Center for Public Education, 2005) has resulted in attempts to link preservice teachers' knowledge of mathematics to student achievement in mathematics (Shirvani, 2015).

Research has consistently shown that teacher efficacy is related to a variety of desirable student outcomes (Tschannen-Moran & Hoy, 2001; Knoblauch & Hoy, 2008; Putman, 2012) and is considered a powerful influence on teachers' overall effectiveness with students (Pendergast, Garvis, & Keogh, 2011). Graham, Harris, Fink, and MacArthur (2001) assert that teachers' efficacy is "one of the few teacher characteristics that reliably predicts teacher practice and student outcomes" (p. 178). At the same time, research supports the idea that teacher efficacy can be developed among preservice teachers (Charalambous et al., 2008; Palmer, 2006).

Efficacy beliefs have long been associated with the work of psychologist Albert Bandura (1977), who defined efficacy as intellectual activity by which one develops one's beliefs about his or her ability to achieve a certain level of accomplishment. As a social cognitive theory, self-efficacy conceives a set of beliefs about teachers' capacity to have a positive influence on their students' learning (Henson, 2002). When applied to teaching, efficacy beliefs are considered along the two factors of personal self-efficacy, which is the perception that an individual has about his or her capacity to teach, and outcome expectancy, which is the perception of the

students' ability to learn from his or her teaching. Teachers with low efficacy regarding their ability to effectively teach mathematics and affect student learning are more likely to avoid teaching from an inquiry and student-centered approach than those with high mathematics teaching efficacy (Swars, Daane, & Giesen, 2006).

Teachers with high levels of content knowledge, attitudes toward mathematics, and self-efficacy are better able to produce higher student achievement (Evans, 2011). Teacher content knowledge is a necessary, but not sufficient, condition for good teaching (Ball, Hill, & Bass, 2005). The strong influence of both content knowledge and self-efficacy on pedagogical behavior has made these two topics of particular interest to educational researchers, leading to various investigations of these factors in regard to preservice teachers. Philipp et al. (2007) found that preservice teachers with field experience at the elementary level showed an increase in mathematical content knowledge and positive beliefs, while those who did not have field experience did not show this increase. In the area of science education, preservice teacher content knowledge was found to relate to personal teaching efficacy but not to outcome expectancy (Cantrell, Young, & Moore, 2003). Similarly, a positive moderate relationship was found between preservice teachers' mathematics content knowledge and personal teaching efficacy with no relationship between content knowledge and outcome expectancy (Newton, K. J., Leonard, J., Evans, B. R., & Eastburn, J. A., 2012). Swars et al. (2007), however, found no relationship between preservice teachers' mathematics content knowledge and either personal teaching efficacy or outcome expectancy. Taking into consideration the increasing demands on institutions of higher education to prepare teachers who can immediately contribute to the improved achievement of all students (Council for the Accreditation of Educator Preparation, 2015), along with the observations that teacher education programs contribute to acquisition of

content knowledge while also influencing the development of self-efficacy (Charalambous, Philippou, & Kyriakides, 2008; Palmer, 2006; Pendergast, Garvis, & Keogh, 2011), the possible relation between preservice teachers' mathematics content knowledge and their self-efficacy for teaching mathematics is of particular importance to teacher educators.

Research Question and Design

Given the limited and inconclusive findings of studies that examine the relationship between preservice teachers' content knowledge and teacher efficacy, further investigation is warranted. The purpose of this study was to investigate the relationship between elementary preservice teachers' mathematics content knowledge and mathematics teaching efficacy. A one-group posttest-only design was used to examine the dependent variable of mathematics content knowledge and two independent variables--personal mathematics teaching efficacy (PMTE) and mathematics teaching outcome expectancy (MTOE).

Data Collection and Analyses

The sample included 41 elementary (K-6) preservice teachers at a single, southeastern university. All participants were seeking a Class B teaching certificate in both Elementary Education and Collaborative Teaching (K-6). Participant demographics (female, seniors and predominantly Caucasian) were typical of this program. Instruments included the *Praxis*® Elementary Education Multiple Subjects Mathematics Subtest (Test Code 5033) and the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI). A passing score of 157 on the Mathematics Subtest is required before participants begin their student teaching semester. The MTEBI was disseminated to a convenience sample of preservice teachers enrolled in an elementary mathematics methods course during the last week of their semester immediately prior to student teaching. Due to missing data from seven individuals, only 34 responses were

analyzed for the study. A multiple regression analysis was conducted to determine if the MTEBI subscales predicted the participant's score on the *Praxis*® mathematics subtest. Assumptions of linearity and normality were checked and met. The responses for the Mathematics Teaching Outcome Expectancy (MTOE) subscale indicated that the teachers' expectation of student mathematics learning were divided (M = 3.6581, SD = .42) between 3-uncertainty and 4-agreement on the Likert-type scale. Additionally, the responses for the Personal Mathematics Teaching Efficacy (PMTE) subscale was similar to the results of the MTOE where the responses were divided (M = 3.94, SD =.39) between 3-uncertainty and 4-agreement on the Likert-type scale. The mean for the content knowledge score was 162.71. To assess internal reliability of MTEBI items, Cronbach's alpha was computed. Cronbach's alpha for the Mathematics Teaching Outcome Expectancy (MTOE) and Personal Mathematics Teaching Efficacy (PMTE) subscales were .679 and .765, respectively. The PMTE subscale met the .7 or higher recommended level (Johnson & Christensen, 2014) while the MTOE was near the recommended measurement level. The Pearson correlation was not statistically significant between the MTOE subscale and the *Praxis*® score, nor the PMTE subscale and the *Praxis*® score.

Discussion of Findings

There was no statistical significance found for the relationship between the MTOE subscale and *Praxis*® scores or the PMTE subscale and *Praxis*® scores. These findings are similar to those of Newton et al. (2012) who found a positive moderate relationship between content knowledge and personal teaching efficacy and no relationship between content knowledge and outcome expectancy. As suggested by Newton et al., elementary preservice teachers' prior experiences with learning mathematics content may become less important in

terms of efficacy judgments as they gain positive experiences with teaching mathematics. Evans (2011), working with 42 new inservice teachers completing an alternative certification program in New York, found that teaching experience can contribute to immediate growth in mathematics content knowledge. It would be interesting to follow preservice teachers into student teaching to examine whether and how their mathematics teaching efficacy changes as they gain procedural and conceptual knowledge of the mathematics taught in the elementary grades along with teaching experience.

Another possible explanation for the non-significant findings in the current study could be the small sample size. Since there were divided responses between uncertainty and agreement on the MTOE and the PMTE subscales of the MTEBI instrument, further study is recommended to include a larger number of participants.

Limitations that should be acknowledged in this study include the use of a convenience sample and a self-report data collection instrument. As a result of the fairly homogenous participants from a single university, the generalizability of the findings is limited. Additionally, the issue of response validity in survey research is inherent.

The growing number of career opportunities that require advanced mathematical understanding make it essential that every child is prepared for high school and college mathematics; thus, every elementary teacher must be both knowledgeable in mathematics and confident in his or her abilities to teach mathematics effectively. Teacher preparation programs must examine their general education mathematics requirements along with their mathematics methods courses and field experiences to identify opportunities to positively impact preservice teachers' content knowledge as well as their mathematics teaching efficacy.

References

Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide? *American Educator, 29*(1), 14–17, 20–22, and 43–46.

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

Cantrell, P., Young, S., & Moore, A. (2003). Factors affecting science teaching efficacy of preservice teachers. *Journal of Science Teacher Education*, *14*(3), 177–192.

Center for Public Education. (2005). *Teacher quality and student achievement: Research review.* Retrieved from http://www.centerforpubliceducation.org/Main-Menu/Staffingstudents/Teacher-quality-and-student-achievement-At-a-glance/Teacher-quality-and-student-achievement-Research-review.html

Charalambous, C. Y, Philippou, G N., & Kyriakides, L. (2008). Tracing the development of preservice teachers' efficacy beliefs in teaching mathematics during fieldwork. *Educational Studies in Mathematics, 67*(2), 125-142.

Council for the Accreditation of Educator Preparation. (2015). Standard 2: Clinical partnerships and practice. Retrieved from http://caepnet.org/standards/standard-2

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

Evans, B. R. (2011). Content Knowledge, Attitudes, and Self-Efficacy in the Mathematics New York City Teaching Fellows (NYCTF) Program. *School Science & Mathematics, 111*(5), 225-235.

Graham, S., Harris, K. R., Fink, B., & MacArthur, C. A. (2001). Teacher efficacy in writing: A construct validation with primary grade teachers. *Scientific Studies of Reading, 5*, 177-203.

Henson, R. (2002). From adolescent angst to adulthood: Substantive implications and measurement dilemmas in the development of teacher efficacy research. *Educational Psychology, 37*(3), 137-150.

Johnson, R. B., & Christensen, L. (2014). *Educational research: Quantitative, qualitative, and mixed approaches.* Thousand Oaks, CA: SAGE Publications.

Knoblauch, D. H., & Hoy, A. W. (2008). "Maybe I can teach those kids." The influence of contextual factors on student teachers' efficacy beliefs. *Teaching and Teacher Education, 24*(1), 166-179.

Newton, K. J., Leonard, J., Evans, B. R., & Eastburn, J. A. (2012). Preservice elementary teachers' mathematics content knowledge and teacher efficacy. *School Science & Mathematics, 112*(5), 289-299. doi:10.1111/j.1949-8594.2012.00145.x

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).

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

Pendergast, D., Garvis, S., & Keogh, J. (2011). Pre-service student-teacher self-efficacy beliefs: An insight into the making of teachers. *Australian Journal of Teacher Education, 36*(12), 46-57.

Philipp, R. A., Ambrose, R., Lamb, L., Sowder, J. T., Shappelle, B. P., Sowder, L., E., et al.

(2007). Effects of early field experiences on the mathematical content knowledge and beliefs of prospective elementary school teachers: An experimental study. *Journal for Research in Mathematics Education, 38*, 438–476.

Putman, S. M. (2012). Investigating teacher efficacy: Comparing preservice and inservice teachers with different levels of experience. *Action in Teacher Education, 34*(1), 26-40.

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

Swars, S., Hart, L. C., Smith, S. Z., Smith, M. E., & Tolar, T. (2007). A longitudinal study of elementary pre-service teachers' mathematics beliefs and content knowledge. *School Science and Mathematics, 107*(8), 325–335.

Thanheiser, E., Browning, C., Edson, A. J., Jane-Jane, L., Whitacre, I., Olanoff, D., & Morton, C. (2014). Prospective elementary mathematics **t**eacher content **k**nowledge: What do we know, what do we not know, and where do we go? *The Mathematics Enthusiast,* 11(2), 433-448.

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17*(1), 783-805.

Shirvani, H. (2015). Pre-service elementary teachers' mathematics **c**ontent knowledge: A predictor of sixth graders' mathematics performance. *International Journal of Instruction, 8*(1), 133-142.