Teacher Training in Urban Settings: Inquiry, Efficacy, and Culturally Diverse Field Placements

Sheryl L. McGlamery, Bridget A. Franks, and Saundra L. Shillingstad

Abstract

This study describes two years of findings with a unique field experience (teaching science inquiry activities to African-American girls in a summer STEM camp) for preservice elementary education majors. It reports on the effects of the field experience, in conjunction with blocked science and mathematics methods courses, on preservice teachers' scores on the Science Teaching Efficacy Belief Instrument (STEBI-B), as well as their rankings of their course experiences with regard to science self-efficacy.

Introduction

What is culturally responsive teaching? Geneva Gay (2012) defined it as using cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively. To do so requires a number of commitments, including developing a cultural knowledge base, demonstrating caring and building learning communities, communicating with students from diverse ethnic and cultural groups, and responding to ethnic diversity in the delivery of instruction (p. 106). For U. S. preservice teachers, most of whom are young, white, and from middle class families (Barnes, 2006), acquiring these skills can be a challenge, especially if they have little or no experience with children from cultural backgrounds different from their own. On the way to becoming culturally responsive teachers, they need two basic experiences to start with: one is simple exposure and interaction time with students of different ethnic groups and/or cultures, and the other is successfully teaching content knowledge and/or skills to those students.

The challenge of culturally responsive teaching is even greater when preservice teachers are dealing with a content area in which they often feel they have little expertise, such as science. Elementary school experiences serve as children's introduction to science and science exploration, so it is vital that they experience positive science-learning outcomes. Such outcomes are unlikely, however, if teachers hold negative attitudes about science or lack confidence in their ability to teach it.

In offering students the kinds of experiences that will help them to become more culturally responsive, the benefits of a community partnership in teacher training can hardly be overemphasized. Urban community settings, whether in schools or elsewhere, offer vital points of contact between preservice teachers and the culturally diverse students they will be teaching. They also allow preservice teachers experience with a key feature of culturally responsive teaching, that of selecting participation structures that reflect *students'* ways of knowing and doing, rather than their own. As Elizabeth Kozleski (2010) recommends, teachers should put themselves in situations where they are not dominant or are a noticeable minority, to recognize how this feels and to "sit with the discomfort" (p. 6). In working with groups of mostly Black students, our mostly White preservice teachers had the opportunity to experience such a situation, and to consider how it affected their self-efficacy for teaching science.

This study explored the effects of a unique field experience (teaching science lessons in a summer STEM camp for predominantly African-American girls) in conjunction with blocked science and mathematics methods courses, on the scores of preservice elementary teachers on the Science Teaching Efficacy Belief Instrument (STEBI-B). It also explored the preservice teachers' rankings of their course experiences with regard to science self-efficacy. Data collected during two years of the summer camp program are reported here.

During each of the two summers, the preservice teachers participated in a field experience with EUREKA-STEM!, a summer camp designed to promote STEM education. The camp is held yearly on the campus of a mid-size urban university, and is offered in cooperation with *Omaha Girls, Inc.*, a community support program for girls. Most of the girls who participated in the program were from single-parent families with annual incomes below $30,000. Most were African American, but African (Somali), Latina, and Asian girls also participated.

Perceptions of Science and Efficacy for Science Teaching

Preservice elementary teachers historically have negative perceptions regarding science education and science learning, as well as reduced understanding of scientific principles (Buss 2010). Research suggests they often have had negative experiences while learning science, and as a result may express a low level of interest in it, or undervalue its relevance to their lives (Bleicher & Lindgren, 2005; Watters & Ginns, 1995). This reduced level of scientific engagement can result in a lack of efficacy about presenting science lessons (Bergman & Morphew, 2015).

Compared to other elementary content, such as language arts, preservice elementary teachers exhibit lower efficacy ratings for science and mathematics, possibly due to their lack of knowledge. They often feel uncomfortable and sometimes unable to teach these subjects effectively (Buss, 2010). The combination of previous negative learning experiences and lack of knowledge can lead to negative emotions, attitudes, beliefs, and values, all of which may affect teachers' ability to learn, and later to teach mathematics and science (Cassel & Vincent, 2011; Yürük, 2011). The important task of creating positive science-learning outcomes for children that will serve as the foundation for science performance in later grades cannot be accomplished if elementary teachers hold negative attitudes toward science education.

Outcome expectancy refers to the belief that effective teaching affects students' learning positively, whereas self-efficacy refers to the belief in one's *own* ability to teach effectively (Bandura, 1993). Both are necessary if preservice teachers are to view science teaching with confidence. Bleicher (2006) explored both elements in a science teaching methods course based on nurturing conceptual understanding and confidence; following the course, preservice teachers demonstrated significant increases in personal self-efficacy and outcome expectancy, as well as in understanding of basic earth science concepts. Bergman and Morphew (2015) found that a single semester science content course designed specifically for elementary preservice teachers, that emphasized not only content but also strategies for promoting inquiry-based learning, resulted in significant increases in participants' self-efficacy and in their outcome expectancy for teaching science.

The relationship between teacher efficacy and successful teaching outcomes has been widely studied. Teachers with higher self-efficacy have high expectations for their students, set more ambitious goals for them, and effect greater growth (Allinder, 1995). They also spend more class time on academic activities and focus less on discipline than do teachers with lower self-efficacy (Tschannen-Moran & Hoy, 2007). In contrast, teachers with negative attitudes toward science are most likely to use avoidance tactics when teaching science content; thus, they spend less time teaching science-related topics and are less able to stimulate a positive attitude towards science in their students (Jarvis and Pell, 2004; Osborne, Simon, and Collins, 2003). This leads to decreased outcome expectancies for their students' understanding of material (Leonard, Barnes-Johnson, Dantley, & Kimber, 2011).

Field Experiences and Science Efficacy

Requiring a field experience in a science methods class is a common practice. Preservice teachers learn recommended science teaching methods, and receive direct feedback about their own effectiveness in real classroom situations. Cannon and Scharmann (1996) observed higher teaching efficacy among elementary preservice teachers who had experiences in field placement classrooms than among those who did not, and a review of studies on the challenges faced by new science teachers (Davis, Petish, & Smithey, 2006) concluded that field experiences not only contributed to understanding science instruction and teaching efficacy, but also helped preservice teachers learn to anticipate their students' ideas.

Swars and Dooley (2010) observed increased self-efficacy after the opportunity to work directly with children and teach them science activities, and further observed that preservice teachers attributed their work with the children to the increase in their self-efficacy beliefs. This is particularly relevant to the present study because the field experience in Swars and Dooley's (2010) study involved working with children who were predominantly ethnic minorities (65% Hispanic, 20% African American, 8% Asian, 4% multiracial, 3% White) and nonnative English speakers. Efforts to address achievement gaps in science among ethnic minority students, particularly girls, have been a focus of interest among science education researchers for some time (Buxton 2006; Carlone, Johnson, & Scott, 2015; Fraser-Abder, Atwater, and Lee, 2006); the field placement in the present study was designed specifically for ethnic minority girls.

In helping preservice teachers prepare to teach science effectively at the elementary level, particularly in urban environments with students from diverse backgrounds, three kinds of support appear to be crucial. Support for science content knowledge, training in inquiry methods, and experience with real students all are needed to produce effective elementary science teachers who can engage students, particularly those from groups underrepresented in the sciences, in meaningful science activities. This study reports the effects of a science methods class that included all three kinds of support on preservice teachers' science self-efficacy.

Research Questions

The university students who participated in this study were engaged in learning highly interactive, inquiry-based science teaching methods. Since practicing teachers with high self-efficacy are more likely to use such methods, we wanted to see if learning and practicing them, even in a 4-week summer class, would result in improved science self-efficacy. Another reason for exploring self-efficacy in this context was that the practicum experience for the class took place in a summer camp designed specifically to empower girls and interest them in STEM careers. We thought it likely that the experience of providing at-risk girls with an encouraging atmosphere for doing science would have a positive impact on the preservice teachers' confidence as well.

A variety of issues related to inquiry-based pedagogy (some reported elsewhere) were explored with these students. This article focuses on our exploration of their expressed self-efficacy after taking a science methods class with a unique field placement setting. Self-efficacy was measured with the two subscales of the Science Teaching Efficacy Belief Instrument (STEBI-B), Science Teaching Outcome Expectancy and Personal Science Teaching Efficacy Belief (Enochs & Riggs 1990), as well as by student rankings of class experiences. As such, our research questions were as follows:

1. How does the science methods class affect Science Teaching Outcome Expectancy scores for preservice teachers?
2. How does the science methods class affect Personal Science Teaching Efficacy Belief

scores for preservice teachers?
3. How do preservice teachers rank their experiences in the science methods class with regard to their science self-efficacy?

Although it is possible that teaching science concepts to actual students for the first time could affect self-efficacy negatively in some students, our prediction was that the combination of training in inquiry-based science education with a unique field experience designed to be positive and supportive for at-risk girls would result in increases on both subscales of the STEBI-B for elementary education majors. We made no specific predictions about how our participants would rank their experiences in the science methods class.

Setting

The Summer School Experience

For both years of the study, the preservice teachers were all registered in TED 4340/4330, blocked science and mathematics methods courses taken during a summer term. The courses taken were required for all elementary majors to complete, and no effort was made to recruit or allow for self-selection into the summer block. All the elementary education majors who enrolled in the course block were due to student teach within two semesters of completing the TED 4340/4330 block.

The Field Experience

For the preservice teachers enrolled in TED 4340, the EUREKA-STEM! Camp served as their required field experience. The four-week summer camp experience is designed to introduce at-risk female students to STEM education in a positive college setting. Topics for the camp included robotics (working with CEENBoTs), an introduction to programming and coding, financial literacy, physics, biology, chemistry, engineering and mathematics. University faculty, staff, and graduate students planned and executed the summer program, which also included physical education and swimming. Science classes were part of the program, and each preservice elementary teacher was required to teach a series of four science lessons to a small group of girls. Although these students were in middle school, their science content knowledge was estimated to be 2-3 years below their grade levels, as reported by our community partners. Thus, the science content taught ranged from 6^{th} to 8^{th} grade level.

The preservice elementary teachers were divided into teams of three. Each team was required to teach 4 class sessions of 90 minutes each. The 90 minute classes were divided into 3- 30 minute segments. Each team was assigned a thematic science topic and given four to six science lessons to adapt and teach to their small (2-3 students) group of middle school girls. Each team set up their science lessons in a center format. The groups of middle school girls rotated through the science centers, spending 30 minutes at each assigned center. The teams of preservice teachers were instructed to adapt the lessons to three 30-minute sessions, and to expect to teach the lesson of the day three times, with each preservice teacher taking a turn at leading the lesson. The four teaching sessions lasted 90 minutes each. The teacher candidates also turned in a written science lesson plan and science journal reflections after teaching each 90-minute session.

Other Class Assignments and Activities Used to Address Efficacy

The preservice teachers were immersed in a science methods course designed to teach inquiry as a pedagogy to assist students in learning science. The components of the course and assignments are described below. While inquiry pedagogy is not the focus of this article, it is necessary for the reader to recognize that in order to be successful at teaching science, preservice elementary teachers must understand inquiry and its application to science teaching. Therefore, we were interested in which parts of the course influenced the preservice teachers most with regard to their science teaching efficacy.

The class assignments used to address efficacy were the same for both years, and included:

1. What is Inquiry? (pre-assessment). An open-ended question was posed and pre-service elementary teachers wrote about their understandings of inquiry-based science instruction.

2. Science Biography (self report). Pre-service elementary teachers reported on the courses they completed in high school and college science and mathematics, and described the type of learning experiences they had in these courses.

*3. Faculty presentations***.** Faculty gave presentations on inquiry-based teaching methods and engaged the preservice teachers in discussion questions about inquiry-based instruction in science.

4. Participation in Inquiry Labs (six labs total). Each week for the four weeks of the course, the preservice elementary teachers performed inquiry-based labs in class. Following the field experience, the in-class labs resumed.

5. Inquiry Reflection Paper. After reading several articles on teaching science using inquiry, preservice teachers wrote a paper indicating their understanding of inquiry-based instruction. The paper was completed during the third week of class.

6. Field-based teaching of inquiry-based labs (structured level) in a college setting. The pre-service teachers taught inquiry based science labs to middle school students for two weeks, with a total of four lessons taught per pre-service teacher.

7. Preservice elementary teachers constructed inquiry-based labs given only researchable questions (guided level). After the field experience and during the last week of the course, preservice elementary teachers were given questions about science and asked to design an inquiry-based lab experiment for elementary age children to complete. They were expected to select the researchable question, phrase the question, identify the variables, and write the procedure for the experiment. Subsequently, they performed the experiment, gathered data, graphed their data, and reported their findings and conclusions.

Method

Participants

Participants in Year One were 27 undergraduate elementary education majors (2 males, 25 female) who were enrolled in blocked science and mathematics methods courses taken during a summer term. Participants were all Caucasian students at a medium-sized urban university in the Midwest. Participants in Year Two were 20 undergraduate elementary education majors (1 male, 19 female) who were enrolled in the same methods courses during a summer term at the same University; there were 19 Caucasian students and one Hispanic female student. As described earlier, the field component of the courses involved working with primarily African-American female middle-school students who were enrolled in a summer STEM camp held on a university campus.

In Year One, the camp participants were 60 girls ages 11-14; 4 were African (Somali), 3 were Latina, 1 was Asian, and the remainder were African American. In Year Two, the camp participants were again 60 girls ages 11-14; 5 were African (Somali), 3 were Latina, 1 was Asian, 1 was Caucasian, and the remainder were African American.

Instruments

The preservice version of the Science Teaching Efficacy Belief Instrument (STEBI-B), (Enochs & Riggs, 1990) was used in both years to assess students' self-efficacy regarding science teaching. This widely used instrument measures two subscales, Personal Science Teaching Efficacy Belief (13 items) and Science Teaching Outcome Expectancy (10 items). A re-examination of the instrument's reliability and validity (Bleicher, 2004) established that the two subscales were homogenous, with factor loadings comparable to those reported by Enochs and Riggs (1990), and concluded that the basic integrity of the STOE and PSTEB scales were upheld, supporting the continued use of the instrument. Participants rate their beliefs on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each subscale contains both forward-phrased ("I will continually find better ways to teach science") and reverse-phrased ("I will not be very effective in monitoring science experiments") items. In a more informal measure, during the fourth week of class, the participants were asked to rank each of the seven components of the course (listed above) in terms of its influence on their self-efficacy in teaching science. The three most highly ranked activities were then reported.

Procedure

In both years, the STEBI-B was administered to all the students on the first day of class, before any content was covered and after introductions were completed. Students then participated in the field experience and other efficacy-related course assignments, as described above. At the end of the 4-week session, the posttest administration of STEBI-B occurred on the last day of class, following the class session but before the last exam.

Since all elementary education majors are required to take this methods class, random assignment to this class or to some other methods class was not possible; therefore, a quasi-experimental, within-groups design was used to compare self-efficacy scores between pretest and posttest scores in each of two separate years.

Results

We first calculated the internal reliability of the STEBI-B instrument as a whole for our sample, using the pretest scores. The Cronbach's alpha for the measure was .80, indicating a good level of instrument reliability. Paired samples *t* tests were then used to evaluate differences between pretest and posttest scores for the two subscales of the STEBI-B, Science Teaching Outcome Expectancy (STOE) and Personal Science Teaching Efficacy Belief (PSTEB).

Table 1 illustrates the results observed for the two subscales in Year One. On the STOE subscale, the difference between pretest and posttest scores was significant, $t\ (26) = 2.12$, $p = .04$. On the PSTEB subscale, the difference between pretest and posttest scores was also significant, $t\ (26) = 3.18$, $p = .004$. Using an Eta^2 formula for a paired samples *t* test, a large effect size of .15 was obtained for the STOE subscale and an even larger effect size of .28 was obtained for the PSTEB subscale (Cohen 1988).

Table 1

Paired samples t-tests with pretest and posttest scores on Science Teaching Outcome Expectancy and Personal Science Teaching Efficacy Belief subscales of the STEBI-B, Year One.

Subscale	N	Mean, SD Pre	Mean, SD Post	*t*(26)	*p*	Effect size*
STOE	27	36.48 (3.30)	37.85 (3.46)	2.12	.04	.15
PSTEB	27	47.93 (6.60)	51.33 (4.58)	3.18	.004	.28

STOE scores out of 50 possible; PSTEB scores out of 65 possible
*Eta^2 values: .01 = small effect, .06 = moderate effect, .14 = large effect (Cohen, 1988)

Table 2 illustrates the results observed for the two subscales in Year Two. On the STOE subscale, the difference between pretest and posttest scores was again significant, *t* (19) = 3.16, p = .005. On the PSTEB subscale, the difference between pretest and posttest scores was also significant, *t* (19) = 3.90, p = .001. Using an Eta^2 formula for a paired samples *t* test, a large effect size of .35 was obtained for the STOE subscale and an even larger effect size of .44 was obtained for the PSTEB subscale (Cohen 1988).

Table 2

Paired samples t-tests with pretest and posttest scores on Science Teaching Outcome Expectancy and Personal Science Teaching Efficacy Belief subscales of the STEBI-B, Year Two.

Subscale	N	Mean, SD Pre	Mean, SD Post	*t*(19)	*p*	Effect size*
STOE	20	34.90 (3.79)	38.15 (4.42)	3.16	.005	.35
PSTEB	20	43.70 (5.22)	48.65 (5.61)	3.90	.001	.44

STOE scores out of 50 possible; PSTEB scores out of 65 possible
*Eta^2 values: .01 = small effect, .06 = moderate effect, .14 = large effect (Cohen 1988)

In addition to the administration of the STEB-B, the preservice elementary teachers were asked to rank the course components, based on the influence each component had on their efficacy about teaching science. In Year One, the field experience was ranked highest, with 98.2% of the preservice teachers indicating it was the most useful aspect of the course in influencing their self-efficacy. The second most influential component of the course was the opportunity to do inquiry labs in class, with 94.7% of the preservice teachers ranking these labs as the second most influential component. The third most influential component of the course was the opportunity to design inquiry labs when given a science question to explore; 90.4% of the preservice teachers ranked it third overall.

In Year Two, results were very similar to Year One. The field experience was again ranked highest, with 97.9% of the preservice teachers indicating it was the most useful aspect of the course in influencing their self-efficacy. The second most influential course component was again the opportunity to do inquiry labs in class, with 96.2% of the preservice teachers ranking these labs as the second most influential component. The third most influential component of the course was again the opportunity to design inquiry labs when given a science question to explore; 89.9% of the preservice teachers ranked it third overall.

Discussion

As our results illustrate, field experiences and other aspects of professional development do not have to be lengthy to have an impact on preservice teachers' self-efficacy. Even after a four-week summer course that involved only 360 total minutes of student contact, the teacher candidates in both years of our study showed marked improvement in both outcome expectancies and personal self-efficacy regarding science education. Thus, our prediction about the positive effects of the course on students' self-efficacy was supported. Such effects have been observed with even briefer professional development opportunities for practicing teachers (Nadelson, Callahan, Pyke, Hay, Dance, & Pfiester, 2013), but the participants in our study had less training and far less experience with children than practicing teachers do. What components of the summer experience are most likely to be responsible for such strong gains in self-efficacy? The students' own rankings provide the best answers to this question.

For both years, the field experience was ranked as the most useful experience for the preservice elementary teachers with regard to self-efficacy. Teaching science to at-risk middle school girls provided an opportunity for the preservice teachers to face and work through their fears and concerns about teaching science. Working with students from a variety of different cultures and ethnic backgrounds may have offered these Caucasian teacher candidates some challenges to their beliefs about teaching science to diverse groups. But the opportunity to experience authentic science teaching using inquiry methods, with the training and support to do so successfully, clearly helped them to overcome their doubts, not only about their personal self-efficacy, but also about their beliefs that the effective teaching of science can influence student learning. Swars and Dooley (2010) reported similar results with preservice teachers who taught science to ethnic minority and nonnative English speaking children. The preservice teachers in their study demonstrated increased personal science teaching self-efficacy following the opportunity to work directly with children on science activities, and they attributed their work with the children to the increase in their self-efficacy beliefs.

By our participants' rankings in both years, the second most useful component of the course with regard to efficacy was the opportunity to perform inquiry-based science labs. Preservice teachers were given multiple labs to complete and analyzed the results. They first completed the labs as an elementary school student would experience them, and then reflected on the content and pedagogy used when completing the lab. Thus, they had the opportunity not only to practice inquiry themselves, but also to review content they will need to teach science in the elementary context.

The third most useful aspect of the course (chosen by the preservice teachers in both years) was the opportunity to design inquiry labs for elementary age students to complete. After the field experience, preservice elementary teachers were given questions about science and asked to design an inquiry-based lab experiment for elementary age children to complete. They were required to select the researchable question, phrase the question, identify the variables, and write the procedure for the experiment. Subsequently, they performed the experiment, gathered data, graphed their data, and reported their findings and conclusions. In completing this last phase of the course, the preservice teachers, who had already used inquiry based science labs to teach children science, were further challenged to explore inquiry from the design perspective. The act of designing their own inquiry lab also proved to the preservice teachers that they were indeed capable of teaching science to children, and they also understood at a higher level the nature and purpose of science inquiry.

Most science methods classes include field experiences in regular classrooms. Our results suggest that this is not the only environment possible for building the confidence of elementary education majors about their ability to teach science. A field experience that provides exposure to students who are very different in ethnicity and culture from teacher candidates, combined with strong support for learning science content and designing inquiry-based activities, can also result in improved self-efficacy.

Limitations of the Study

One possible limitation of this study is that the preservice teachers presented their lessons to the science camp participants in small groups (two to three children) as opposed to the larger groups found in typical classrooms. It is possible that this almost one-to-level of interaction was less difficult and gave them more confidence than would have been the case in a regular classroom setting. Our future research will address this issue by comparing the results we found here with those of students who take the same Methods class during a regular school semester, in a culturally diverse school setting. Another issue that could be addressed in future research is the long-term impact of field experiences; do the increases in self-efficacy reported by the preservice teachers remain with them as they move into more advanced Methods classes and student teaching? This would be difficult to assess, given that the preservice teachers continue to have training experiences that could contribute to their self-efficacy, but it is nevertheless an interesting question. Future research will also need to address the actual gains in science content knowledge experienced by the preservice teachers. Their experiences in designing Inquiry Labs, for example, may have impacted not only their confidence but their actual understanding of scientific concepts.

This research reports only effects on preservice teachers, not on the students with whom they worked. This is because the science camp experiences involved multiple activities with a variety of adults besides the preservice teachers. The science lessons provided to them were only one part of a fulltime, four-week program. Thus, effects on the EUREKA campers could not be attributed only to the experiences designed and presented by the preservice teachers.

Conclusion

It is common for preservice elementary teachers to exhibit lower efficacy ratings for science and mathematics than for other elementary content (Buss, 2010). Finding ways to improve preservice teachers' attitudes and confidence early in their training is crucial to providing an appropriate introduction to science exploration for elementary students. This is especially true for elementary students from minority groups underrepresented in science, and for those at risk for achievement gaps due to poverty. As noted earlier, two basic experiences are needed for education majors to begin the process of becoming more culturally responsive: interacting with students of different ethnic groups and/or cultures, and successfully teaching content knowledge and/or skills to those students. The program described here provided both, and illustrates some benefits of unique non-school community partnerships in helping teachers in training to develop into culturally responsive teachers.

References

Allinder, R. M. (1994). The Relationship between efficacy and the instructional practices of special education teachers and consultants. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children 17* (2), 86-95. doi:10.1177/088840649401700203.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning." *Educational Psychologist 28* (2), 117-148. doi:10.2107/s1532698ep2802_3.

Barnes, C. J. (2006). Preparing preservice teachers to teach in a culturally responsive way. *The Negro Educational Review 57* (1-2), 85-100. Retrieved from Education Research Complete Database.

Bergman, D. J., & Morphew, J. (2015). Effects of a science content course on elementary preservice teachers' self-efficacy of teaching science. *Journal of College Science Teaching 44* (3), 73. doi:10.2505/4/jcst15_044_03_73.

Bleicher, R. E. (2004). Revisiting the STEBI-B: Measuring self-efficacy in preservice elementary teachers. *School Science and Mathematics 104* (8), 383-391. doi:10.1111/j.1949-8594.2004.tb18004.x.

Bleicher, R. E. (2006). Nurturing confidence in preservice elementary science teachers. *Journal of Science Teacher Education 17* (2), 165-187. doi:10.1007/s10972-006-9016-5.

Bleicher, R. E., & Lindgren, J. (2005). Success in science learning and preservice science teaching self-efficacy. *Journal of Science Teacher Education 16* (3), 205-225. doi:10.1007/s10972-005-4861-1.

Buss, R. R. (2010). Efficacy for teaching elementary science and mathematics compared to other content. *School Science and Mathematics 110* (6), 290-297. doi:10.1111/j.1949-8594.2010.00037.x.

Buxton, C. A. (2006). Creating contextually authentic science in a “low-performing” urban elementary school. *Journal of Research in Science Teaching 43* (7), 695-721. doi:10.1002/tea.20105.

Cannon, J. R., & Scharmann, L. C. (1996). Influence of a cooperative early field experience on preservice elementary teachers' science self-efficacy. *Science Education 80* (4), 419-436. doi:10.1002/(SICI)1098-237X(199607)80:4%3C419::AID-SCE3%3E3.0.CO;2-G.

Carlone, H. B., Johnson, A., & Scott, C. M. (2015). Agency amidst formidable structures: How girls perform gender in science class. *Journal of Research in Science Teaching 52* (4), 474-488. doi:10.1002/tea.21224.

Cassel, D., and Vincent, D. (2011). Metaphors reveal preservice elementary teachers' views of Mathematics and Science Teaching. *School Science and Mathematics 111* (7), 319-324. doi:10.1111/j.1949-8594.2011.00094.x.

Cohen, J. 1988. *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Eribaum.

Davis, Elizabeth A., Debra Petish, & Julie Smithey. 2006. Challenges new science teachers face. *Review of Educational Research 76* (4), 607-651.

Enochs, L. G., & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale. *School Science and Mathematics 90* (8), 694-706. doi:10.1111/j.1949-8594.1990.tb12048.x.

Fraser, A., Pamela, M. A., & Okhee L. (2006). Research in urban science education: An essential journey. *Journal of Research in Science Teaching 43* (7), 599-606. doi:10.1002/tea.20156.

Gay, G. (2002). Preparing for culturally responsive teaching. *Journal of Teacher Education 53* (2), 106-116. doi:10.1177/0022487102053002003.

Jarvis, T., & Pell, A. (2004). Primary teachers' changing attitudes and cognition during a two-year science in-service programme and their effect on pupils. *International Journal of Science Education 26* (14), 1787-1811. doi:/10.1177/0022487102053002003.

Kozleski, E. B. (2010). Culturally responsive teaching matters! Tempe, AZ: The Equity Alliance at Arizona State University. Retrieved from ERIC Database. (ED 520 957).

Leonard, J., Barnes-Johnson, J., Dantley, S. J., & Kimber, C. (2011). Teaching science inquiry in urban contexts: The role of elementary preservice teachers' beliefs. *The Urban Review 43* (1), 124-150. doi:/10.1007/s11256-010-0173-7.

Nadelson, L. S., Callahan, J., Pyke, P., Hay, A., Dance, M., & Pfiester J. (2013). Teacher STEM perception and preparation: Inquiry-based STEM professional development for elementary teachers. *The Journal of Educational Research 106* (2), 157-168. doi:10.1080/00220671.2012.667014.

Osborne, J., Simon, S., & Collins S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education 25* (9), 1049-1079. doi:/10.1080/0950069032000032199.

Swars, S. L., & Dooley, C. M. (2010). Changes in teaching efficacy during a professional development school-based science methods course. *School Science and Mathematics 110* (4), 193-202. doi:10.1111/j.1949-8594.2010.00022.x.

Tschannen-Moran, M., & Hoy, A. W. (2007). The differential antecedents of self-efficacy beliefs of novice and experienced teachers. *Teaching and Teacher Education 23* (6), 944-956. doi:10.1016/j.tate.2006.05.003.

Watters, J. J., & Ginns, I. S. (1995). Origins of, and changes in preservice teachers' science teaching self-efficacy. San Francisco, CA: National Association for Research in Science Teaching. Retrieved from ERIC Database (ED 383 570).

Yürük, N. (2011). The predictors of pre-service elementary teachers' anxiety about teaching science. *Journal of Baltic Science Education* 10 (1), 17-26. Retrieved from Education Research Complete.

Author Information

Sheryl L. McGlamery is a professor of science education and co-director of the Office of STEM Education in the Department of Teacher Education, College of Education at University of Nebraska at Omaha. She holds a PhD from Florida State University in Science Education and has research background in teacher development and the enhancement of STEM learning.

Bridget A. Franks received her PhD in Educational Psychology from the University of Nebraska – Lincoln. Formerly on the faculty of University of Florida, she is currently an assistant professor in the Teacher Education Department at the University of Nebraska at Omaha, where she teaches courses in human development and research methods.

Saundra L. Shillingstad is a professor of teacher education in the College of Education at the University of Nebraska at Omaha. She holds an EdD from Kansas State University in Educational Administration and Leadership.

Sheryl L. McGlamery
Professor of Science Education
Department of Teacher Education
College of Education
406 Roskens Hall
University of Nebraska at Omaha
6005 University Drive North
Omaha, NE 68182-0163
E-mail: smcglamery@unomaha.edu
Telephone: 402-554-3525
Fax: 402-554-3881

Bridget A. Franks
Assistant Professor of Educational Psychology
Department of Teacher Education
College of Education
406 Roskens Hall
University of Nebraska at Omaha
6005 University Drive North
Omaha, NE 68182-0163
Email: bafranks@unomaha.edu
Telephone: 402-554-2763
Fax: 402-554-3881

Saundra L. Shillingstad
Professor of Teacher Education
Department of Teacher Education
College of Education
406 Roskens Hall
University of Nebraska at Omaha
6005 University Drive North
Omaha, NE 68182-0163
Email: sshillingstad@unomaha.edu
Telephone: 402-554-2807
Fax: 402-554-3881