Journal of Elementary Science Education, Vol. 21, No. 2 (Spring 2009), pp. 35-48.

The Effects of Outdoor Science Lessons with Elementary School Students on Preservice Teachers' Self-Efficacy

Sarah J. Carrier, North Carolina State University

Abstract

Teachers' self-efficacy develops based on their appraisal of their experience with a task or similar tasks. Elementary science education should provide opportunities for students to experience science learning opportunities in authentic settings. This retrospective study describes one example of preservice teachers teaching elementary school students environmental science lessons in the outdoors during their science methods course. The preservice teachers' recognition of the students' enthusiasm and excitement of learning science in the outdoors positively impacted their confidence level as future teachers of science and helped them recognize the potential for using the outdoor setting as an effective location for science instruction.

Science education in elementary schools should expand beyond the four walls of the classroom. Many opportunities abound in the outdoor setting for learning about science. Environmental sciences include topics such as nutrient cycles, ecological awareness, and the water cycle, allowing students to personally experience many learning opportunities in the outdoor setting. Studies have found that teachers do not think they have the knowledge or abilities to teach environmental sciences because they lack the training (Smith-Sebasto & Smith, 1997), and many teachers also feel ineffective teaching in the outdoors (Ferry, 1995; Simmons, 1998). Yet, teaching concepts in the setting studied, such as the outdoors, holds tremendous value for providing authentic learning experiences for students (Cronin-Jones, 2000; Hammerman, Hammerman, & Hammerman, 1985; Schmidt, 1996). The backgrounds of elementary preservice teachers are not traditionally focused on science, and while environmental education's inclusion in elementary school curricula is intended to provide useful information and awareness to students, its quality depends on teachers' knowledge and attitudes toward teaching environmental education (Moseley, Reinke, & Bookout, 2002).

Many elementary school teachers feel less qualified to teach science than other subject areas (Abell & Roth, 1991; Bursal & Paznokas, 2006; Weiss, 1997), and elementary teacher education programs are responsible for preparing future teachers to effectively teach all subject areas in an elementary education program, including science. In addition to having a need for science content knowledge, teachers need to feel that they have the ability to translate the content to their students. *Self-efficacy* is an individual's belief in her or his capabilities to produce given attainments (Bandura, 1997). Teachers' self-efficacy develops based on their appraisal of their experience with a task or with similar experiences (Ross &

Bruce, 2007); therefore, in order to build their self-efficacy in teaching science, it is important for preservice teachers to have experiences in which they feel successful teaching students during their science methods courses.

A science teacher educator in an elementary teacher education program may face the challenges of first convincing the preservice teachers the value of science as well as providing them with strategies for effectively presenting science content and inquiry opportunities with their future students (Stamp & O'Brien, 2005). Bandura (1997) suggests that efficacy can be influenced early in a teacher's career, leading researchers to explore preservice teacher efficacy (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Other researchers (Chun & Oliver, 2000; Wingfield & Ramsey, 1999) have found that self-efficacy can improve through experience. For instance, providing preservice teachers with positive outdoor teaching experiences can impact their feelings of effectiveness in teaching students in the outdoors. Lakin (2006) described a survey of teacher trainees which asked if they would be willing to conduct outdoor lessons with students. In their initial response, 82% said they would not be willing to take students to an outdoor river due to risk factors. After the teacher trainees explored the macro-invertebrate populations at the river themselves, their intentions changed to 75% in favor.

Bandura's (1997) work on self-efficacy indicates the link between teachers' Pedagogical Content Knowledge (PCK), their content knowledge in science, and their feelings of high or low efficacy in teaching science. PCK is the connection between knowledge of subject matter and pedagogy that is unique to teachers (Shulman, 1987). PCK is essential knowledge for teachers of science, and research has indicated that classroom practice plays a significant role in its development (Lee, Brown, Luft, & Roehrig, 2007). Preservice teachers lack experience teaching students and, because elementary school teachers feel less qualified to teach science than other subjects, science teacher educators should strive to develop preservice teachers' content knowledge and PCK to help build their self-efficacy. I will describe one effort for preparing preservice teachers with science content and strategies for teaching their students effective science lessons in the outdoor setting.

Context of Study

In the summer of 2006, I taught science and mathematics methods courses for preservice elementary teachers at a mid-sized land grant university in the southeastern United States. Students were enrolled in this course during their junior year of their teacher education program, and these courses provided their first actual teaching field experience. They had observed in classrooms but had not had experiences teaching students prior to this semester. The state guidelines required the students to have experiences working with and teaching children. During the summer, all traditional elementary school programs in the area consisted of short school days filled with lessons and drills that included only remedial reading and remedial mathematics experiences; therefore, it was a challenge to provide opportunities for my preservice teachers to work with children doing science. I contacted the local Forest Ecology Preserve's director and educational director, and we were able to coordinate a partnership. After creative shuffling of schedules and negotiating for permission from my department, I was able to place my preservice teachers for a portion of their student field experiences with elementary school students who attended the local Forest Ecology Preserve's summer day camp programs.

The Forest Ecology Preserve summer day camp program is located approximately five miles from the university and is a community outreach program of the School of Forestry and Wildlife Sciences. It has 110 acres of wooded trails and a pond as well as an outdoor classroom to host field trip opportunities for local school programs.

In addition to the two-week outdoor field experience, each preservice teacher also completed two separate two-week field experiences in traditional indoor classrooms as part of the summer methods course. These summer school classes consisted of remedial reading and mathematics small group instruction experiences, so their only opportunity for teaching science with students was at the camp. I spent the first week of our university classes training the preservice teachers in Project WILD and Project WILD Aquatic environmental and interdisciplinary curricula. These nationally known programs were selected because they focus as much on effective teaching methods as on the content included in activities (Irvin, 2007).

Outdoor Experiences

The preservice teachers were told that they would spend the first week at the camp observing the camp counselors as they conducted lessons and assisted in the summer day camp program. During the second week, they would work with a partner and conduct lessons in the outdoors with the students. Each pair of preservice teachers chose from one of the Project WILD or Project WILD Aquatic lessons that were preselected by the camp's educational director and me so that they could plan and practice for their team teaching. Each set of two preservice teachers shared equally in all aspects of the planning and teaching experience. The activities consisted of lessons on topics such as life cycles, needs of living things, sensory awareness, and camouflage. Many required the students to use the science process skills of observation and classification as well as making inferences and interpreting data. The opportunities for introducing the students to science inquiry developed from the open-ended design of the lessons. The potential to extend the activities based on students' questions and ideas helped the preservice teachers to make connections between the science methods course's discussions and readings on inquiry to their field work with the students. The outdoor setting lent itself to students' curiosity and wonder.

Many of the preservice teachers expressed hesitation about the upcoming field experience. They said they were uncomfortable about the outdoor setting as a location for learning since most had no experience with learning outside of a traditional classroom, and they were also unsure about their abilities to teach science to elementary school students. Yet, despite these concerns and much to the surprise of many of the preservice teachers, working with students at the Forest Ecology Preserve became the favorite of their field experiences during that semester.

I have spent ten years conducting research in schoolyard ecology, training inservice teachers in teaching science in the classroom and the outdoors, and providing preservice teachers with strategies for helping elementary school students discover the wonder of learning science in the outdoors. Outdoor science lessons are conducted either during field trips or summer camps, or they can be conducted more consistently using the schoolyard as the outdoor setting. Throughout my years of experience, I have seen preservice teachers become more comfortable with science, but the excitement of the preservice teachers that

summer seemed significant. I decided to conduct a retrospective study of their experiences. I collected written comments about the outdoor field experience from the students' final reflection papers they wrote at the end of the semester. In addition, I conducted follow-up interviews seven months later to examine how their attitudes, impressions, and intentions for including outdoor opportunities with their future students had maintained or changed over time.

Method

My research aim was to document the preservice teachers' attitudes regarding science and their developing self-efficacy as teachers of science, including outdoor science, based on their field experiences at the Forest Ecology Preserve. My intent was to document the preservice teachers' personal experiences to illustrate the effectiveness of including environmental science in more teacher education programs (Buethe & Smallwood, 1987). Another goal was to investigate strategies to improve preservice teachers' perceptions that they can effectively teach science, including environmental science education lessons, in the outdoors (Moseley et al., 2002).

Fourteen of the 23 preservice teachers enrolled in the science methods course agreed to be included in the study and to participate in the interviews conducted seven months after the completion of the course during their internship semester. The written reflections and interview data were triangulated with field notes from observations of the lessons they conducted with students in the outdoors. The field notes consisted of written narrative descriptions of observations I made during the preservice teachers' outdoor lessons. I included observation notes about the preservice teachers' content knowledge, effective presentation of science content (i.e., PCK), their interactions with students, and lesson presentation strategies such as whether the lesson started with an analysis of existing knowledge and ended with a review of the material.

My research questions were as follows:

How do outdoor field experiences teaching science lessons to elementary school-age students impact preservice teachers in . . .

- their feelings of efficacy in teaching science?
- their recognition of the potential for using the outdoor setting to teach science?
- their intent to include outdoor science lessons with their future students?

I did not use a single methodological framework for my data collection. I compiled and categorized preservice teachers' comments from the end-of-the-semester written reflections along with field notes from my observations. I also compiled responses to interviews (see the interview questions in Appendix 1) that I conducted seven months after the field experience to generate concepts from the data for coding by organizing the data into meaningful categories (Coffey & Atkinson, 1996). In order to classify the preservice teachers' comments, I color coded their statements to help me organize common themes.

The overriding themes that emerged from the preservice teachers' end-of-the-semester reflection papers and from the interviews conducted seven months later emphasized the similarities in the preservice teachers' reactions to the outdoor Forest Ecology Preserve experience. I started with the preservice teachers' end-of-the-semester reflection papers. I read through each of the papers multiple times

and found commonalities in their written comments. I color coded the shared impressions of the field experience at the Forest Ecology Preserve and classified the comments into categories. I also used color coding to organize preservice teachers' responses during the interviews that were transcribed and matched them with the categories from the reflection papers. The field notes were also color coded to match my observations of the preservice teachers' lesson presentation with the common themes found in the reflection papers and interview responses.

Since self-efficacy in teaching is related to experiences, each of the themes that correlated with positive feelings of success in preservice teachers' teaching efforts was matched to the first research question, "How do outdoor field experiences teaching science lessons to elementary school-age students impact preservice teachers in their feelings of efficacy in teaching science?" The themes that matched this first research question were (1) the preservice teachers' pedagogical transformations seeing their roles transition from students in a teacher education program to seeing themselves as effective teachers and (2) the realization of the value of teachers learning along with their students.

Each theme that addressed using the outdoors as a learning environment was matched to the second research question, "How do outdoor field experiences teaching science lessons to elementary school-age students impact preservice teachers in their recognition of the potential for using the outdoor setting to teach science?" The themes that matched the second research question were (1) the science learning opportunities in the outdoors and (2) the students' enthusiasm as they participated in the outdoor lessons.

The third research question asked the preservice teachers, "How do outdoor field experiences teaching science lessons to elementary school-age students impact preservice teachers in their intent to include outdoor science lessons with their future students?" I collected written statements from the end-of-the-semester reflection papers that signified their intent to conduct outdoor lessons with their future students. This question was also addressed directly during the interview seven months later. At this time, I asked preservice teachers if they had conducted activities with students during their internship and to predict on a scale of one to ten how likely they would be to conduct outdoor science lessons with their future students. Their responses are included in the "Results" section.

Results

Research Question #1

The first research question asked how the outdoor field experiences impacted preservice teachers' feelings of efficacy in teaching science. Preservice teachers' pedagogical transformations provide a contributing step toward gains in self-efficacy. During the initial week at the Forest Ecology Preserve, the preservice teachers displayed insecurities about the potential for student learning in the outdoor setting and about their confidence in their abilities to teach science students. Field notes listed frequent observations of preservice teachers grouped together. Most were initially hesitant about participating in the instruction activities with students, which was documented in the field notes describing how the Forest Ecology Preserve counselors needed to encourage the preservice teachers to interact with students, coaxing them to participate in the activities. By the second week, the preservice teachers were much more self-directed as they interacted with students and guided lessons. The field notes included statements

such as (pseudonyms are used), "Susan and Kyle approached two campers and directed them to the animal tracks. Assuming teacher roles rather than helper roles noted last week." Six preservice teachers wrote in their reflection papers that they initially expected the outdoor experience to be bad, and nine expressed surprise that it ended up as the best experience of any of the three field experiences.

One preservice teacher pictured herself as a teacher because of students' receptiveness to her teaching and wrote,

> I was able to establish a relationship with the students as a teacher figure, and I could tell that they respected me. The students were eager to learn and truly wanted to be there. They were excited to learn and they were excited to learn from me.

One preservice teacher wrote, "I learned that teachers need to be well-rounded in many instances. . . . I'm no longer afraid to teach science." These feelings persisted for an initially hesitant preservice teacher who explained in the interview seven months later,

> I must admit that I was very intimidated by the idea of being at the Forestry Preserve. I couldn't have been more wrong about my predictions about the Preserve. I loved every minute of it.

The theme of preservice teachers' recognition of the value of their own learning along with the students also addresses the first research question that explored the impact of the Forest Ecology Preserve experience on their self-efficacy for teaching science. Many highlighted their learning along with the students as a valuable part of the experience and a part of learning to be a good teacher, helping build confidence about their abilities as teachers. They expressed this through written statements from the reflection papers such as, "I found myself learning along with the students and growing as a scientist myself," and

> My most memorable lab experience was working at the Forestry Preserve. I found myself learning along with the kids. Working at the Forestry Preserve was another huge milestone in my career as a future teacher.

During the follow-up interview, one preservice teacher described her impressions, stating that

> I was very nervous. I fully expected that we would have to lead hikes and talk about different trees and I had no knowledge about anything more than like the basic what's a maple tree. I thought I was going to have to teach kids who would know more than me, and I would just look stupid. I realized it's not just knowing what's out there but how things work, how things interact. That shock on their face . . . them learning. And light bulbs went off. So that was fun.

Of the 14 preservice teachers who participated in the study, 12 either wrote descriptions of students' enthusiasm in their reflection papers or talked about it during their interviews. It was clear from the written reflections, interview responses, and field notes that witnessing the students' enthusiasm and excitement helped the preservice teachers experience success, which improved their feelings of effectiveness as teachers.

Research Question #2

The second research question examined the impact of the field experience on the preservice teachers' recognition of the potential for using the outdoor setting to teach science. The themes regarding the science learning opportunities in the outdoors and their observation of student enthusiasm applied to this research question. Their recognition of the science learning opportunities in the outdoors was expressed in their reflection papers in various ways such as "Being out there in the outdoors you can actually show them what you're talking about" and "Being outside is also visual, there's auditory, you can hear, you can see. So I really realized that being outside is a way to reach all the kids."

Another example of the persistence of the impressions came from an interview with a preservice teacher who commented that

> At first I was apprehensive to go to the Forestry Preserve because I did not think that it would be a good experience because it is not an "in classroom" experience. I felt that the Forestry Preserve would just be a waste of time, and I could not have been more mistaken. I came away from the Forestry Preserve with a feeling that there are teachable events that occur outside of the classroom.

The second theme regarding the potential for teaching science in the outdoor setting came from descriptions of the students' excitement and learning about science as a best memory. One of the most powerful comments was from a preservice teacher in the study who exclaimed during the interview that "It was thrilling for me to see young kids excited about nature and yearning to learn more. . . . Now I'm not afraid to teach science."

Field observations of the lessons they conducted with the students clearly showed a shared enthusiasm that seemed to initiate with the students and then spread to the preservice teachers. As they guided students in activities and recognized the students' excitement about the activities, the preservice teachers' enthusiasm grew. Excerpts from my field notes help illustrate that "Teachers grouped together, not interacting with students. Two students approached [the] preservice group with [a] katydid they found. Teachers engaged with students' excitement. Teachers spread apart and start working more closely with students. Smiles abound." Their experiences at the Forest Ecology Preserve allowed them to witness students' learning and recognize that they were learning too in the outdoor setting, both of which helped them see the outdoors as a setting for conducting effective science lessons. Further accounts of observations from field notes describe preservice teachers' learning:

> Ornithologist guest speaker gave brief lecture and students excited to see and touch birds before he released them. Karen [a pseudonym] brought her group of students to me with a huge smile. She had reviewed his visit with her students and wanted them to tell me what they'd learned from the ornithologist. She excitedly told me that she never knew about birds before today. [She] [t]old me how happy she was to share the learning experience with the students.

Research Question #3

The third research question dealt with the preservice teachers' intent to use outdoor activities in their future classrooms. The end-of-the-semester reflection papers were open ended and preservice teachers were not asked to describe their future intentions, although six of the 14 reflection papers included statements about their intention to conduct outdoor lessons. One preservice teacher wrote the following:

> As I learn these new teaching strategies, I am eager to implement them in my future classroom. . . . I also feel more confident in teaching science. In the past, it was not my favorite subject, and I honestly did not feel comfortable teaching some of the concepts. Now, after having this course, I feel that my knowledge of the science content area is stronger than ever, and I feel encouraged to increase my scientific knowledge and scientific literacy.

As I observed the preservice teachers presenting their lessons, I tried to stay in the background, but there were three notations in my field notes of an individual or team approaching me with excited statements such as, "The kids love this stuff. They really get it. I can't wait to do this in my classroom."

During the interviews that were conducted seven months later, preservice teachers were asked to rate on a scale of one to ten how likely they felt they would include outdoor science lessons in their future classrooms, with one being least likely and ten being most likely. All preservice teachers expressed some intent to use outdoor activities, giving their intention a rating of six or higher. Ten of the 14 ranked their intention a nine or ten. Four of the 14 preservice teachers said that they had conducted outdoor lessons during their subsequent internship experiences, and three said that they had asked their supervising teachers but were not given permission to conduct outdoor science lessons. These intentions that were expressed seven months after the initial experience indicate a persistence of self-efficacy (Moseley et al., 2002) for a period of at least seven months.

Discussion

The preservice teachers' enthusiasm about the students' excitement for the outdoor lessons and learning about science were apparent during the field observations and were common themes in both the written end-of-the-semester reflection papers and during the interviews conducted seven months after the completion of the course. These data illustrate the potential for science methods courses to include opportunities for preservice teachers to have positive experiences teaching science to elementary school students. These experiences provide the preservice teachers with not only positive models for effective teaching strategies, but the impact of their being able to affect student learning potential and see the students excited about science is a valuable part of a positive science teacher education experience.

In this study, the preservice teachers' increased comfort in teaching science as a result of their field experiences emphasizes the power of modeling and the positive impact of their observing students' excitement about learning science. During the methods course, I modeled strategies for presenting lessons to elementary students prior to their field placements. During their field placement at the Forest Ecology Preserve, the preservice teachers first observed the lead teachers model science

lessons with elementary students that engaged the students and allowed them to explore, interact with the materials, and communicate their observations and conclusions. They then conducted Project WILD lessons with the students, having both models to build upon in the planning of their activities.

This study, augmented by previous studies (Gabriel, 1996; Simmons, 1998; Tschannen-Moran et al., 1998), emphasizes the need for preservice teachers to be exposed to authentic settings for science instruction during their science methods courses. In order to gain experience and receive feedback, teachers need to have opportunities during their teacher education programs to instruct and interact with children in similar settings to which they will be teaching. In this study, the transition of the preservice teachers' attitudes about conducting science lessons in the outdoors seemed to be a result of the portion of the science methods course that included working with students in the outdoor setting. The preservice teachers saw their efforts as contributing to students' enthusiasm about learning science. "Self-efficacy is situational" (Ross & Bruce, 2007, p. 50), and, after the preservice teachers in this study experienced feelings of success conducting outdoor science activities with students, they were able to establish a base upon which to build confidence in their abilities to facilitate positive outdoor science activities with their future students. These positively perceived teaching experiences can help improve preservice teachers' self-efficacy in teaching science, and the outdoor setting is conducive to sparking students' excitement.

The findings from this study support the positive impact science education courses can have on preservice teachers' self-efficacy when the courses include factors such as use of the inquiry approach (Jarrett, 1999; Posnanski, 2002), practice teaching (Cannon & Scharmann, 1996; Kelly, 2000), and a classroom environment that includes fun and success (Watters & Ginns, 2000). The outdoor field experience in this study provided these for the preservice teachers. While the term *inquiry* is a key component of the *National Science Education Standards* (National Research Council [NRC], 1996), there is not a consensus in literature on what constitutes inquiry. During this course, preservice teachers learned about using the 5E learning cycle strategies to orchestrate opportunities for student inquiry. In addition, our class discussions addressed the notion that hands-on activities are not enough to ensure inquiry (Butts, Hofman, & Anderson, 1994). While this was a brief exposure to inquiry for these preservice teachers, it is a goal that their introduction to the concept of inquiry and their increased self-efficacy in teaching science will encourage them to further explore both creating opportunities for student inquiry and using the outdoors as an authentic setting for student learning.

Elementary school teachers are usually generalists, and most do not have special preparation in science but yet are expected to conduct science inquiry in the classroom (Atkinson & McDuffie, 2002). By modeling engaging, inquiry-oriented science activities for preservice teachers, science teacher educators can encourage them to strive to provide science inquiry opportunities with their future students. It can be especially effective when preservice teachers work with students in the outdoor setting as an authentic location for enticing students' excitement. Witnessing the students' eagerness for learning science in the outdoors during their science methods course can provide preservice teachers with positive reinforcement for using the outdoors to conduct science lessons when they become teachers.

The descriptions of preservice teachers' field experiences in this study can impact science teacher educators, helping them to be able to design effective experiences for preservice science teacher education programs as well as

professional development opportunities for inservice teachers. While the inclusion of the Forest Ecology Preserve setting proved valuable to these preservice teachers, other outdoor locations can be used just as effectively. The critical experience for the preservice teachers included the modeling of effective science lessons and witnessing students' excitement about learning science. The lessons can either be conducted in summer programs or during the traditional school year. The students' enthusiasm as they participated in science lessons conducted by preservice teachers best communicated the potential for effective outdoor science lesson strategies to the preservice teachers.

Future Research

Future research should include longitudinal studies that begin with preservice teachers' experiences in science methods courses, soliciting their expressed intentions of including outdoor lessons that then follow them into the classroom to document their actual practices with their students. Many times, teachers learn a teaching strategy and have full intentions of introducing it into their classroom, but they neglect to implement it due to either time constraints or any of the many other distractions of school life. This is especially prevalent for brand-new teachers who often spend their first year trying to manage the day-to-day requirements they face. Research has shown that, regardless of the influences of a science methods course, even when the class was instrumental for the preservice teacher at the time, the positive intentions for using the strategies do not spread to the inservice teacher's classroom (Ginns & Watters, 1998; Tilgner, 1990; Weiss, 1997). Professional development and support as part of the longitudinal study could encourage teachers to follow through and include outdoor lessons in their elementary science program. Other research should involve preservice teacher placements in a traditional classroom that also incorporates outdoor schoolyard science activities with the students. The schoolyard can be a readily available and effective outdoor classroom (Carrier-Martin, 2003; Cronin-Jones, 2000).

Implications

Science teacher education for elementary teachers presents many challenges for science teacher educators. An initial goal is to help preservice teachers recognize science as a crucial component of students' elementary education. Outdoor lessons help illustrate the ubiquity of science and the relationships of science to students' lives for both the preservice teachers and their students. There are numerous outdoor connections with topics spanning the physical, life, and Earth sciences.

Convincing preservice teachers that they can effectively teach science is another goal. The outdoor field experiences described in this study can contribute to meeting these goals. The methods immersion provided this study's preservice teachers with useful teaching strategies that formed connections between the methods course and authentic teaching. The preservice teachers' experiences with students excited about learning science empowered their feelings that they could effectively teach science to elementary students.

Various locations are available for outdoor science education. Summer day camp programs can be utilized to provide preservice teachers with field experiences when schools are not in session. Outdoor lessons can be conducted in the schoolyard and are a consistently available resource when schools have limited science budgets. The authentic setting can be right outside the classroom

door, providing teachers and students with opportunities for outdoor learning on a regular basis. Teacher education programs that strive to provide preservice teachers with positive experiences working with students can create opportunities to build their self-efficacy in teaching science. The results from this study can contribute to efforts to enhance teacher education programs by offering one example of an outdoor program that positively impacted preservice teachers' attitudes and impressions in regards to science education.

References

Abell, S., & Roth, M. (1991). *Coping with constraints of teaching elementary science: A case study of a science enthusiast student teacher*. Paper presented at the National Association for Research in Science Teaching, Lake Geneva, WI. (ERIC Document Reproduction Service No. ED340607)

Atkinson, A., & McDuffie, A. (2002, January). The elementary science teacher as researcher. In *Proceedings of the Annual International Conference of the Association for the Education of Teachers in Science*. Charlotte, NC.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Buethe, C., & Smallwood, J. (1987). Teachers' environmental literacy: Check and recheck, 1975 and 1985. *The Journal of Environmental Education, 18*(3), 39-42.

Bursal, M., & Paznokas, L. (2006). Mathematics anxiety and preservice elementary teachers' confidence to teach mathematics and science. *School, Science, and Mathematics, 106*(4), 173-180.

Butts, D., Hofman, H., & Anderson, M. (1994). Is direct experience enough: A study of young children's views of sounds. *Journal of Elementary Science Education, 6*(1), 1-16.

Cannon, J., & Scharmann, L. (1996). Influence of a cooperative early field experience on preservice elementary teachers' science self efficacy. *Science Education, 80*, 419-436.

Carrier-Martin, S. (2003). The influence of outdoor schoolyard experiences on students' environmental knowledge, attitudes, behaviors, and comfort levels. *Journal of Elementary Science Education*, *15*(2), 51-63.

Chun, S., & Oliver, J. (2000, January). *A quantitative examination of teacher self efficacy and knowledge of the nature of science*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Akron, OH.

Coffey, A., & Atkinson, P. (1996). *Making sense of qualitative data*. Thousand Oaks, CA: Sage Publications.

Cronin-Jones, L. (2000). The effectiveness of schoolyards as sites for elementary science instruction. *School Science and Mathematics*, *100*(4), 203-212.

Ferry, B. (1995). Enhancing environmental experiences through effective partnerships among teacher educators, field study centers, and schools. *Journal of Experiential Education, 18*, 133-137.

Gabriel, N. (1996). *Teach our teachers well: Strategies to integrate environmental education into teacher education programs.* Boston: Second Nature. (ERIC/SMEAC Document Reproduction Service No. ED401104)

Ginns, I., & Watters, J. (1998). *Beginning teachers' professional growth: Confronting the challenge of teaching elementary school science*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Hammerman, D., Hammerman, W., & Hammerman, E. (1985). *Teaching in the outdoors.* Danville, IL: Interstate Printers & Publishers.

Irvin, T. (2007). Nature lessons. *Educational Leadership*, *64*(8), 54-56.

Jarrett, O. (1999). Science interest and confidence among preservice elementary teachers. *Journal of Elementary Science Education, 11*(1), 49-59.
Kelly, J. (2000). Rethinking the elementary science methods course: A case for content, pedagogy, and informal science education. *International Journal of Science Education, 22*, 755-777.
Lakin, L. (2006). Science beyond the classroom. *Journal of Biological Education*, *40*(2), 89-90.
Lee, E., Brown, M., Luft, J., & Roehrig, G. (2007). Assessing beginning science teachers' PCK: Pilot year results. *School, Science, and Mathematics, 107*(2), 52-60.
Moseley, C., Reinke, K., & Bookout, V. (2002). The effect of teaching outdoor environmental education on preservice teachers' attitudes toward self-efficacy and outcome expectancy. *The Journal of Environmental Education, 34*(1), 9-15.
National Research Council (NRC). (1996). *National science education standards* (*NSES*). Washington, DC: National Academy Press.
Posnanski, T. (2002). Professional development programs for elementary science teachers: An analysis of teacher self-efficacy beliefs and a professional development model. *Journal of Science Teacher Education, 13*, 189-220.
Ross, J., & Bruce, C. (2007). Professional development effects on teacher efficacy: Results of a randomized field trial. *The Journal of Educational Research, 101*(1), 50-60.
Schmidt, K. (1996). Green education under fire. *Science, 274*, 1828-1830.
Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*, 1-27.
Simmons, D. (1998). Using natural settings for environmental education: Perceived benefits and barriers. *The Journal of Environmental Education, 29*, 31-33.
Smith-Sebasto, N., & Smith, T. (1997). Environmental education in Illinois and Wisconsin: A tale of two states. *The Journal of Environmental Education*, *29*, 23-31.
Stamp, N., & O'Brien, T. (2005). GK-12 partnership: A model to advance change in science education. *Bioscience, 55*(1), 70-77.
Tilgner, E. (1990). Avoiding science in the elementary school. *Science Education, 74*(4), 421-431.
Tschannen-Moran, M., Woolfolk Hoy, A., & Hoy, W. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research, 68*, 202-248.
Watters, J., & Ginns, I. (2000). Developing motivation to teach elementary science: Effect of collaborative and authentic learning practices in preservice education. *Journal of Science Teacher Education, 11*, 301-321.
Weiss, I. R. (1997). The status of science and mathematics teaching in the United States: Comparing teacher views and classroom practice to national standards. *National Institute for Science Education Brief*, *1*(3). Retrieved March 31, 2009, from www.wcer.wisc.edu/archive/NISE/Publications/Briefs/Vol_1_No_3.
Wingfield, M., & Ramsey, J. (1999, January). *Improving science teaching self-efficacy of elementary preservice teachers*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Austin, TX.

Appendix 1: Interview Questions

1. What is your best personal memory during the Forest Ecology Preserve experience?

2. What was your best memory having to do with students during the Forest Ecology Preserve experience?

3. What was your least favorite personal memory during the Forest Ecology Preserve experience?

4. What was your least favorite memory having to do with students during the Forest Ecology Preserve experience?

5. How did you feel about the prospect of conducting lessons in the outdoors prior to the summer field experience?

6. Did your impression of outdoor lessons change after the summer experience? If so, how?

7. What did you feel was the most effective teaching method you learned at the Ecology Preserve?

8. What is your impression of how the students reacted to the outdoor activities?

9. What was the most valuable science content material you learned during the Forest Ecology Preserve experience?

10. Since you've now had seven months to reflect on the Forest Ecology Preserve experience, how does it compare to the more traditional lab experiences you've had with children?

11. Have you, or do you plan to, conduct outdoor lessons during your current internship?

12. How likely (on a scale of 1 to 10, with 1 being least likely and 10 being most likely) are you to incorporate outdoor lessons into your own future classroom?

13. Are student behaviors more of a challenge in the outdoors?

14. How prepared do you feel to teach science in your own classroom?

15. Does that change in regards to outdoor science?

16. Do you have any other comments you'd like to add regarding the inclusion of the outdoor experience in the science methods course?

Correspondence regarding this article should be directed to

Dr. Sarah J. Carrier
North Carolina State University
317J Poe Hall
Box 7801
Raleigh, NC 27695
(919) 513-2808
Fax: (919) 513-0919
sarah_carrier@ncsu.edu

Manuscript accepted May 28, 2008.