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ABSTRACT

This paper describes an existing early field experience program and discusses strategies implemented by the instructor working within the constraints of the program design. The workshop approach presented provides a structure for implementation of teaching strategies learned by preservice teachers during their methods course, and serves as a springboard for dialogue on pedagogical issues and theories. Student feedback on their experience over the semester with the workshop approach is included to illustrate the kinds of cognitive and affective outcomes achieved. (KHR)

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**A Workshop Approach: Instructional Strategies for Working within the
Constraints of Field Experiences in Elementary Science**

**Paper presented at the annual meeting of the
Association for the Education of Teachers of Science
St. Louis, Missouri
February, 2003**

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Introduction

Situated cognition, as described by Brown, Collins, and Duguid (1989) challenges the practice of separating what is learned from how it is learned and used. Learning and cognition, rather, are viewed as fundamentally situated, and developed, within social and physical contexts. If we think of knowledge as analogous to a set of tools (Perkins, 1986), it is quite possible for preservice teachers to acquire tools, such as knowledge of methods and strategies for teaching science, yet to be unable to use them. Settlage (2000) explored such relationships between teachers' instructional intentions and the actualization of strategies. Those who actively use tools, rather than just acquiring them, are able to build more robust understandings of the contexts in which the tools are used, and about the tools themselves.

Learning how to use a tool, for example a teaching strategy, involves far more than can be captured by any explicit set of guidelines or steps. Implementation consists of reacting to conditions and situations that arise within the context of teaching-- including the environment and the students themselves. As such, methods classes alone cannot sufficiently prepare preservice teachers for the challenges of teaching science at the elementary level. Field-based teaching experiences are critical as a context for authentic practice. Field experiences that optimize pre-service teachers' opportunities to experience success implementing methods taught in science methods courses are necessary to bridge the gap between knowing and doing, theory and practice.

However, the extent to which field experiences provide authentic practice and opportunity to implement learned strategies is mediated by a number of constraints which prevent these experiences from closely approximating that of a classroom teacher- most

notably, the length of time and frequency which preservice teachers have contact with elementary students. Several studies (e.g. Wilson, 1996) have examined innovative designs for elementary science methods courses and field experiences, but what about those science educators who must work within the constraints of their existing programs?

The purpose of this paper is to describe an existing early field experience program and discuss strategies implemented by the instructor, working within the constraints of the program design. The workshop approach presented in this paper provides a structure for implementation of teaching strategies learned by preservice teachers during their methods course and serves as a springboard for a dialogue on pedagogical issues and theories. Student feedback on their experience over the semester with the workshop approach is included to illustrate the kinds of cognitive and affective outcomes achieved. The author's personal account of her experience developing and implementing this approach can inform other science teacher educators work within the constraints of the field experience component of their university's teacher preparation programs.

Early Field Experience

The Early Field Experience is part of a 9-credit hour cluster of courses taken by elementary education majors, usually their junior year, as the first of their professional preparation courses. Thirty students are enrolled in the course, the majority of which are white females around 20 years of age. For many of the preservice teachers, this is their first time entering the schools in an instructional capacity. In addition to the early field experience, students are enrolled in math and science methods courses as part of the cluster arrangement.

As part of the early field experience, each of the preservice teachers is assigned to a classroom in a local elementary school for a period of 45 minutes, once a week, for 9 weeks, where they work with a small group of 4-5 students. Four of the sessions are dedicated to science teaching, during which preservice teachers are required to implement a lesson following the Learning Cycle (see Bybee, Buchwald, Crissman, Hell, Kuerbis, Matsumoto, & McInerney, 1989) for science.

In the semester in which the workshop approach was implemented, the author, a former elementary teacher and then graduate student, was an instructor of the semester-long elementary science methods course, and the accompanying early field experience. This was her third year teaching the methods course, and her second semester teaching it in conjunction with the early field experience. In her experience with teaching the course, she encountered several inter-related constraints of the course design, which functioned together to serve as barriers to providing an optimal learning experience for preservice teachers.

Working Within Constraints

Time is just one constraint under which methods instructors and field experience supervisors must design their courses. While Cannon (1999) found that extended practicum experiences in elementary science teaching positively increases preservice science teachers personal-science-teaching-efficacy beliefs, extended practicum experiences such as these are not the reality in all universities, as illustrated by the situation described in this paper. Since many preservice teachers enter their methods courses with negative perceptions of science and low enthusiasm for teaching science

(e.g. Ellsworth & Buss, 2000) providing them with a positive experience in their field placement is critical for increasing their science teaching self-efficacy (Bandura, 1997).

Additionally, with such little time spent in the schools, preservice teachers have limited opportunities to interact with the classroom teachers, whose students they teach. In previous semesters, this lack of interaction was perceived as a lack of interest on the teachers' part by some of the preservice teachers. One student reflected on her final day of the field experience:

It was as if [the teacher] didn't even know we were coming. It was either this or just the fact that she didn't care. I don't understand; were we not expected, or worse, wanted? (Claire)

As a requirement of the science methods course, the preservice teachers plan a sequence of lessons relating to a pre-determined science topic for the grade level of the classroom to which they are assigned. The Learning Cycle (see Bybee, Buchwald, Crissman, Hell, Kuerbis, Matsumoto, & McInerney, 1989) has been the chosen lesson format and method of teaching for students to implement, across all sections of the science methods courses. Feedback given anonymously by students on the final course evaluations indicates that they perceived this as a constraint to their own teaching and learning:

One change I would like to see in the [field experience] is to present more of a combination of methods approach [sic] than such a strong focus on one methodology. (Anonymous)

The intent is that the Learning Cycle would occur over the course of the four sessions, however because these sessions took place once a week, this served as a barrier to effective instruction; preservice teachers often found that students could not recall what

had occurred the previous week. Other preservice teachers indicated that in light of the time constraints, the expectations for teaching science were unreasonable:

I honestly feel that it is virtually impossible for the students to do a minds-on, hands-on activity in the 45 minutes that we are in the classroom.
(Anonymous)

As this is the first cluster of their professional courses, it has traditionally been the case that preservice teachers would teach their lessons to small groups of 4-5 students. While this situation certainly differs from the practice of classroom teachers, who must handle instruction of the entire class, and thus can be viewed as a constraint to providing authentic practice, research shows this arrangement may provide several benefits to preservice teachers' efficacy. Wilson (1996) reported preservice teachers preferred small group activities, which increased self-efficacy. A cooperative early field experience investigated by Cannon and Scharmann (1996), in which preservice teachers team-taught lessons, had a similar positive influence on students' science teaching self-efficacy.

However, when combined with an enrollment of 30, this method of separating the students into different groups and classroom assignments during the field placement poses a challenge for the instructor, who is solely responsible for providing preservice teachers with feedback regarding their teaching. With thirty preservice teachers spread out into six different classrooms located in different areas of the campus, and with five lessons occurring simultaneously within each of these classroom, there is very little opportunity to observe individuals on a regular basis for extended periods of time, which is necessary for providing meaningful feedback that can assist the preservice teachers in improving their practice, and can be an important source of information for building self-efficacy (Bandura, 1997).

In light of the constraints of this teaching assignment, providing students with an opportunity for authentic practice and for success in teaching science effectively to students would be difficult, though possible, for the instructor to provide. The means for achieving this would be come from within the course itself.

The Workshop Approach

In one of the assigned readings for the science methods course, an article from *Science and Children* by Jones (1999) described a “workshop approach” in which teachers created learning centers focuses on a single science concept. In past semesters, this had been a favorite among the preservice teachers, and one they consistently recommended be retained on the reading list. The appeal of the article was that it gave practical solutions for dealing with constraints to teaching science such as limited time, money for supplies, classroom management, organization, and space while at the same time focusing on pedagogical issues such as constructivist perspectives on learning, questioning strategies, and the teacher’s role during inquiry. In addition, the fact that it was published in a practitioner’s journal and was written about the experiences of actual teachers seemed to lend it a higher degree of credibility in the eyes of the preservice teachers. This, combined with their own familiarity with learning centers from their days as elementary students, gave credence that this would be something they’d likely implement in their future classroom teaching—and thus to them, an “authentic practice”.

The workshop approach also fit well with the course focus on the *National Science Education Teaching Standards*, as the author described how the approach was consistent with Teaching Standard B: Teachers of science guide and facilitate learning, and Teaching Standard D: Teachers of science design and manage learning environments

that provide students with the time, space, and resources needed for learning science (National Research Council, 1996, chapter 3). The workshop approach became the inspiration for a structure that would allow the instructor to work within the constraints of the course which were beyond her control, namely that students would have four days of science teaching in the schools, would be required to implement the Learning Cycle method, and would work with small groups of students. Rather than plan a series of lessons that would be taught to a small group of children, the preservice teachers would plan a series of explorations that could be performed by small groups of children in a workshop format.

The school in which preservice teachers were placed for their field experience had a separate science lab facility, which was a converted classroom that now contained laboratory tables rather than desks. The principal agreed to reserve the lab for the field experience students during their assigned teaching sessions. Four teachers, two each at the primary and intermediate levels, were recruited to bring their classes to the lab for one of the teaching sessions. Their students would be divided into groups of five before they arrived in the lab on their assigned day for a “science workshop”. The instructor and the teachers reviewed the teacher’s long-range plans and curricula to choose topics consistent with the state academic standards for science, and that would complement their own classroom instruction. It was decided that the four workshops would focus on electrical circuits (4th grade), magnetism (kindergarten), properties of light (6th grade), and sound (2nd grade).

During the first part of the semester, preservice teachers worked in cooperative groups to design four different learning cycle lessons in which the exploration phase

consisted of a “science workshop”. Each of the five groups were responsible for planning one of five inter-related stations which would help students develop a conceptual understanding of the topic. The “workshop” itself would be an hour-long event during which a single class of elementary students would rotate in groups through a series of learning centers facilitated by the preservice teachers. The cooperative planning of the workshop around a single topic and “big idea” assisted preservice teachers in overcoming “Activitymania”, a phenomenon described in another of the course readings by Nelson and Moscovici (1998; see also Moscovici, 1999) in which science instruction consists of disjointed and disconnected prepackaged activities. Rather, the stations were coordinated through among-group cooperation to ensure these related in a way that built upon and reinforced students’ conceptual understanding of ideas such as “What do magnets attract?” and “What is a circuit?”.

Groups prepared a list of necessary materials, organized their arrangement for the station, and prepared lists of questions to facilitate the activity, following the Elstgeest model (Elstgeest, 2001). Their plans were submitted in draft form for feedback and approval (non-graded) to the instructor before the event; upon completion of the event, a revised Learning Cycle lesson plan containing the complete science workshop was submitted along with preservice teachers’ reflections on the experiences for formal evaluation. (For an overview of the science workshop for *What is a circuit?*, see Appendices.)

The day of each workshop, preservice teachers arrived early at the school site, to set up their stations in the science laboratory. At the designated times, the teacher brought their classes to the lab, divided them into groups, and reviewed rules for behavior

before sending each group to a station to begin. At each workshop, the teacher remained in the lab with her students, taking an interest in what the preservice teachers had planned and were doing at each station. Several requested a copy of the workshop plans for their own use, which was a compliment to the preservice teachers. The principal also visited during two of the workshops, remaining to provide positive feedback to the preservice teachers at the conclusion of the event. This interaction, though minimal, was important to the preservice teachers, and contributed to their sense of success in implementing their lessons.

The room was noisy and filled with people, yet this did not serve to distract the elementary students during their investigations. All groups appeared intensely engaged at their stations, and often hesitant to move on to the next one when it was time to rotate. Upon the conclusion of the workshop, the reaction of the elementary students, as well as the teachers, indicated it had been a positive experience for them. Smiles abounded and inquiries as to whether they would be able to return to the lab again the following day were made by several students. The preservice teachers seemed energized by this feedback.

In Reflection

Being able to facilitate the lesson multiple times within a single workshop as small groups of children rotated to their station allowed the preservice teachers to improvise and adjust ineffective strategies in order to improve their instruction. Normally, these preservice teachers would implement a lesson a single time, and if that lesson proved unsuccessful or ineffective, they would have no such chance to adjust their strategies and try again. According to Bandura (1986, 1997) mastery experiences are one

of the most powerful sources of self-efficacy information, and directly influences self-perception of teaching competence. Thus, early success in science teaching is important for preservice teachers. In a debriefing session held at the conclusion of the workshops, the general consensus of the preservice teachers was that they had improved with each rotation of the students through their station—gaining comfort in their ability to guide the students with questions, and their abilities to innovate and improvise within the goals of their plans for the activities. One student commented:

Each time I led the activity, I changed a question I asked or added something. By the end, I felt like an expert. (Bethany)

Additionally, the benefit of the elementary students having multiple encounters with a concept was apparent; the preservice teachers reported a noticeable difference in students' understanding after several rotations, and the confidence with which they approached each new station. This served to reinforce the idea conveyed by the instructor during the methods course that science cannot be taught as a series of "one-shot" lessons, but should build upon and connect to each other to promote students' conceptual development.

Another benefit of this approach was the opportunity to host science workshops with students at different grade levels. These experiences provided a context for discussion of developmentally appropriate practice in the methods courses. Preservice teachers were able to offer firsthand examples of differences in elementary students' cognitive functioning and abilities in science and relate these to course topics such as misconceptions, conceptual change, and process skills and how these could be applied to students at a variety of grade levels. For example, the persistence of misconceptions was

evident in the case shared by two preservice teachers of a kindergartener who insisted that magnets attracted all metals, despite the fact she could not make a magnet attract aluminum foil. The preservice teachers discussed how a teacher should respond in such cases. Instances such as these served as springboards for class dialogue concerning ways to address misconceptions, and the question of students' developmental readiness for conceptual change.

Furthermore, experience with teaching science to students in various grade levels also alleviated preservice teachers' concerns about being able to teach and adapt instruction in science to an unknown grade level in their future student teaching, and in some cases served as a "wake up call" for the need to strengthen their own content knowledge in science:

I couldn't get over how much the kids knew. As a teacher, I'm really going to need to know my stuff. (Jessica)

Similar to findings by Wilson (1996) and Cannon and Scharmann (1996), the preservice teachers also indicated that the cooperative structure of the science workshop was a positive aspect of the field experience:

I like the "team teaching" approach. I feel a lot less pressure, because if I mess up, hopefully someone else will catch my mistake, or if I forget to include something we talked about, someone can fill me in. I would rather teach like this than alone. I like to work as team with people, and I think our group of teachers worked well together. We had a good dynamic; where one person had difficulties the other was stronger in that area... (Lucy)

Additional feedback given by preservice teachers in debriefing sessions following the workshops indicated they found the experience relevant and meaningful, and they felt enthusiasm for teaching science:

[The workshop] helped prepare us for actually teaching an elementary science class. (Allison)

I really value the fact that after this semester I feel much more comfortable with the idea of teaching science. (Karen)

Even those students who entered the course with positive attitudes toward science and relatively comfortable with the idea of teaching science benefited:

Even though I felt confident about science teaching before this... I learned so much that now I am more enthusiastic and confident about guiding children in their exploration of science concepts. (Amanda)

Summary

Science teacher education is not limited to methods courses; the accompanying field experience in science (where it exists) and student teaching are both important elements in preparing preservice elementary teachers for the challenges of teaching science at the elementary level. Early field experiences should provide preservice teachers with meaningful and relevant opportunities to experience success in teaching science to children.

While educators of teachers of science may not always have the freedom to design ideal field experiences for their preservice elementary teachers, there are ways to find freedom within the constraints of existing programs. The workshop approach is just one example of a successful undertaking that allows preservice teachers to develop their instructional skills in an authentic setting, and can provide the prior experience necessary for internalization of content presented in methods courses. Further research on innovative approaches for field experiences, such as the workshop approach, can benefit

educators of teachers of science in designing their own courses and field experiences and working to overcome the constraints they encounter.

Appendix

6th Grade Science Workshop Overview: What is a circuit? Learning Cycle Exploration Phase

Station One: Light the Bulb Challenge

Materials: D-cell batteries, bulbs, wires

Students are challenged to light the bulb using the materials provided, and then formulate a list of “rules” for making the bulb light.

Station Two: Conductors & Insulators

Materials: D-cell batteries, bulbs, wires, assortment of conducting and insulating materials to test

Students explore circuits made using different materials to determine which can be used successfully to light the bulb.

Station Three: Will it light?

Materials: circuit drawings, D-cell batteries, bulbs, wires

Students examine drawings and make predictions about whether or not the bulb will light. They build the circuit as shown to test their predictions.

Station Four: The Switch is On

Materials: D-cell batteries, bulbs, wires, assortment of conducting and insulating materials including note cards, cardboard, paperclips, paper fasteners

Students are challenged to design a switch that can turn the light off and on by opening and closing the circuit.

Station Five: Circuit Puzzles

Materials: preconstructed circuit puzzles, D-cell batteries, bulbs, wires

Students test connections between contact points on the circuit puzzles, observing whether the bulb lights and making inferences about the configuration of the connections within the puzzle.

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