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TEAMS

Teaching Excellence and Achivement in Mathematics and Science

A Collaborative Project Among
Iowa State University 334000
Ames Laboratory 0305000
Ames Community Schools

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Abstract: *The Teams project was a collaborative effort among Iowa State University College of Education, Ames Laboratory and the Ames Community Schools. For the project, teams of four preservice teachers, one scientist, one classroom teacher and one teacher educator were formed. Students in the project participated in a laboratory experience for two hours each week, participated in a classroom experience for two hours each week and attended seminar for one hour each week. At the end of each semester, students and their cooperating scientists taught a lesson that included some of the material the students had worked with in the science laboratory. Results from interviews of project participants indicate that preservice teachers attitude and self concept toward science improved during the project. Results also suggest methods for making similar collaborative projects using scientists and teachers effective.*

TEAMS was designed to improve the quality of the mathematics and science preparation of elementary preservice teachers through the involvement of scientists and practicing elementary teachers. A primary goal of TEAMS was to improve preservice teachers' knowledge of, confidence in, and attitudes toward math and science, in general, and teaching math and science, specifically, by providing the preservice teachers with opportunities for meaningful interactions with world class scientists and nationally recognized elementary math and science teachers.

As was previously stated, TEAMS participants were divided into squads; each squad consisted of a scientist, a practicing teacher, a teacher educator, and three to five preservice teachers. Working in squads, each week the preservice teachers spend two hours with their scientist in a research laboratory and two hours in the classroom of their practicing teacher. In addition, all of the preservice teachers met weekly in a one hour seminar with the teacher educators.

During 1995 and 1995, 24 preservice teachers, 4 scientists, 4 teacher educators, and 4 nationally recognized elementary science teachers participated in the project.

The role of the scientist and the science laboratory experience

Under the direction of the scientist, the science laboratory experience was to provide the preservice teachers with opportunities to be a part of a science research team, experience the processes of science, and develop professional relationships with individuals in the scientific community. Thus, the goals of the scientists in the science laboratory were to:

- introduce the preservice teachers to scientific research by exposing them to the research conducted in the laboratory and providing a big picture context of the purpose and implications of the research.
- involve the preservice teachers in the processes of science by designing investigations that are subsets of the laboratory research yet appropriate for the knowledge and skill level of the preservice teachers;
- serve as math/science mentors to the preservice teachers helping them understand that the scientific community is comprised of real people.

Shadowing and hands-on activities in the science laboratory

As originally envisioned, the laboratory component was to be a shadowing experience for the preservice teachers; the preservice teachers were to develop their understanding of science research by being in a rich, science environment, following the scientists around the laboratory, observing the tasks in which they engaged, and asking questions about science content and the implications of the studies.

Early attempts at this approach proved unsuccessful; scientists reported that it was not manageable or meaningful. They stated that shadowing was too vague in that it did not outline specific activities in which the scientists could engage that would be meaningful for the preservice teachers to observe. In addition, the shadowing experience did not specify what the preservice teachers were to gain from their observations of the scientists.

The scientists explained that often their activities in the laboratory were too varied for the preservice teachers to learn much science. "I do too much running around putting out fires; following me around would be a disaster.

They wouldn't get anything out of it." Furthermore, because of the highly specialized nature of the science research, the scientists suggested that the students did not have the science background, level of expertise, or vocabulary needed to make shadowing a meaningful experience.

To accommodate the students' needs, the scientists, collectively and individually, redefined the laboratory component from a shadowing to a hands-on experience. It was decided that each scientist would develop and engage the preservice teachers in hands-on activities based on research in their laboratory.

For example, Scott Chumbley, a materials scientist, studies the microstructures of metals. He is specifically interested in the composition of metal microstructures, the mechanical properties of metals, and the affects of micro-structural changes on the properties of metals. His primary tools for examining microstructures and properties of metals are microscopes and various mechanical tests (e.g. hardness and tensile). Thus, the laboratory activities Scott developed for TEAMS involved two basic tasks: microscopy and mechanical testing.

To acclimate the students to the laboratory environment, Scott conducted extensive tours of his research environment. In so doing, he provided the preservice teachers with a broad understanding of materials science research and the implications of his work. Through the use of the optical and electron scanning microscopes, the hands-on activities began with basic examinations of common metals. These included brass and steel nuts and aluminum from beverage containers. The activities progressed to include the examination of laboratory research samples, discussions of data analysis, operation of sample preparation equipment, examination of sample properties and implementation of simple mechanical tests.

Preservice teacher perspectives of the laboratory experience, science, and scientists

The TEAMS experience expanded the preservice teachers conceptions of science. This was a major theme that emerged from comments during focus groups and interviews. One student commented, "I have a better idea of the big picture in science, what the parts are,...how the parts fit together." The science laboratory component authenticated and legitimized science for the preservice teachers most of whom acquired knowledge of and interactions with science through lectures, plug-and-chug formula equations, and textbook-driven experiments. Members of a focus group explained, "we see a different part of science than we are used to in the classroom; we get to see what the scientist does, how they go about what they do, ...what questions they are trying to answer."

The elements of the science laboratory experience most cited by the preservice teachers were the setting and the people. As previously mentioned, the

laboratory experience occurred in the research facilities of the participating scientists. This setting allowed the preservice teachers to be emerged in an environment where the on-going practice of science was the norm; they were exposed to a culture where the practice of safe, rigorous, objective scientific inquiry is the highest value. In this environment the preservice teachers used the research equipment, engaged in meaningful science processes, and interacted with and observed the various participants.

Having the opportunity for regular small group and one-on-one interactions with a scientist helped make the science laboratory experience meaningful for the preservice teachers. The scientists created the atmosphere for the laboratory experience. Three characteristics of the laboratory atmosphere emerged from the comments of preservice teachers: practical, personal, and profitable.

Practical: The activities of the laboratory required the students to take action; they measured elements, made samples, mixed compounds, etc. The activities were conducted as a group, thus enabling and encouraging conversations. Frequently, one question lead to another which often led to another. This allowed the preservice teachers to engage in science, verbalize their actions, and discuss the implications of the phenomenon with an expert. One preservice teacher commented, "We can ask her questions, she is up on such a high level, but no question is too stupid. We get some really interesting discussions going."

Personal: Because each squad consisted of three preservice teachers, the science experience became more personal to them. Working with the scientist on an activity for which each member had ownership, the squads developed a bond and a sense of camaraderie. One preservice teacher confessed, "Maybe this sounds corny, but we were a team, reaching out, working together." In addition, the preservice teachers had the opportunity to know the scientist on a more personal level. This helped them view scientists as regular people with whom they have something in common.

Profitable: The preservice teachers considered the time in the laboratory to be productive; not so much in the sense of developing a product, but in the sense of fostering attitudes toward learning. Of her laboratory experience, one student reported "I saw the value of making mistakes. We started out by making mistakes...lots of them. We learned a lot. Everyone learns that way."

The role of the classroom teacher and the classroom experience

To increase the preservice teachers' exposure to and experience in the classroom, they spent two hours each week in the room of the practicing classroom teacher on their squad. (Each practicing teacher who participated in

TEAMS was the recipient of the Presidential Award of Excellence in Math or Science Teaching.) The purpose of the classroom experience was to provide the preservice teachers with an opportunity to critically analyze the processes and techniques of effective math and science teaching and begin to incorporate these methods into their own teaching practices and beliefs about education. The goals of the practicing teachers were to:

- facilitate the development of the preservice teachers' math and science instructional knowledge and skills, and
- increase the preservice teachers' confidence in their ability to effectively teach math and science.

The practicing classroom teachers were considered to be the professionals who would most influence the teaching philosophies and strategies of the preservice teachers in the TEAMS program. Thus, the primary objective of the practicing teachers was to model (with reflection) effective classroom practice. As a professional role model for the preservice teachers, the practicing teachers demonstrated (through their regular classroom practices) a variety of strategies that create ideal environments for math and science learning.

An essential component of the classroom experience was the guided reflection component. As part of the each week's experience, the practicing teacher would spend 15-20 minutes with the preservice teachers reflecting on the activities that occurred. One teacher summed up her role by stating "My goal is to let them see what went right or wrong with my lessons." These guided reflection opportunities assisted the preservice teachers in analyzing the teaching and learning process and helped them fully understand the techniques, strategies, and processes of effective math and science teaching.

<u>Shadowing in the classroom and preservice teacher perspectives</u>
Similar to the science laboratory experience, the classroom component was originally envisioned to be one where the preservice teachers would "shadow" the teachers. That is, the preservice teachers were to observe the actions of the practicing teacher and participate in the classroom environment as directed by the teacher. The notion of a shadowing experience worked well in the classroom. Because of their academic background and knowledge of teaching, the guided observation experience was meaningful for the preservice teachers.

Comments from the preservice teachers during interviews and focus groups suggested that the classroom component was a valuable experience. "Suzanne is so open. She shares what she is doing and what she is thinking," a preservice teacher commented. Although all of the preservice teachers had observed classrooms (as part of the teacher preparation program) prior to the TEAMS program, they indicated that the classroom component of TEAMS was different than their other experiences. They reported that the guided

observations and the time for reflection significantly helped them learn from the classroom teacher. One preservice teacher reported, "I got a sense of what a really good teacher is like... I got to look at teachers differently...I got a sense of figuring out why they do what they do and ask what they ask."

TEAMS: More than a laboratory and a classroom experience

The focus of the TEAMS project was not simply to provide interesting science laboratory and classroom experiences for the preservice teachers. Rather, a central purpose of the program was to facilitate an experience where the preservice teachers would see a connection and possible avenue for transferring the science and their laboratory experiences to the classroom. To assist the preservice teachers in doing this, each squad was to design and implement a lesson based on the laboratory.

It was evident through the lessons developed by the preservice teachers that they identified connections between the laboratory and the classroom. For example, Squad A had grown crystals in the laboratory and had observed lessons on geometry in the classroom. To integrate the experiences, they designed and taught lessons that used crystals structures as a mechanism to explore polygons and angles with fifth grade students.

In addition to the lessons, the comments of the preservice teachers indicated that they had saw similarities between science and education. Many times in their comments about the scientists and teachers they would refer the scientist as a teacher. "I really enjoyed Barb....She is a teacher even though she doesn't realize it...we can ask her all kinds of questions...". The preservice teachers also referred to the practicing teachers as scientists. "Suzanne is a scientist. She is always testing out hypotheses. 'I wonder if...Did you see what I did differently in the first class?...Why do you think I did...'"

Both the practicing classroom teachers and the scientists influenced the science and education philosophies of the preservice teachers. One preservice teacher commented, "When I look back through it, and I'm interacting with my kids, I can see myself doing things that she has done. She's been a great model for me and what I want to do with my students." Another stated, "When I was taking science, I don't remember a lot of people liking science. Now I've had this experience of actually working with scientists, seeing what they do...I'll be able to tell my students 'this is what I did when I was in the lab.'"