Teaching Science with a Child-Focused Internet Resource: What Do Teachers Need to Know, Where Do They Learn It, and How Does It Change Their Teaching?

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Abstract

This research[1] addresses the learning done by fifth and sixth grade teachers as they facilitate an innovative three-week unit on weather, incorporating computer communications for information research and inter-classroom information exchange between distant student groups. The teachers may be situated in a community of practice where they learn about computer use in regular classrooms while teaching. Little research has been done on teachers' learning in these types of settings and no communities of practice linked by computer networks have been reported in the education research literature.

Teaching practices and learning were studied. Both quasi-experimental and qualitative methods were employed. To discern the differences in teaching practices, comparisons were made of videotapes taken in classrooms with computers and others without. Teacher journals, questionnaires, and telephone interviews were employed to understand problems faced by the teachers, their contacts with experts, the problem resolution, and changes to their teaching practices due to both their learning experiences and to the innovations of the curriculum. With a better understanding of the teachers' learning, the research team will revise future field tests, anticipating teachers' needs when they incorporate computer telecommunication technology in innovative science units.

Introduction

There is currently a resurgence of interest in situated cognition in educational research (Brown, et al., in press), because there are features of communities of practice that are quality features that more school-like learning experiences should adopt. Among the central tenets of this philosophy is that knowledge is not static "furniture of the mind" (Hall, quoted in Brown, et al., in press), but is situated in activity. Lave and Wenger (1991) see the learning process not as "the acquisition of propositional knowledge," but as "certain forms of social coparticipation" (p. 14). "Learning can be viewed as a special *type* of social practice" and "as a *feature* of practice" (Lave & Wenger, 1991, p. 18, emphasis in the original). Their community of practice envisions "a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice"

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(Lave & Wenger, 1991, p. 98). Thus, learning occurs when a less-skilled member of the community of practice (a newcomer) is engaged in the practices of the community and is guided by a more-skilled member of the community (an old-timer). In the case of this study, the activity to be studied will be teachers learning how to incorporate computer communications tools in regular fifth and sixth grade classrooms as they teach weather concepts. Though the nature of the learning process engaged in by the teachers is not clearly understood, Turkle (1984) suggests that learning to use computers employs more-experienced users assisting novice users to master routine procedures necessary to become a proficient user. This research will attempt to determine if a community of practice exists for the teachers to learn more about computer use and, if so, how it is constituted.

Most of the classroom research in education dealing with situated cognition and situated learning has focused on students (Brown, in press; Campione, in press; Lave, 1990; Brown, et al., 1989; Resnick, 1987). Doyle (1990, p. 17) "suggests the need for a theory of teacher education that addresses both how teachers learn about teaching and how knowledge about teaching is used to interpret and solve teaching dilemmas." The research contemplated by these authors will diverge from the student-focused research and enter relatively uncharted waters where, in answer to Doyle's call for research on teacher education, the teachers' learning will be studied (Remillard, 1992; Feiman-Nemser & Remillard, in preparation; Resnick, 1983). Specifically, this research investigates **what teachers learn** as they incorporate computer technology to teach an innovative unit on weather in fifth and sixth grade science classes and **how their learning experiences change their teaching.**

The Field Test

The field test, which is reported here, will be the first research cycle in a three-year research program titled *Kids as Global Scientists: The Utilization of the Internet for Middle School Atmospheric Science (the KGS project)* (Songer, 1992). In the first two weeks of the unit on weather, teachers of fifth and sixth grade students in six distant sites will guide students working in teams to become experts in one of five areas of study:

- clouds and humidity,
- environmental concerns,
- precipitation,
- severe weather, and
- winds.

During the third week of the field test, teachers facilitated their students' use of the Internet to build on their local expertise through the questioning of other student groups at distant sites and the answering of questions received from other student groups at distant sites.

The school sites are regular classrooms in public schools without any unusual resources. The one requirement is access to at least one Macintosh computer with modem capabilities for computer communications. The schools are diversely situated to represent different student populations and weather conditions:

- Mountain Elementary School, Mountain, CO[2] - mountain weather;
- Front Range Middle School, Boulder, CO - plains/front range weather;
- Navajo Reservation School, Four Corners, AZ - desert weather;
- Florida Middle School, Tallahassee, FL - tropical weather near the sea;
- Bronx Public School, New York City, NY - northeastern U. S. urban weather by the ocean and
- Australian Middle School, Melbourne, Australia - weather in the southern hemisphere.

One of the central innovations to this weather unit is that the teachers will incorporate computer communications tools so students will have access to archival resources and regional weather experts.[3]

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[2] Pseudonyms are used for the field site schools.

[3] Songer researches student learning in her companion article submitted for this conference.

Teacher Learning During the Field Test

The research focused specifically on teachers in three of the six locations. Since it is in the area of computer communications technology that the classroom teachers have the least training, we hypothesize that the teachers will learn not only about incorporating the computer technology, but also about how to get expert advice when they need assistance. Thus, the planned study will focus on how teachers at Mountain, Boulder and Four Corners learn about computer telecommunications as they facilitate use of technology for information research and inter-classroom information exchange during a three-week science unit.

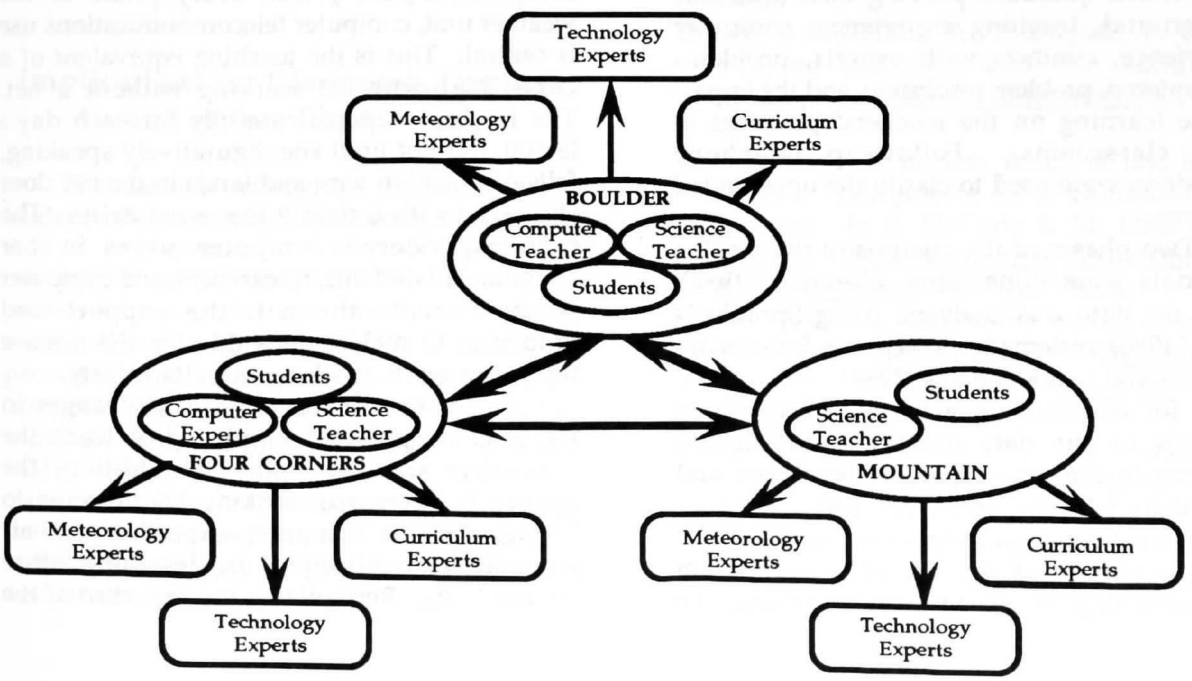
In order for a community of practice to exist, there must be "participation in an activity system about which participants share understandings concerning what they are doing" (Lave & Wenger, 1991, p. 94). Figure 1 shows how the field-site participants and their support teams are connected both in person and via Internet.

At Boulder and Four Corners, the classroom teacher works with a computer expert in their building to incorporate the technology in the classroom. In addition, each classroom teacher is assigned experts in meteorology, technology, and curriculum aspects of the field test. Of the people in this web, who do teachers ask for help when resolving problems of computer implementation in the classroom? Does the resolution of these problems suggest old-timers assisting newcomers as the newcomers move along a learning trajectory? How could the weather unit and support materials be organized by the research team to better facilitate teachers' learning about computer communications tools and their in-class use? The focus of the research will be:

- What the teaching practices were used to incorporate the computer communications technology?
- What problems did the teacher encounter when incorporating the computer communications?
- What expert was contacted for what problems?
- How were the problems resolved?
- What changes did the teacher make in classroom practices as a result of problem resolution?

From these general questions, the research investigates if the ways of resolving teaching

Figure 1. Participants in the field test showing their location and computer telecommunications connections.



dilemmas suggest a community of practice - as construed by Lave & Wenger - requiring old-timers, newcomers, and routine practices for moving from novice to mature identities.

Data Collection, Methodology and Analysis

Both quasi-experimental and qualitative methods were used to gather data from the field test. In the quasi-experimental portion, the Boulder teacher is being videotaped teaching in two different classes - one experimental and one control. The same weather unit is being taught in both, but the experimental class uses various computer technologies and the control does not. By comparing the videotapes from these classes, teaching practices for incorporating the computer communications tools were discerned.

Primarily qualitative methods were used to collect written and interview data about the teachers' learning (Erickson, 1986). Over the course of the three-week field test, the three designated teachers kept journals, making at least twice-weekly entries. The journal entries were directed, that is they will focus on the problems that are identified "on-the-fly" in the teaching of the unit, the experts contacted, the problem resolution, and changes to their teaching practices. At the conclusion of the field test, the three teachers wrote answers to open-ended questions probing their academic background, teaching experience, computer experience, contacts with experts, problems encountered, problem resolution, and the impact of the learning on the teachers' practices in their classrooms. Follow-up telephone interviews were used to clarify the open-ended responses.

Two phases of the analysis of the written materials were done (after Eisenhart, 1992). First, the data was analyzed using Spradley's (1979, 1980) systematic procedures for domain analysis and van Maanen's (1988) more literary ideas for constructing vignettes. Second, an analysis of the data located and followed patterns in the way expertise developed and was shared by the teacher. These analyses may provide enough information to determine if a community of practice exists. With an understanding of the teachers' learning, the research team is prepared to revise future field tests, anticipating the learning needs of teachers when they incorporate computer communication technology in innovative units in science.

Research Results

Preliminary results indicate that a community of practice exists wherein the science teacher, a novice computer user, learns about computer use from more-experienced computer users. The teacher in the Boulder school uses three resources to help resolve problems as they occur with the computer telecommunications:

- the **computer teacher** in her school in whose computer lab her class meets to use computers,
  members of the research team who have computer expertise, and
- **her students** who have computer expertise and, more rarely, **advanced student users** who are not in her class, but who inhabit the lab during their free time.

The benefits of teaching in this type of environment come from the strong support of the community. Consider the substantial risks that a teacher such as the Boulder middle school science teacher takes when teaching an innovative unit such as the one employed in the field test. The Boulder science teacher is not a computer expert; yet, at every phase of the weather unit, computer telecommunications use is central. This is the teaching equivalent of a circus high-wire act working without a net. The teacher prepares carefully for each day's lesson, but not until she, figuratively speaking, falls off the high wire and lands in the net does she know with certainty that a net exists. The more-experienced computer users in her community (students, researchers, and computer teacher) create the net, the support and guidance, to make it possible for the science teacher to teach and learn simultaneously.

This is one of the substantial changes in the teaching practices employed to teach the innovative weather unit. In addition, the science teachers are thinking about ways to "design in" the computer expertise of their students and colleagues in designing other science units. Recognizing the expertise of the

students implies a considerable shift in the balance of responsibility for the teachers and students. In the case of the teachers in the field sites, teachers are less the recognized experts or dispensers of knowledge and more facilitators, sharing responsibility for the expertise with the students.

This sharing of expertise and responsibility is particularly evident in the experimental classroom. In both control and experimental classrooms, the teacher guides the student groups as they research their topics. Students in the control classroom use traditional library resources, as well as phone calls to experts (insurance agents to ask about the financial impact of hail, weather services to find weather records, etc.). On balance, students in the experimental classrooms use primarily electronic resources: on-line weather services, e-mail "dialogues" with meteorologists, on-line weather maps and satellite images, and e-mail "dialogues" with students at other sites. During the exchange of information between student groups at different sites, the teacher guides the students as they prepare questions for students at other sites and as they provide answers to students' questions from other sites. Here the teacher is teaching her students to use students at other sites as a resource, possibly a resource with more status than an encyclopedia or other hard-copy resource, certainly a resource whose responses are more-narrowly focused, and hence more relevant to the student groups.

Implications for Classroom Teachers and Future Field Tests

The teachers' willingness to learn from the students they teach and from computer experts was a key element of the success of the innovative weather unit. As Brown, et al. (in press) foresaw, the community of practice model (Lave and Wenger, 1991) holds the possibility of quality educational opportunities. In teaching the innovative weather unit, teachers were able to teach while learning which allowed for using classroom curricula that does not depend solely on the teachers' expertise. This significantly broadens the range of the possible for classroom activities.

In addition, the recognition of a community of practice allows the research team to provide support materials that facilitate the learning of the teacher. Guidelines for understanding the level of computer expertise in the classroom will be added to the support materials for the next field test. Also, information about those routine procedures needed to become a proficient computer user will be included.

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