EXPERIENCED TEACHERS AND COMPUTERS: CREATING A COMMUNITY OF PRACTICE

DISSERTATION

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By

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ABSTRACT

This research investigates how women who are experienced elementary teachers learn to integrate computers into their curriculum. The five participants are teachers at Briar Elementary School, a language arts/computer magnet school. I recount their tellings of the ways in which they learned to operate computers, to integrate computers into their first through fifth grade curriculum, and the hindrances they encountered.

Qualitative research methods guide this research. Data include a group discussion, interviews, a grounded survey, participant observations, and documents. Lave and Wenger's (1991) theory of legitimate peripheral participation in tooled environments aids my understanding of the data during the later stages of the study. I extend this theory to include new communities of practice as the members learn to use a new tool. I also highlight the importance of expertise with common tools of everyday practice as the teachers in this community learn to use and integrate the new tool.

This research finds that middle-aged women who are experienced elementary teachers make-up an untapped resource in the movement to integrate computers into the elementary curriculum.
This group of women models teaching as practiced by thoughtful and knowledgable practitioners. They also prompt us to change our collective perceptions of what a teachers is and does to include the use of computers as a tool for teaching and learning.

Lave and Wenger's (1991) constructs of community of practice, learning curriculum, continuity, displacement, technologies of practice, identity, visibility, invisibility, and transparency provide multiple lenses for examining the complex process of integrating computers into an elementary curriculum. In the final chapter, Wenger's (1990) distinction between procedural transparency and cultural transparency serves as a means for bringing the cultural significance of artifacts into the conversation. Computers are tools developed by the military and business. These tools are now finding their way into elementary classrooms, the provinces of women and children. I suggest that women elementary teachers need to become aware of the ways in which computers embody the environments in which they developed. This awareness will help teachers understand the impact of military and business cultures on classroom practice.
DEDICATION

Dedicated to the memory of two strong women:

Dollie Fox Hall
1926 — 1993

and

Denise D. Hall
1953 — 1993
ACKNOWLEDGMENTS

I wish to thank my advisor, Suzanne Damarin, for her support throughout my graduate school program. Her editorial expertise and her probing questions aided immensely in writing-up this research. I also wish to thank Marge Cambre and Bob Donmoyer for their support and assistance in my development as a researcher. I offer sincere thanks and gratitude to the teachers of Briar Elementary School. Their accessibility and honesty allowed me to learn about the daily lives of master teachers as they rethink their curricula to include computers. I also wish to thank the principal and staff of Briar Elementary for their cooperation and for their interest in this research.

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CHAPTER 1

TEACHERS AND COMPUTERS: 
THE DUAL/DUEL ROLES OF JUST PLAIN FOLKS 
AND PRACTITIONERS

Like earlier machines the computer entered the field of education with the promise that it would finally reform the American educational system (Olson, 1988; Snider, 1992). For over two decades, time, energy, and research dollars have gone into investigating the ways computers might influence student learning. Some researchers, closely following the behaviorist paradigm, have studied whether traditional instruction or computer assisted instruction (CAI) is the best means of content delivery (Greates & Green, 1994; Lin, Podell, & Tournaki-Rein, 1994). Becker (1987) examined the effects of CAI on children's thinking skills. Articles appear regularly with classroom activities for using computers in every area of the curriculum—social studies (Unia, 1991; Beneson, Braun & Klass, 1992), science (Wagner-Pine & Keith, 1994), math (Bachelis, Maxim, James & Stout, 1994; Battista, 1994; Widmer & Sheffield, 1994), and language arts (Simic,
1994). And now we have the Internet, and its multimedia component the World Wide Web, that teachers must learn to use and to integrate into the curriculum (Harris, 1993; Monahan, 1994).

Very little research has dealt with classroom teachers' lives as they attempt to integrate computers into their classroom practices. And yet, these are the professionals who are charged with learning to use computers and then rethinking their classroom routines to include computer activities. In 1991, Stephen Kerr noted that:

How technology figures in teachers' thoughts about their work, their planning of instructional activities, and their vision of classroom organization is a topic that has been little investigated. In particular, the literature in educational technology is remarkably silent on such questions as how teachers learn not only to use computers, but also to integrate them into the curriculum and the flow of classroom activities that realizes that curriculum. There is little attention paid to the important question of teacher time: How much time does it take for the teacher to learn how particular technologies work, to figure out how to integrate one technology (e.g., computers) with another (e.g., video), to develop an image of what a classroom using technology looks like, to communicate that image to students, and to evaluate the results. (p. 122)

As a former elementary school teacher, my interest in teachers learning to integrate computers was fueled by Kerr's article. How do teachers go about learning to use computers? How do they rethink their approaches to teaching and learning to include computers? How does a computer integrated curriculum look in practice? I began searching for answers to Kerr's questions.
A January 1995 survey of teachers and technology staff developers revealed a bleak picture of teacher training in the areas of computer inservice and computer integration (Siegel, 1995). The results showed that 28 percent of those responding to the survey spent no money at all on technology staff development. And, staff development accounted for only 8 percent of all funds allocated for technology. Although well over half of the respondents (60 percent) acknowledged the importance of integrating technology into the curriculum, 66 percent said that their workshops do not include ideas for using technology to enhance and enrich the curriculum. Instead, their workshops focus on specific pieces of software or hardware.

The survey also revealed that half of the technology training was conducted in half-day workshops. Only about one-fourth (26 percent) of the training extended over several days or weeks, even though training that stretches over time offers teachers the opportunity to try new ideas in their classrooms and to bring the results back to the group for discussion. The teachers and trainers who responded to this survey also indicated that lack of follow-up to training, not enough time, and insufficient hands-on practice were problems (Siegel, 1995).

But, how do experienced teachers "develop an image of what a classroom using technology looks like" (Kerr, 1991). How do they make use of their computer training once they return to their classrooms? How do they go about the process of rethinking their teaching strategies? There are no answers to Kerr’s questions in this 1995 survey.
Many of those proposing school reform see technology playing a major role in classrooms of the future ("Teachers Want Change", 1993; Bruder, Buchsbaum, Hill & Orlando, 1992; Campoy, 1992). According to Jane L. David (1991), current technologies may succeed in changing school environments due to the "power, versatility, portability, and ease of use of today's technologies" (p.38) and "the simultaneous presence of restructuring activities" (p.38). Collins (1991) states that "schools should start using computers as tools as much as possible ... [because] if you have computers that are easy to understand and that are powerful tools for doing schoolwork, then people will eventually figure out how to use them" (p. 35). He envisions schools where teachers guide students through cooperative activities incorporating computer technologies. Newman (1992), on the other hand, cautions that to assume that technology adoption will result in school restructuring is to oversimplify the situation. In his description of the Earth Lab technology environment, Newman gives us some insight into how carefully planned computer integration can foster restructuring. At the Ralph Bunche School in Central Harlem, students and teachers in third- through sixth grades used a local area network to collaborate on an earth science curriculum. Over the six years discussed in the Newman article, collaborations resulted in interdisciplinary study with connections to math, physics, writing, and social studies. But, how do teachers talk about rethinking their daily activities? When and how do they learn to use the technology? Kerr's questions are not answered here, either.
In their much cited work on situated cognition and learning, Brown, Collins and Duguid (1989) discuss the embeddedness of learning in activity. These authors note that tools and concepts are similar in that both must be used to be fully understood and through this use "the user's view of the world and adopting the belief system of the culture in which they are used" (p. 33). The integration of technology into elementary classrooms may require teachers to learn to use not only new tools but also new concepts in their roles as educators.

Olson (1988) discussed two of the most likely scenarios for computer use in schools. In one scenario teachers become 'machine minders,' stepping aside and allowing software designers to guide learning. The popularity of integrated learning systems (ILS) suggests that some school boards, administrators, and teachers favor this scenario. Olson's alternative view is of a "teacher-centered framework" where the computer is "a tool for teaching and learning whose value flows from an interaction amongst teacher, student, and program" (p. 11).

Teachers learning to use and to integrate computer technologies into a teacher-centered framework are simultaneously just plain folks \(^1\) (Lave, 1988) and practitioners. Just plain folks (jpf) deal with emergent problems and dilemmas in actual situations. They produce negotiable meaning and socially constructed understanding. Lave

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\(^1\) Just plain folks is the term used by Lave (1988) when she criticized the influence of cognitive psychology and the theory of transfer in education. The term denotes those acting in everyday, ill-defined problem-solving situations. It is in that sense that the term is used here.
notes that "jpf's actively give meaning to, and fashion, processes of problem solving in the midst of ongoing activities in relevant settings" (1988, p. 63). Practitioners, on the other hand, deal with ill-defined problems in conceptual situations while also producing negotiable meaning and socially constructed understanding. The activities of just plain folks and practitioners are similar in that their activities are situated within the cultures in which they work (Brown, Collins, and Duguid, 1989).

In the rapidly changing world of computer technology, teachers, like the rest of us, must deal with the emerging problems of learning to use new hardware and software. In this sense teachers are just plain folks, actively making sense of the processes of learning to use computers. As they use computers to write letters, to keep track of family finances, or to create hand-outs for class, teachers, in their roles of just plain folks, increasingly make sense of the processes involved in using the tool. According to Brown, Collins, and Duguid (1989), "People who use tools actively rather than just acquire them ... build an increasingly rich implicit understanding of the world in which they use the tools and of the tools themselves" (p. 33).

But, teachers are also practitioners of a profession. With the introduction of new tools into their working environments, teachers must rethink conceptual tools that "reflect the cumulative wisdom of the culture in which they are used and the insights and experience of individuals" (Brown, Collins, and Duguid, 1989, p. 33). Teachers' increasing experience and expertise with the tool, the computer,
interact with their understanding of pedagogy and result in the design of new learning experiences for their students; authentic experiences that will result in more meaningful knowledge of the world, not just school knowledge. For classroom teachers the dual roles of just plain folks and practitioners constantly inform one another.

The situated cognition literature fails to address how people can be both just plain folks and practitioners. For teachers, there is dissonance created by these dual roles because the computer is not a tool with a "natural" place in current educational practice. Teachers must learn to use the tool as just plain folks or students in classroom settings. In either case, individuals must transform these new skills into tools appropriate for teaching and learning in a classroom. The dissonance teachers feel can become so overwhelming that they 'burnout' or simply refuse to adopt the new computer technologies. The dissonance can also become a source of professional renewal by stimulating teachers to investigate the possibilities of new tool use and new concept use in their classrooms. The questions raised are: What conditions in the school environment support teachers when the feelings of dissonance created by their dual roles of just plain folks and practitioners begin to overwhelm them? How do teachers learn to use the hardware and software? Why do some teachers integrate computers as production tools while others use them for CAI delivery? What types of computer (tool) uses inspire teachers to rethink the curriculum?
At the elementary level several factors make these questions particularly interesting. Teachers at this level generally have self-contained classrooms, meaning that their students are with them throughout most of the day. Does this make using the computer for restructuring the school day for interdisciplinary study less complicated than at higher grade levels? On the other hand, elementary teachers must prepare to teach six or seven subjects daily, unlike many teachers at the upper grade levels. Does this mean that there is less time for them to think about, and plan for, using the computer for interdisciplinary study? Teaching, at least at the lower levels, is still a woman's profession. Women's experiences with, and attitudes toward, computers are generally different than those of men (Turkle, 1984; Turkle & Papert, 1990). How does this effect the use of computers in elementary classrooms? Women have historically produced and used technology (Stanley, 1983). Autumn Stanley cites numerous instances when women's inventions have been classified as domestic rather than technical. She asserts that it is the definition of technology, and especially significant technology, i.e. weapons and machines, that have led to the pervasive belief that women do not produce or use technology.

Significance of the Study

The significance of my study is the voice it gives to these five women who are also experienced classroom teachers. I investigated the daily lives of these teachers who represent a group — middle-aged women — rarely mentioned in the literature dealing with computer
integration. These teachers are professionals who have an understanding of pedagogy and classroom practice. They have many years of successful teaching on which to rely. How did these five teachers deal with the dissonance between learning to use the tools as just plain folks and rethinking their teaching strategies as education professionals? How much tool expertise did they need before they could begin to envision conceptual situations in which the computer would become a learning tool for students? What is the interplay between their tool knowledge and their conceptual knowledge when they are in their classrooms? An examination of the daily working lives of these five women helped me begin to address Kerr's questions.

Site and Participants

This study is based on information from the teachers and principal of an elementary school located in Bedford Falls, a suburb of a Midwestern city. Although the population of the greater metropolitan area is quite diverse, the population of Bedford Falls and the Lakeside School District at the time of this study was predominantly middle-class, white, and young.

The school, Briar Elementary School, was and is a computer/language arts magnet school that draws its students from approximately half of the geographic area of the district. Northwood Elementary, Briar Elementary's sister school, serves as the computer/language arts magnet school for the remainder of the district. These two schools were designated as computer/language arts
magnet schools during the 1988-89 school year. They opened as magnet schools in autumn 1989. Briar Elementary School houses only five classes, one class each in grades one through five.

The 1994-95 school year, the period of the most intense data gathering for my study, was the sixth year of the computer/language arts program at Briar Elementary. In those six years there had been four principals. During the 1994-95 school year, Mack Favorite, the principal, was in his second year with the school. His administrative duties were split between Briar Elementary and Willa Cather Elementary, the science, mathematics, and technology magnet school in the Lakeside School District.

Four of the five women who made up the faculty during this study were members of the original faculty in autumn 1989. They were: Cybill Servant\(^1,2\), second grade teacher, Amelia Kelly, third grade teacher, Amber Geddes, fourth grade teacher, and Dicey Tillerman, fifth grade teacher. The first grade teacher, Lisa Redford, joined the faculty in autumn 1991. All of these women had taught in the Lakeside School District for several years before being chosen as members of the Briar Elementary School faculty. None of these teachers had prior training or expertise in integrating computers into the elementary curriculum. Lisa Redford had computer certification from a local university; but she had not attempted to fully integrate computers into her classroom practices.

\(^1,2\) The five teachers and the principal selected their own pseudonyms.
Overview of Research Methods and Data Analysis

I conducted this research using qualitative methods. These included a group discussion, classroom observations, field notes, participant interviews, a grounded survey, and document analyses. The documents included assignments completed by the teachers while they were students in an Ohio State University telecourse, products and projects generated by the students of Briar Elementary School, grant proposals authored or co-authored by the teachers, and magnet school documents. My intention in conducting this study was to provide a description of the complex process of learning both to use computers and to rethink the elementary curriculum as computers are integrated as a tool for teaching and learning. In reporting these data, it was very important to me to allow the teachers who lived this experience to use their own voices in telling their stories.

I made the decision to use Jean Lave and Etienne Wenger's work for data analysis in the spring of 1995. As I synthesized the literature on situated cognition for Chapter Two of this dissertation, I kept returning to Lave's Cognition in Practice (1988) and Lave and Wenger's Situated Learning: Legitimate Peripheral Participation (1991). At the same time, the data had been gathered and I was repeatedly going through it looking for patterns. I began to see Briar Elementary as a site where masters of the practice of teaching were brought together to create a community that would include a new technology of practice, the computer. The communities of practice in Lave's (1988) and Lave

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1.3 See Appendix A for a chronology of data analysis.
and Wenger's (1991) work included newcomers/apprentices learning from old-timers/masters. The Briar Elementary teachers were old-timers in the practice of teaching but newcomers, without old-timers, in the practice of integrating computers into the elementary curriculum. I began to analyze the data with the Lave and Wenger writings in mind.

Limitations of the Study

The site of my research was not representative of most elementary schools in several ways. Among these are the size of the school, the number of computers per pupil provided by the school district, and the autonomy granted the teachers in local decision making. Transfer of any findings to another setting would require great caution.

Another limitation of this study could come from the teachers' reporting of the processes of learning to use computers and integrating computers into the curriculum. Briar Elementary School had been a computer/language arts magnet school for five years before I began data gathering. Some of the important parts of the processes of learning to use computers and integrating them into the Briar Elementary curriculum could have been forgotten or could have become such a natural part of the teachers' practice that they did not think to mention them.
CHAPTER 2

REVIEW OF RELATED LITERATURE

This is a study of five women who are experienced elementary teachers and the environment in which they have co-developed a process for integrating computers into their classroom practices. In this chapter, I briefly highlight the theories of learning that influenced my decision to delve deeper into a social-interaction theory of learning. I review the works of Jean Lave and Etienne Wenger (Lave, 1988, Wenger, 1990, Lave & Wenger, 1991) because these are the primary lenses through which I analyze the data of this study. I then synthesize a large body of research that examines classroom teachers as they use technology.

Eclectic Roots

During the twentieth century, various academic disciplines have proposed theories of cognition and learning. In discussing the depths to which these individual academic disciplines influence our thinking,
or the "subjectivism charge," Geertz (1983) said, "[I]f one interprets ideologies or theories wholly in terms of the conceptual horizons of those who hold them, one is left without a means of judging either their cogency or the degree to which one represents an advance over another" (p. 154). Here I briefly review the theories of cognition and learning of the educational philosopher John Dewey and psychologists Lev Vygotsky and Jean Piaget. In an attempt to answer the "subjectivism charge," I also consider the work of philosopher of science Michael Polanyi and anthropologist Clifford Geertz. Some commonalties of these theories have contributed to my understanding of a social-interaction theory of learning. I do not attempt to judge "the degree to which one represents an advance over another."

**John Dewey**

Early in the century, John Dewey discussed the importance of experience and adjustment to change in the development of knowledge. According to Dewey, knowledge is the result of an individual's interaction with a problematic situation, the resolution of dissonance, and satisfactory readjustment (Archambault, 1966). Dewey (1938) called this recursive process of new ideas leading to new experiences, new questions, and new resolutions leading to more new ideas the "continuous spiral" (p. 79).

Dewey (1938) stressed the importance of *intelligent* activity as the alternative to activity for its own sake. This is manifested in schools as meaningful give-and-take between the students and the teacher,
resulting in a mutual understanding of the importance of an activity and the possible directions to be pursued within the activity. The teacher, for Dewey, is a guide, helping students develop their ideas and organize them into a meaningful association with past knowledge, all in a framework of experience. The facets of Dewey's work of interest to me are the importance of activity and the dynamic nature of knowledge.

**Lev Vygotsky**

Lev Vygotsky, a sociohistorical psychologist and contemporary of Dewey, noted not only the importance of the *activity* in learning but also the acute importance of the *context* of the activity or interaction. For Vygotsky (1978), learning is essentially social and embedded in a particular cultural setting. Vygotsky also considered learning to be potentially multidirectional rather than unidirectional. A child's actual developmental level is determined by the problems s/he is capable of solving independently. A child is able to solve more difficult problems under the guidance of an adult or through collaboration with peers. The difficulty of the problems solved with assistance determines the potential developmental level. The difference between the level of independent problem solving and collaborative problem solving is the "zone of proximal development." The direction of the learning within the zone of proximal development depends on the context, the people involved, the goals, and the guidance.
Vygotsky states that cognitive skill is apparent "twice or in two planes" (1978, p. 163). First it appears externally in social interaction and then it appears internally in thinking. The setting of the interaction is used to classify what Vygotsky termed "everyday" concepts and "schooled" concepts. Gallimore & Tharp (1990) interpret Vygotsky as saying that exchanges of spoken language are the principal mode of learning everyday concepts. These exchanges, or sensory experiences, are generalized and become the foundation of everyday concepts. Abstract generalizations, which are not sensory experiences, are the foundation of schooled concepts. In reviewing Vygotsky's work, Hedegaard (1990) discussed theoretical knowledge which must be learned through activity. Theoretical knowledge results from connecting contradictory phenomena through methodological problem solving. Theoretical knowledge then becomes what Vygotsky referred to as a "psychological tool." The features of Vygotsky's work that are pertinent here are his emphasis on activity, the importance of the setting in learning, and the idea that knowledge originates in social interaction.

Jean Piaget

For cognitive psychologist Jean Piaget (Gruber & Voneche, 1977), cognition and learning develop through learning stages. Greatly influenced by his training as a biologist, Piaget was equally concerned with the biological and psychological implications of knowing. According to his "genetic epistemology," there is a never ending
construction and reconstruction of our views of the world. The intellect is self-constructed, as opposed to being imposed from the outside, and is regulated by existing cognitive structures. Events are assimilated into these existing structures. Piaget sometimes used the term *constructivism* to explain that each child invents rather than discovers ideas. According to Piaget's theory, ideas are not out there ready to be discovered but must be invented by the child (Gruber & Voneche, 1977). Since Piaget, this notion of constructivism has been elaborated, refined, and applied by numerous educational theorists. Piaget is relevant because of the importance he places on activity and his emphasis on the continuous reconstruction of knowledge.

**Michael Polanyi**

In *Personal Knowledge*, anthropologist Michael Polanyi (1958), defines knowing "as an active comprehension of the things known, an action that requires skill" (p. vii). He discusses the relationship between master and apprentice in his fourth chapter, "Skills." Here, Polanyi notes that through practice in the presence of the master, "the apprentice unconsciously picks up the rules of the art, including those which are not explicitly known to the master himself" (p. 53). "Connoisseurship" is thus imparted through example and not through a dictated course of action.

Polanyi (1959) makes the distinction between *explicit* and *tacit* knowledge. "*W*e always *know tacitly that we are holding our explicit knowledge to be true" (p. 12, italics in original). Explicit knowledge is
public, objective, and open to critical reflection. It takes form in writing, maps, and calculations. Tacit knowledge is unformulated, particular to the individual, and cannot be reflected upon in the same way as explicit knowledge. The learner's role is essential in shaping knowledge because tacit knowledge can only be revised through action. Polanyi states, "We must learn to accept as our ideal a knowledge that is manifestly personal" (1959, p. 27). Polanyi's writing points out the significance of activity, context or setting, and human interaction in learning.

Clifford Geertz

Clifford Geertz (1983), an anthropologist, notes that cultural anthropology tries to figure out what people think is the point of their actions. He points out that determining this depends on "what is seen, upon where it is seen from, and what it is seen with" (p.4). For Geertz, this understanding understanding and then translating it into language used by the observer helps to illuminate the actions but does not capture the full meanings the actions have in situ. Knowledge is inevitably local and cannot be fully understood except in relation to local situations and tools.

Synthesis

Kvale (1993) writes of "radical, paradigmatic changes in knowledge, when the traditional values of a discipline are challenged (p. 227)" and of "the necessity of defining the limits of a discipline, of
establishing the core concepts, methods, and data" (p. 227). A
rethinking of the "traditional values" of behaviorism and a strong
challenge to cognitive science by constructivists are currently taking
place in the field of education. The theories briefly discussed here have
influenced my personal "core concepts" concerning cognition and
learning. The four strands of these theories that interest me are the
emphasis on activity, the dynamic nature of knowledge, context or
embeddedness, and the social nature of learning. Dewey, Vygotsky,
Piaget, and Polanyi all note the importance of activity in knowing.
Dewey's "continuous spiral" and Piaget's notion of the construction
and reconstruction of our views of the world imply the dynamic
nature of knowledge. The importance of the context of learning is
stressed in the work of both Vygotsky and Polanyi. Both Geertz and
Polanyi discuss the social nature of learning whether that interaction is
between master and apprentice or within a community. All of these
pieces come together for me in the social interaction theory of learning,
especially as articulated in the works of Jean Lave and Etienne Wenger

The Social-Interaction Theory of Learning

'Cognition' observed in everyday practice is distributed —
stretched over, not divided among — mind, body, activity
and culturally organized settings (which include other
actors) (Lave, 1988, p.1).

Jean Lave's work, Cognition in Practice (1988), contributed to the
social interaction theory of cognition. Lave, an anthropologist,
criticizes cognitive psychology for its reliance on the concept of transfer to explain the use of school knowledge in the daily lives of just plain folks. She points out that research on learning transfer is often conducted in laboratory experiments that remove the activity from the setting. This separation of the activity from the setting discounts the importance of the setting. Lave sees the setting as a key element of cognition. The privileging of scientific thought as opposed to "everyday" thought is also problematic to Lave. She considers this current hierarchy as the most recent manifestation of nineteenth century studies of 'civilized' and 'primitive' cultures. The insistence of psychology that everyday thought and practice should always be measured against the norms of efficient, rational scientific thought denies the significance of everyday thinking.

In the final chapter of Cognition in Practice, Lave asserts that, if context is considered in the analysis of an activity, then the larger context of this context must also be considered. The result is the examination of activity as it is nested in various contexts. She also calls for the study of the person-acting (body and mind) as "situated in socially and culturally structured time and space" (p. 171).

Building on the work of Lave and others, Brown, Collins, and Duguid (1989) continued the argument that knowledge cannot be separated from the activity in which it is developed; learning and cognition are situated in the activity. They contend that knowledge is like language in that it is amalgamated into the activity that produces it. Conceptual knowledge, then, evolves with use within a particular
cultural setting. Use of conceptual knowledge results in a richer understanding of both the cultural setting and the concept. The world view of the culture and the world view of the immediate community frame the context in which the conceptual knowledge is used. Thus, conceptual knowledge evolves to embody the experiences of its users. "Activity, concept, and culture are interdependent. No one can be totally understood without the other two. Learning must involve all three" (Brown, Collins, and Duguid, 1989, p. 33).

**Authentic Activity**

Brown, Collins and Duguid (1989) make the distinction between school activities in which the domain culture is not apparent and authentic activities which are the "ordinary practices of the culture" (p. 34). Because culture is such an integral part of the activity in which a concept is learned and used, these authors feel that actual practitioners in a domain often would not recognize or validate the school activities in which concepts are taught. The danger in the metamorphosis of authentic activities into school activities is that students will fail to comprehend the ways in which practitioners use conceptual knowledge.

Jean Lave (1988) contrasts *just plain folks* (jpf's) and the ways in which they learn with the ways in which students learn in school where the culture is at best a mixture of the domain culture (of practitioners) and the school culture. In choosing to learn a set of practices jpf's can either become apprentices or students. This is
reminiscent of the "everyday" and "schooled" concepts discussed by Vygotsky (Gallimore & Tharp, 1990). Even schools which are ostensibly set up to provide domain experiences are poor copies of the world of practitioners (Brown, et al., 1989).

Brown, Collins and Duguid (1989) also deal with the activities of just plain folks, students, and practitioners. Their point is that activities of jdfs and practitioners are similar in that both are situated in the authentic activities in which they work. Their problems, insights, and solutions come from the activities in which they engage. Students, on the other hand, engage in artificially controlled activities thus precluding the use of concepts in activities that would be considered authentic by either just plain folks or practitioners. The insights and solutions gained by students are therefore indexes of the constructed activities of school rather than indexing the authentic activities of either just plain folks or practitioners. These authors suggest that "environment, [therefore], contributes importantly to indexical representations people form in activity" (p. 37).

Cognitive Apprenticeship

"Cognitive apprenticeship" is the term used by Collins, Brown and Newman (1989) to stress the needed rethinking of school as it is now generally conducted. One goal of cognitive apprenticeship as a method of teaching is that students closely approximate expert thinking and problem solving "situated in the contexts of their use" (p. 457). Another goal is to concentrate on "learning-through-guided-
experience on cognitive and metacognitive, rather than physical, skills and processes" (p. 457). These teaching methods attempt to make visible the thinking processes of the expert. Students are encouraged to reflect on the differences between novice and expert actions and to develop self-monitoring skills as they learn to approximate expert thinking and problem solving. Cognitive apprenticeship deals with the potential problem of indexicality by decontextualizing knowledge and thus freeing it to be used in a variety of situations. It becomes necessary for teachers to help students identify "the abstract principles underlying the application of knowledge and skills in different settings" (p. 459).

Based upon three successful models of cognitive apprenticeship, Collins, Brown and Newman (1989) created a framework for designing learning environments. Their framework is condensed here and reproduced in tabular form as Figure 1; explanations of the framework are quotations from the original.
Characteristics of Ideal Learning Environments

Content—the appropriate target knowledge for an ideal learning environment is likely to include all four categories of expert knowledge (Collins, et al., 1989, p. 477)

Domain knowledge -- the conceptual and factual knowledge and procedures explicitly identified with a particular subject matter (p. 477)

Heuristic strategies-- techniques and approaches for accomplishing tasks that might be regarded as "tricks of the trade"; they don't always work, but when they do, they are quite helpful (p. 478)

Control strategies-- [deal with] how to select among the various possible problem-solving strategies, how to decide when to change strategies, and so on. (p. 478)

Learning strategies-- strategies for learning any of the other kinds of content [strategies] (p. 479)

Methods--teaching methods should be designed to give students the opportunity to observe, engage in, and invent or discover expert strategies in context (p. 481)

Modeling-- involves an expert's carrying out a task so that students can observe and build a conceptual model of the processes that are required to accomplish the task (p. 481)

Coaching-- observing students while they carry out a task and offering hints, scaffolding, feedback, modeling, reminders, and new tasks aimed at bringing their performance closer to expert performance (p. 481)

Scaffolding-- the supports the teacher provides to help the students carry out a task ... Fading consists of the gradual removal of supports until students are on their own (p. 482).

Figure 1.

Characteristics of Ideal Learning Environments
Articulation-- any methods of getting students to articulate their knowledge, reasoning, or problem-solving processes in a domain (p. 482)

Reflection-- enables students to compare their own problem-solving processes with those of an expert, other students, and ultimately, an internal cognitive model of expertise (p. 482-3).

Exploration-- pushing students into a mode of problem solving on their own ... It involves not only fading in problem solving, but fading in problem setting as well (p. 483).

Sequencing--We have identified some dimensions or principles that should guide the sequencing of learning activities to facilitate the development of robust problem-solving skills (p. 484).

Increasing complexity-- the construction of a sequence of tasks and task environments or microworlds where more and more of the skills and concepts necessary for expert performance are required (p. 484)

Increasing diversity-- the construction of a sequence of tasks in which a wider and wider variety of strategies or skills are required (p. 484)

Global before local skills-- sequencing of lessons such that students have a chance to apply a set of skills in constructing an interesting problem solution before they are required to generate or remember those skills (p. 485)

Sociology--certain aspects of the social organization of apprenticeship encourage productive beliefs about the nature of learning and of expertise that are significant to learners' motivation, confidence, and, most importantly, their orientation toward problems that they encounter as they learn (p. 486).
Figure 1 continued

**Situated learning**-- students carry out tasks and solve problems in an environment that reflects the multiple uses to which their knowledge will be put in the future (p. 487)

**Culture of expert practice**--creation of a learning environment in which the participants actively communicate about and engage in the skills involved in expertise (p. 488)

**Intrinsic motivation**-- students attempt to carry out realistic tasks in the spirit and for the purposes that characterize adult expert practice (p. 489)

**Exploiting cooperation**-- having students work together in a way that fosters cooperative problem solving (p. 489)

**Exploiting competition**-- the strategy of giving students the same task to carry out and then comparing what each produces ... for competition to be effective, comparisons must be made not between the products of student problem solving, but between the between the processes (p. 490)
Legitimate Peripheral Participation

In *Situated Learning: Legitimate Peripheral Participation* (1991) Jean Lave and Etienne Wenger adopted the term 'legitimate peripheral participation' in order to clarify their view that learning cannot be separated from social practice. The concept of legitimate peripheral participation (Lave, 1990; Lave & Wenger, 1991)

provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artifacts, and communities of knowledge and practice. It concerns the process by which newcomers become part of a community of practice. A person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice. This social process includes, indeed it subsumes, the learning of knowledge skills (Lave & Wenger, 1991, p. 29).

The phrase "legitimate peripheral participation" implies a continuous folding in of the changing understandings of the newcomers and of the old-timers as they interact. This sociological theory of the community's constantly changing knowledge as a result of this interaction is similar to the psychological theories of individual knowledge seen in Dewey's "continuous spiral" and Piaget's notion of the construction and reconstruction of our views of the world.

Lave and Wenger develop the constructs community of practice, learning curriculum and teaching curriculum, continuity and displacement, and transparency in their discussion of the theory of legitimate peripheral participation.

Community of Practice. The term "community of practice," in Lave and Wenger's work, refers to
a set of relations among persons, activity, and world, over
time and in relation with other tangential and
overlapping communities in practice. A community of
practice is an intrinsic condition for the existence of
knowledge, not least because it provides the interpretive
support necessary for making sense of its heritage. (p. 98)

Access to the community of practice by novices allows them are
to be exposed to the information and resources of the community,
members of the community including old-timers, and activities of the
community which offer opportunities to participate. Full participants
in a community of practice must be familiar with the technologies used
in day-to-day activities. Lave and Wenger note that it is important for
full participants to use the technologies of a culture of practice because
artifacts are the embodiments of the heritage of the culture of practice.
The degree of understanding that each participant acquires from
engaging with the technologies of practices is dependent on the type(s)
of participation (p. 101).

How are novice computer using teachers to become full
participants in this community of practice through legitimate
peripheral participation? Lave and Wenger (1991) recommend that
newcomers be allowed opportunities for "productive peripherality
[which] requires less demands on time, effort, and responsibility for
work than for full participants" (p. 110). Teachers who are experts in
computer integration and those who are newcomers to the effort are
rarely, if ever, given the luxury of decreased demands from their other
professional duties in order to observe those with more expertise or to
learn to use the hardware and software. Teachers who become computer users do so on their own time.

**Learning Curriculum.** "A learning curriculum is a field of learning resources in everyday practice viewed from the perspective of learners" (Lave & Wenger, 1991, p. 97, emphasis in original). Situated in the community of practice, the learning curriculum cannot be designed apart from the community or examined except in situ. *Instead*, it is revealed as newcomers and old-times engage in everyday practice. If information and knowledge flow freely among peers and near-peers, apprentices often learn from other apprentices. For teachers learning to use computers, identifying a learning curriculum is hampered by the isolation of novices and masters. Although some professional development and inservice time has been given to the instruction in uses of the computer in the classroom, these efforts have had limited effects partially because they did not come from the perspective of the learners.

**Continuity and Displacement.** The concept of continuity and displacement in Lave and Wenger's work is closely tied to the idea of identity. Newcomers attempt to become full participants in an existing community of practice that has evolved over time. As the newcomers enter into the centripetal activities of the community of practice, they have an increasingly vested interest in the perpetuation of the community. Newcomers develop their identities through interactions with old-timers and other newcomers. No community of practice is faithfully reproduced as it develops over time. This creates a
continuous tension in the community as the newcomers displace and replace the old-timers and become old-timers themselves. Some of this tension can be felt in the educational community of practice as computers are introduced into the learning environment. This is not to imply that all novice teachers have fully embraced the integration of computers in the classroom or that all experienced teachers have rejected the integration of computers in the classroom. My personal experience with preservice and inservice teachers suggests that both novice and experienced teachers are on both sides of this issue. The tension is between the identities of "teachers" and "the practice of teaching" as these have been conceived and practiced for nearly one-hundred years, on the one hand, and the potential for fundamental change due to the paradigmatic shift discussed in Kvale (1993).

Fundamental change might be brought about in both identity and practice by the introduction of the computer and computer related technologies.

**Transparency.** "Transparency when used in connection with technology refers to the way in which using artifacts and understanding their significance interact to become one learning process" (Lave & Wenger, 1991, p. 102-3). Transparency is not a property of the artifact but is a part of the process in which using the tool in specific ways aids the newcomer in understanding the culture of practice. In discussing the transparency of tools of everyday practice, Lave and Wenger note the conjoined nature of the invisibility of technology and the visibility of technology. In his doctoral dissertation,
Wenger (1990) stated that the relationship between visibility and invisibility "is not a simple polar opposition since these two crucial characteristics compose transparency by a complex interplay, their relation being one of both mutual exclusion and mutual implication" (p. 103). The authors point out that the relationship between invisibility and visibility is "one of both conflict and synergy ... Invisibility of mediating technologies is necessary for allowing focus on, and thus supporting visibility of, the subject matter. Conversely, visibility of the significance of the technology is necessary for allowing its unproblematic - invisible - use" (Lave & Wenger, 1991, p. 103).

Lave and Wenger note that for newcomers the most important factor in legitimate peripheral participation is full access to the community of practice. This access must include the technologies of practice. "[T]he understanding to be gained from engagement with technology can be extremely varied depending on the form of participation enabled by its use" (Lave & Wenger, 1991, p. 101). The authors go on to point out that the tools of everyday practice evolve within a culture and embody much of the heritage of the practice of the culture. "Thus, understanding the technology of practice is more than learning to use tools; it is a way to connect with the history of the practice and to participate more directly in its cultural life" (Lave & Wenger, 1991, p. 101)

Lave and Wenger have given us new meanings to use when discussing learning. (Emphases in original.)

The person has been correspondingly transformed into a practitioner, a newcomer becoming an old-timer, whose
changing knowledge, skill, and discourse are part of a developing identity - in short, a member of a community of practice (p. 122)

*Situated learning activity* has been transformed into legitimate peripheral participation in communities of practice (p. 122).

*Knowing* is inherent in the growth and transformation of identities and it is located in relations among practitioners, their practice, the artifacts of that practice, and the social organization and political economy of communities of practice (p. 122).

All this takes place in a *social world*, dialectically constituted in social practices that are in the process of reproduction, transformation, and change (p. 123).

The authors have also stated that moving from newcomer to full practitioner means an investment of time, increased effort, more venturesome undertakings, and a growing identity as a full practitioner (p. 111). These conditions are pertinent in reading the literature on teachers, computers, and classrooms.

**Teachers, Computers, and Classrooms**

Every time we assimilate a tool to our body our identity undergoes some change; our person expands into new modes of being. (Polanyi, 1959, p. 31)

Educators have discussed situated cognition and its derivative, cognitive apprenticeship, as these apply to the design of learning environments which include computers. Streibel (1993) asks a series of questions aimed at clarifying the role of the computer-using teacher in
emancipatory social settings. He advocates learning environments where students are active participants in meaningful learning that has a critical focus. Damarin (1993) takes another approach to situated learning and the use of computers in the classroom. She notes that recent research indicates that technology has found an almost privileged place in education and that the growing use of situated cognition theories indicate a movement from psychological to sociological theories as the foundation of teaching and learning practices (p. 27). Damarin discusses the ways in which we all 'travel' among situations that require us to be different people. If the communal production of knowledge, a basic tenet of situated cognition, is to be honored in schools we must be willing to validate the knowledge of all communities, and the experiences of children from those communities, including the previously marginalized. Damarin continues the metaphor of travelers and tourists to make the distinction between those students/tourists who experience the "monuments" of a domain and those students/travelers who immerse themselves in the domain in an attempt to more completely understand the culture. Some students enter technology rich school environments. Many elements in those settings determine whether the students becomes 'travelers' or 'tourists.'

**Travelers and Tourists**

Damarin’s metaphor of the traveler and tourist brings to mind Gibson’s (1979) discussion of affordances, the potentials or possibilities
that an object or an environment *provide or furnish* (p. 127). Gibson notes that there is a 'complementarity' between the observer and the environment or object. "Affordances are properties taken with reference to the observer" (p.143). "[W]hat we perceive when we look at objects are their affordances, not their qualities ... . [W]hat the object affords us is what we normally pay attention to (p. 134)." Affordances do not change with the needs of the observer but are always there to be perceived by the observer. A traveler immersed in a domain is more likely to recognize the affordances of the environment and of objects in that environment. A tourist is more likely to recognize the most obvious, and possibly superficial, affordances in a domain. Direct interaction offers the observer the opportunity to perceive the affordances of an environment or object.

Damarin's metaphor of the traveler and tourist also recalls Wenger's (1990) discussion of cultural transparency, fields of meaning, invisibility, and visibility of technology. Cultural transparency is "the degree to which fields of meanings in specific circumstances become realized as understanding" (Wenger, 1990, p. 102).

These fields of meanings are multilayered and are composed of multiple interrelated viewpoints ... They are textured further by the differences in legitimacy and universality claimed for the perspectives of various communities. Fields of meaning ... are not something that exist "out there" but relations that situate knowing persons and artifacts in the world as constituted by the combined production of multiple practices. (Wenger, 1990, 102)

Wenger states that, "The cultural significance of artifacts is much broader than their own structure and even the simplest artifact gives
rise to a vast and complex field of meanings" (1990, p. 102, emphasis in original). A traveler in a domain has more opportunities to become a "knowing person" thus gaining a sense of the ways in which it is "multilayered" and "composed of multiple interrelated viewpoints." A tourist would presumably miss the conjoined nature of the visibility and invisibility that constitute the transparency of an artifact or technology.

In the case of computers in the classroom, and whether teachers and students become travelers or tourists, we must look at the complementary relationship between the teacher and the computer. The classroom environment has been changed with the introduction of computers because the affordances offered have changed. What conditions make it possible for teachers to recognize those affordances? According to Gibson (1979):

The natural environment offers many ways of life, and different animals have different ways of life. The niche implies a kind of animal, and the animal implies a kind of niche. Note the complementarity of the two (p. 128).

In the current discussion of teachers, computers, and learning environments, I would restate Gibson to read:

The classroom environment offers many ways of learning, and different teachers have different ways of teaching. The classroom environment implies a kind of learning and the learning implies a kind of classroom environment. Note the complementarity of the two.

Teachers' underlying theories of teaching and learning are reflected in the classroom environments they construct and in the
ways in which they utilized the available technologies within those environments.

The unique knowledge of the teacher and the unique properties of the computer offer new affordances for teaching and learning. These affordances are always there, even when they are not perceived by the teacher. Unlike more familiar objects in the classroom environment, the affordances of the computer are covert. Simply looking at a computer does not reveal the affordances it offers for learning. Only through direct interaction between the teacher and the computer will the unique affordances of the computer to the learning environment be perceived by the teacher. Teachers' perceptions of the affordances of the computer determine whether the teacher and her students become 'travelers' or 'tourists' in classrooms with computers. The more affordances the teacher perceives the more likely it is that she and her students will become 'travelers' in computer domains. Current literature is surprisingly silent on the ways in which classroom teachers begin to perceive the affordances of computers. Is there a progression from non-user to tourist to traveler? Current accounts extolling the uses of computers in the classroom (Stevens, 1993; Baxter, 1995; Strech, 1995) generally discuss teaching strategies and rarely tell us how teachers' understandings of epistemologies and pedagogies inform them when incorporating computers into the learning environment.
Underlying Epistemologies in Classroom Practices

Olson (1988) notes that "[t]he fact that computers can serve radically different functions of schooling shows us that "educational computing" is not a value-neutral term in spite of its apparent blandness" (p. 3). It is tempting to want to use computers in all ways that support learning. But, Olson points out, computers can be used in
that support learning. But, Olson points out, computers can be used in support of two underlying epistemologies that lead to quite different classroom practices. Drill-and-practice, tutorials, and simulations support traditional schooling. These computer programs are 'closed' in that they limit the responses available to students. Computers can also be used to restructure the classroom into an inquiry based environment. According to Olson, "[I]t may be that what computers are best able to support is not the kind of thing many teachers are really comfortable with -- independent learning, open-ended problems, flexible curriculum" (p. 5). Olson observes that there is a heightened "level of expectation about what might be accomplished and the importance attached to achieving it" (p. 9) surrounding computers that was not a part of previous technology movements in schools. Damarin (1993) concurs when she states that "technology itself is honored in new ways within education" (p. 27).

The 'closed' uses of computers support teaching aimed at skill and fact acquisition. The teacher can set up a computer workstation where one or two students can be 'taught' by the computer. The teacher is indirectly teaching these students but still free to continue leading classroom activities as usual. There are those who advocate this use of computers in classrooms assuming "that the computer can do what teachers often do not — it can rescue the classroom from mindlessness" (Olson, 1988, p. 9). The outcomes of this type of computer use are generally measured using standardized tests. This is the 'school learning' that has been called into question by researchers
in the area of situated cognition (Lave, 1988; Brown, Collins & Duguid, 1989; Collins, Brown & Newman, 1989; Collins, 1991; Lave & Wenger, 1991). Computer assisted instruction (CAI) requires teachers to become familiar with only the affordances of the computer that have been recognized by the software programmer. If the design of the interface is effective in making the technology invisible, even these affordances may not be visible. This limits the affordances which the teacher must perceive in order to use the software as it was designed. It is not surprising that CAI and ILS (integrated learning systems) are popular with many school administrators and teachers. These programs can be put in place with little investment in teacher inservice and little threat to traditional classroom practices. It is much less expensive to encourage teachers to become "tourists" in their uses of computers. Stories are heard of the lone teacher in a building who has written grants, culled the want ads, and salvaged old machines to create a classroom environment that is inquiry-based and student-centered. The lack of computers and peripherals in our classrooms indicates that few building or district administrators have the funds or the means to acquire the resources needed to enable all teachers to create similar learning environments.

Knupfer (1993) sees the teacher's role as so central to change "that educational change depends on what they do and think ... In short, teachers must help to guide educational change and not be its victims" (p. 173). She discusses the "sociology of educational computing" (p. 165) in a series of questions dealing with teachers'
attitudes, desires, prejudices, fears, expectations, and decisions concerning computers in the classroom. Computers may change daily classroom practices, pedagogy, and relationships in the classroom and school. It is difficult for teachers with little computer experience to fully embrace the independent learning and open-ended problem solving that computers might encourage because of tension between "the routine" and "the novel" (Olson, 1988, p. 28). Teachers use routines to relieve some of the strain of classroom life. New practices need enough novelty to question current practices but not so much novelty that they become overwhelming for teachers and students. There must be time and energy remaining for reflection.

The process of change ought not to entail substituting one practice for another by fiat, but of subjecting existing practices to a challenge posed by another well-conceived practice. The effect of the challenge is to provide reasons to modify the existing practice through a process of critical comparison (Olson, 1988, p. 29).

The attitudes of teachers concerning the race, class, gender and abilities of students effect the ways in which computers are distributed and accessed in the school, the blending of computers and curriculum, and the teaching strategies employed (Knupfer, 1993). In the areas of race, class, and gender certain groups of students might be encouraged to use the computer more often or for activities that are more challenging.
Fostering Computer Integration

Several conditions in the learning environment make computer integration more likely (Kerr, 1990). Teachers need time to consider how to use computers in the classroom; and, they must have long term expectations for learning to use the technology. Schools and districts must be willing to support computer integration efforts. Several computers per classroom are, arguably, another necessity. Finally, flexible district policies regarding computer use that allow teachers to adapt computer technologies to their teaching styles are needed. Kerr states that meeting these conditions can result in the restructuring of classroom environments to facilitate project-oriented cooperative learning, shifts in teachers' roles, and openness of students to become more accountable for their own learning.

Knupfer (1993) sees the interactions between and among teachers, administrators, and students as the focal point for changing schools and attitudes; she points out the timeliness of social interaction theory in studying educational computing. Support for teachers, at all levels of the implementation process, is crucial. Knupfer suggests that there are four levels of successful computer assimilation (p. 172).

- Understanding the process of educational change
- Planned implementation of an innovation
- Understanding of the broad possible applications of computers to education
- Acceptance by a large, diverse, and at times fragmented constituency

A survey of computer-using teachers by Hadley and Sheingold (1993) provides insight into the process of integrating computers into
the classroom. The 608 participants in the study represented computer using teachers in all 50 states and all major cities, with some smaller cities also being represented. The significant factors which allowed the teachers in this study to continue to use computers, and thus to be identified as computer-using teachers, were motivation and commitment to students' learning and their own professional development; support from colleagues within their schools or districts; and access to enough computers to allow students and themselves the time needed to work with the technology. These authors found teachers who use computers regularly to be very comfortable with the use of computers in the classroom. They make multiple uses of computers, often being willing to take risks by experimenting with unfamiliar hardware and software. The emphasis for the teachers in this study was on students: the products they create, their learning activities, the conditions for their learning. Hadley and Sheingold also noted a shift in computer uses over time. Less experienced teachers relied more heavily on computer assisted instructional software. As teachers gained experience they began to incorporate more application software while reducing enrichment, remediation and drill uses of the computer.

Computer using teachers in this sample reported several conditions that encouraged them to continue the process of changing their teaching through the use of computers. They cited some degree of regular access to computers, some support and time which allowed them to learn to use the computers and plan for their integration, a
school climate that invited risk-taking, and enough time, five to six years, to develop a personal teaching style that includes computers. However, these computer using teachers continued to experience barriers to computer integration. They identified lack of time to develop lessons that utilize the computer, problems scheduling access to computers, the high student/computer ratio, and the school schedule as the top barriers in their continued efforts to integrate the computer in teaching and learning.

**Conflicting Views of Schooling**

Many educators and many members of the business community do not share a vision of the purposes of schools. The dominant business view holds that schools are the training grounds for future workers. These training functions of schools would be better served by replacing teachers with computers to become more efficient and cost effective (Kerr, 1990). Educators tend to be concerned with nurturing children in the process of becoming critically thinking adults, as well as, future employees of business.

The military influenced the development of computers for specific uses in defense. Business and industry adapted these flexible tools for the production of consumer products and services. In schools this *product approach* leads to CAI/ILS uses of computers which tend to reinforce existing social and economic structures. The product approach encourages teachers to be tourists in areas of computer
integration while the fields of meaning and affordances of computers remain unacknowledged.

The *process approach* to the use of computers in schools, as advocated by Streibel (1993), Damarin (1993, 1994, 1995), Olson (1988), Kerr, (1991) and others, is much more complex. Teachers need experience as computer students to gain computer skills. Teachers need experience teaching with computers to begin to perceive the many learning affordances of the computer. Teachers must then teach students the computer skills needed to operate the hardware and software. Finally, they must guide students in the uses of the computer as a tool for learning. With the rapid changes taking place in computer technologies, this cycle of teacher-as-computer-student, teacher-as-educator, teacher-as-technical trainer, and teacher-as-learning facilitator is becoming tighter and tighter causing many teachers who have little training or support in the innovative uses of computers to give in to CAI/ILS computer uses or simply not use the machines at all.

Examples from the business world may be helpful in clarifying what teachers are being asked to do with computers. Bank tellers learn to use their computer terminals to keep track of debits and credits. When a customer makes a deposit or cashes a check, the teller does not turn the computer terminal around and begin using it to instruct the customer on how to calculate the compounded annual interest on their savings account. Members of a secretarial staff are expected to use computers to write letters and create forms. They are not expected to use computers to teach their clientele the fine points of writing.
through multiple drafts of a document. But this is just what teachers are being asked to do—to use the computer, a product oriented machine, to teach learning processes and strategies with far less training in using the hardware and software than the average bank teller or secretary. With ATMs, computerized form letters, and so on, the work done with computers in business increasingly becomes the work done by computers. In contrast, what schools need to be doing is preparing students for precisely those tasks which cannot be performed by computers (Damarin, in prep.)

Many teachers have not given much thought to using computers when their 'old technologies'—books—are very useful in a process approach to learning. Books have been in most teachers' lives since early childhood. Their youth was spent in learning the nuances of how books present information for learning and pleasure. During college, books were the focus of their content and methods courses. Teachers are travelers in the domains of books; they understand the affordances for learning with and from books. Considering this lifetime of learning and professional preparation using one technology, how can we expect teachers to embrace computers with minimal training in the educational uses and affordances of these complex machines?

The literature reviewed here on situated cognition, legitimate peripheral participation, and computers in education will be used to analyze data gathered at Briar Elementary School. This is a computer/language arts magnet school in a suburb of a Midwestern
city. The five women who comprise the faculty of Briar Elementary have created variations on a theme of integrating computers into their elementary curriculum.
CHAPTER 3

METHODOLOGY

There is a national movement to raise the status of teaching to a "legitimate profession." A major part of that movement is the identification of a knowledge base that is "a systematic codified technology that is universally known to practitioners" (Pellegrin, 1976, p. 348). One of the dangers of this technical view of teaching is the marginalizing of the knowledge of practicing teachers and the privileging of the current knowledge of researchers in generating this knowledge base that would then be used to transmit skills through inservice training (Cochran-Smith & Lytle, 1993). One prevailing purpose in conducting this study was to resist the trend in education to create a technology of teaching that discounts the knowledge and insights of classroom teachers. My dissertation is one attempt to understand and honor the key roles teachers play in shaping the principles that guide their work in the schools.
Research Paradigms

Guba and Lincoln (1989) define a paradigm as "a basic set of beliefs, a set of assumptions we are willing to make, which serve as touchstones in guiding our activities" (p. 80). Two dominant paradigms of investigation are currently employed in social research: the positivistic, objectivist, conventional, or quantitative paradigm and the naturalistic, interpretive, constructivist, or qualitative paradigm.

Simply stated, a basic belief in the quantitative paradigm is the view that reality is outside of the individual, that reality has a structure that can be modeled. Thought is determined by and reflective of that external reality. Meaning is not dependent on, but rather external to, the understanding of the knower. Symbols represent reality and are the components of the inner representation of external reality (Jonassen, 1991). Quantitative researchers are willing to assume that it is possible to design research which results in findings free of contaminating influences due to researcher bias. Their practical goal is the development of increasingly better ways to predict and control events and circumstances (Guba & Lincoln, 1989).

The other dominant paradigm in social research is known as the naturalistic, interpretive, constructivist, or qualitative paradigm. In contrast to the quantitative paradigm, reality in the qualitative paradigm is believed to be determined by the experiences and interpretations of the individual. Thought grows out of experiences and is grounded in perception. Meaning depends on the knower's understanding of the world. Symbols are used by the knower to
represent inner reality (Jonassen, 1991). Researchers in the qualitative paradigm employ methods which result in increasingly better understandings of social interactions (Guba & Lincoln, 1989).

Researchers, and their works, identified within each paradigm are richly diverse. There is more disagreement within each research community on the value of findings that result from various data gathering and data analysis methods than there is disagreement over the distinctions between the paradigms. The purpose here is not to add to the body of knowledge concerning these research paradigms but rather to acknowledge their influences on this study.

A Qualitative/Constructivist Approach

The qualitative paradigm and its methods were predominant in this study for two reasons. First, the qualitative paradigm most closely matches my personal world view. And, qualitative methods are recommended when doing a case study (Patton, 1990). My intention in this study was to conduct an in-depth inquiry into the lives of teachers in the field in order to understand how they learned to integrate computers into their daily classroom practices. The participants in this study are an unusual group of women who have successfully integrated technology into their elementary curriculum. Qualitative methodology fit my purposes.

In current literature, the qualitative paradigm is most often represented as taking three approaches. These are to understand, to emancipate, and to deconstruct. Processes involved in listening,
restating, and observing aid constructivists in their attempts to understand multiple realities. Critical theorists view reality as socially constructed but dominated by the constructions of the most powerful. The goal of critical theory is to inform and emancipate the dominated. Post-structuralists aim to deconstruct meaning and reality based on the work of such philosophers as Foucault, Derrida, and Daignault.

A constructivist approach was used to guide this inquiry because, as befits the purposes of the study stated above, this research had understanding as its major (and driving) goal. But, it had secondary purposes as well. I do hope that creation of an alternative understanding will contribute to the emancipation of elementary teachers and students from the domination of mundane and controlling uses of computers. By examining and reporting ways in which mature, women teachers appropriate technology, I hope to problematize the identification of technological fluency with young men as symbolized by the hacker.

Guba and Lincoln (1989) use the term "constructivist paradigm" rather than "qualitative paradigm" to discuss ontology, epistemology, and methodology. In their writings, a constructivist approach to research rejects a priori theory because "designing a study to focus on one set of variables or concepts precludes (in positivist terms) pursuing others" (p. 99). The approach I used in the analysis of these data would therefore not be considered strictly "constructivist" if measured against Guba and Lincoln’s definition. As noted earlier, the theory of
legitimate peripheral participation was used during the later stages of data analysis to aid in understanding the data\textsuperscript{3.1}.

However, the theory of legitimate peripheral participation is constructivist in its roots because it seeks to explain the role of community on the sense-making of individuals and the roles of individuals on the evolution of the community. In this research, I have extended the theory from existing communities of practice to include new communities of practice created with the purpose of incorporating a new tool. In future research, I intend to focus on existing communities of practice attempting to incorporate new tools.

Having made these statements about my basic beliefs and use of qualitative methods, I must admit to reporting data gathered using Lickert scales, generally associated with quantitative methodology. While the participants were enrolled in a telecourse at The Ohio State University, they provided demographic information on their ages, number of years of teaching experience, other technology related workshops or courses taken, frequency of use of technology in their teaching, confidence in their technical skills, confidence in their knowledge of integrating technology, and local hindrances to technology integration. I believe that these data represent pieces of the teachers' stories and for that reason they are included in the biographies in Chapter Four.

\textsuperscript{3.1} See Appendix A for a chronology of data analysis.
Sampling

Patton (1990) states that "the logic and power of purposeful sampling lies in selecting *information-rich cases* for study in depth" (p. 169). Purposeful sampling was the method used in locating participants for this research. This sampling method was chosen because my intent was to work with a group that included some women elementary teachers. In particular, I wanted to study experienced teachers between 40 and 60 years of age who used technology as a teaching and learning tool. There were several reasons for focusing on experienced teachers. First, these teachers are comfortable with classroom management and instruction. This allows them more time and energy to be creative in their approaches to instruction. Women between 40 and 60 years of age did not interact with computers as children. They were not taught how to integrate computers into the curriculum as undergraduates if they have a number of years of teaching experience. And, these women would have had little opportunity to observe other teachers modeling the integration of technology in the elementary classroom.

The two purposeful sampling techniques I used were intensity sampling and homogeneous sampling (Patton, 1990). "An intensity sample consists of information-rich cases that manifest the phenomenon of interest intensely (but not extremely)" (p. 171). The purpose of choosing a homogeneous sample is "to describe some particular subgroup in depth" (p. 173). In 1993, I was a graduate teaching assistant and the instructional designer for a graduate
telecourse, "Technology in the Curriculum." Teachers and administrators enrolled in the telecourse were asked to send demographic and computer integration information to the instructors of the telecourse. The Briar Elementary School teachers were all enrolled in this telecourse so I had access to their demographic and computer integration information. All of the Briar Elementary School teachers were in the target age range and all described themselves as using technology several times per week; but they were not confident with their technology integration skills. The teachers at Briar Elementary happened to all be women. This particular group of teachers met all of my criteria.

There was also an element of convenience sampling (Patton, 1990) in the choice of Briar Elementary School as the site for my dissertation research. The school was within the distance I had set as the limit I would be able to travel to a research site. However, intensity sampling played the most important role in the choice of this site.

Access

Access to the site was gained by first making telephone contact with the teachers in September 1993. At that time a meeting was set up for September 16, 1993. On that date, I went to Briar Elementary and met with three of the five teachers explaining that I wanted to gain some insight, through their experience, into how teachers go about integrating technology into classroom practice. These three teachers took my proposal to the teachers who could not be present. I called
Briar Elementary on September 17, 1993, and was told that all five teachers were willing to participate in my study.

In summer 1994, the proposal for this dissertation was submitted for human subjects review. After permission was granted to continue, I sent a letter to the Lakeside School District requesting permission to conduct intensive data gathering. This data gathering was completed from October 4, 1994, through December 6, 1994. Additional data were gathered in October 1995, on December 18, 1995, and on February 8, 1996.

**Data Collection Methods**

I employed multiple data collection methods for this study. A group discussion involving myself and the five Briar Elementary teachers was held at the school in November 1993. I took field notes and audio taped the discussion. The audio tape was later transcribed. Two or three individual interviews with each teacher were conducted between winter 1994 and winter 1996. The principal was interviewed once in autumn 1994. All interviews were audio taped and transcribed. I made field notes during classroom observations conducted between autumn 1993 and autumn 1994. A grounded survey based on the group discussion and first round interview topics was given to the teachers in winter 1994. A document analysis of assignments completed by the teachers while they were students in the telecourse, products and projects generated by the students of Briar Elementary, grant proposals authored or co-authored by the teachers, and magnet
school documents also contributed data for this study. School district demographic documents were used to create a profile of the Lakeside School District. Community information was gathered from the Bedford Falls Chamber of Commerce.

**Group Discussion.** One group discussion was conducted early in the study — on November 11, 1993 — to identify themes related to technology integration. This was a guided discussion\(^3\) relating to the telecourse, "Technology in the Curriculum," that the teachers were taking at the time. The group discussion lasted approximately forty minutes and ranged over a wide variety of issues. Besides the questions I had prepared, topics included some early history of learning to use the computers at Briar Elementary, the teachers' frustrations with lack of time to learn to use software, and conditions in the school and the district that the teachers felt were conducive to computer integration at Briar Elementary.

**Interviews.** The first interview with each of the teachers took place between January 27, 1994, and March 3, 1994. These were guided interviews with questions and topics related to the group discussion, classroom observations and the teachers' responses to reflective assignments completed during autumn 1993 for the telecourse. The second set of guided interviews took place in autumn 1994 toward the end of eight weeks of intensive classroom observation. The questions for the guided interviews were designed to probe topics which emerged during previous data gathering. The interviews were casual and

\(^3\) See Appendix B for the group discussion questions.
encouraged in-depth responses from the participants. This guided approach gave me the opportunity to spontaneously incorporate follow-up questions when needed. Third interviews to clarify earlier data were conducted in February 1996 with two of the teachers.

The principal was interviewed in November 1994. He was asked about his views of Briar Elementary as a teaching and learning environment and his role in setting the school climate. Mr. Favorite was also asked to comment on the differences between the technology uses of the teachers at the two schools where he was the building administrator. Other areas of discussion during the interview included troubleshooting with hardware and software, parental responses to the curriculum, Mr. Favorite's and district administrators' expectations of the teachers at Briar Elementary School, and assessment of the success of the new computer lab.

**Grounded Survey.** The grounded survey\(^3\)\(^4\) built on themes that emerged after the group discussion and three of five teachers had been interviewed in the first round of guided interviews. All five teachers had mentioned lack of time to learn to use hardware and software and lack of troubleshooting skills as personal frustrations when attempting to integrate technology. In spite of these frustrations, these women persisted in using computers as a teaching tool.

As an elementary teacher and as an observer of elementary teachers, I noted that administrators tend to give superficial support in gaining competence in new teaching methods. Teachers are expected

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\(^3\)\(^4\)See Appendix C for the grounded survey.
to garner these on their own. However, many elementary teachers, and all of the Briar Elementary teachers, are women with many family and household obligations. Part 1 of the survey included items relating to the number of people living in the household, family demands on time, and personal professional growth. Part 2 related to influences within the teaching environment at Briar Elementary. Part 3 of the grounded survey included questions about computer and other technology use during the 1993-94 school year.

I placed the grounded surveys in the teachers' mailboxes at Briar Elementary on Monday, February 21, 1994. I picked the surveys up from the school secretary on Thursday, February 24, 1994. Four of the five teachers returned the survey.

**Participant Observation.** During the 1993-94 school year, I spent a total of seven days observing classes at Briar Elementary. During the 1994-95 school year, I spent 25 days observing. I also attended the school's "Technology Showcase Night" on November 17, 1994, and the third- and fourth grade open house displaying their work on magnets and circuitry on November 28, 1995. When my role was more observer than participant, notes were taken during observations. Often, my role also included being a participant in classroom or computer lab activities. In those instances, I made notes as I had time during the day or after leaving the school. Several times I stopped in the parking lot of a small strip mall near the school to record observations and reflections on the day. These field notes were transcribed and coded during data analysis.
**Document Analysis.** Several types of documents were included in the document analysis. The Briar Elementary School mission statement and goals statement were analyzed. A district brochure on "The Magnet School Programs, 1993-1994" was also included. This brochure contained sections on the language arts and computer magnet school program: program overview, philosophy, student attendance in the program, and school size. The sections dealing with the mathematics and science magnet school program contained an overview of the program, philosophy, and student attendance in the program. A schedule of informational meetings for parents, application procedures, and a student application form completed the brochure.

Two grant proposals authored or co-authored by the Briar Elementary teachers were included in the document analysis. One grant proposal submitted by the two computer/language arts magnet schools was funded by GTE under the Pioneering Partners™ for Educational Technology program. The narrative for this grant proposal included sections on goals for awareness, adoption, evaluation, and grants/funding. This grant was submitted in spring 1994. Funding began in autumn 1994. The grant proposal for state funds to create a virtual community for the teachers and students of the Lakeside School District's three magnet elementary schools was submitted to the state in autumn 1994; funding began in autumn 1995. It contained sections defining the school improvement initiative, documentation, indicators of success, and indicators of progress.
Briar Elementary School's application to the Regional Professional Development Center to become a language arts site was part of the document analysis. One narrative section of this application detailed the teachers' rationale for naming Briar Elementary an exemplary site for language arts teaching and learning. The other narrative section included the teachers' reasons for wanting to become a language arts site. Briar Elementary was not selected as one of the Regional Professional Development Center's language arts sites.

All individual reading response assignments\textsuperscript{3,5} and the final projects completed for the telecourse, "Technology in the Curriculum," in autumn 1993 were analyzed. The assignments were directed reflections in response to scholarly articles on technology and the craft of teaching, technology and restructuring, technology as an agent of education change, and thinking in visual images. The final projects for the telecourse were individual reflections on the process of learning to integrate technology into the elementary curriculum.

\textbf{Data Analysis Methods and Data Analysis}

The data were read during and after data gathering in an effort to recognize emerging patterns and categories. From early passes through the data, the categories that emerged were: school climate, views about teaching and learning, strengths of technology, weaknesses of technology, reorganizing planning and instruction to include technology, technology and the changing roles of the teacher, and

\textsuperscript{3,5} See Appendix D for the reading assignments.
becoming a technology using teacher. By summer 1995, the group
discussion, interviews, classroom observations, faculty meeting
observations, telecourse assignments, student projects, magnets school
documents, and grounded surveys were coded for analysis. Final
coding categories included:

1. Conditions in the school and district which fostered the
   integration of computers
2. Conditions in the school and district which hindered the
   integration of computers
3. Changes in individual teaching styles of teachers
4. Learning to use the hardware and software
5. Teachers' perceptions of benefits gained from computer
   integration
6. Teachers' sharing of expertise with each other and with me
7. Teachers' attitudes and beliefs about technology, themselves,
   and learning
8. Uses of computers by Briar Elementary School students

Each of the coding categories was assigned a color. As I read
classroom observation notes, interviews, the group discussion,
teachers' assignments from the telecourse, and documents gathered
from the school and district, pertinent passages were marked with one
or more colors to indicate the area(s) in which they would be included
for analysis. Eventually subcategories emerged from each of the eight
major areas of analysis. These, too, were color coded to organize the
data for further analysis and the writing of Chapter Four of this
dissertation.

The analysis of the data was guided by research on cognition and
learning in the areas of educational philosophy, cognitive psychology,
and anthropology, as well as research in the area of classroom uses of computers. The major story that emerged from the data was the creation of a "community of practice" (Lave & Wenger, 1991) that grew around the developing computer expertise of the teachers of Briar Elementary School.

As discussed in Chapter One, the decision to use the work of Lave (1988) and Lave and Wenger (1991) as the major lens for data analysis was made in the spring of 1995\textsuperscript{3,2}. The theory of legitimate peripheral participation did not guide the data gathering but did guide the writing of Chapter Four and, to some extent, Chapter Five. My personal brand of constructivist research does not reject the use of a theory for data analysis.

Lave and Wenger’s theory of legitimate peripheral participation deals with the continuous development of communities of practice that incorporate craft and tool skills. In these communities, newcomers learn from old-timers and eventually replace the old-timers through attrition. My intent in using this body of work was to examine how the teachers of Briar Elementary School had come together to create a new community of practice which included the integration of computers in the elementary curriculum. There was no attempt to prove or disprove the theory of legitimate peripheral participation. On one hand, this theory facilitated my understandings of the data as I analyzed them for how well they "fit" with Lave and Wenger's (1991) analyses of other communities of practice. On the

\textsuperscript{3,2} See Appendix A for a chronology of data analysis.
other hand, I extended the theory of legitimate peripheral participation to include new communities of practice created by expert users of the tools of everyday practice as they learn to incorporate a new tool. In this case, the experts are experienced elementary teachers and the new tool of practice is the computer.

The Role of the Researcher

One of the aspects of qualitative research that draws me to this methodology is the acknowledgment that the researcher invariably effects the research. In addressing researcher credibility, Patton (1990) states that "[t]he principle is to report any personal and professional information that may have affected data collection, analysis, and interpretation—either negatively or positively—in the minds of the users of the findings" (p. 472, emphasis in original).

As described elsewhere in this dissertation, I taught elementary school from 1979 though 1991. During that time, computers were introduced into my school. I was never satisfied with my own attempts to integrate computers into the curriculum and less satisfied with the ways in which my school district eventually mandated that computers were to be used in my school. The participants in my study are women much like myself—middle-aged, experienced elementary teachers. When I read their reading responses for the telecourse and then met these women, I was struck by their success at integrating computers in a way that is supportive of constructivist learning
principles. I wanted to understand how they had been successful at a
task that I had found extremely frustrating.

While there is no way to be certain, I feel my experience as a
classroom teacher and my willingness to participate in classroom and
computer lab activities at Briar Elementary School resulted in more
detailed and revealing data than would have been possible if I had been
viewed by the teachers as more of an 'outsider' to the profession. I
could understand and empathize with their daily lives. My classroom
experience also aided me in probing during interviews.

A more detailed account of my teaching experiences and views
appears in Chapter Four where I included an autobiography in the
section titled The Participants.

I am a feminist who believes that technologies become gendered
through cultural processes. I am also typical of many women
elementary teachers in that one of my concerns is the nurturing of
children. As implied in Chapter One, I am leery of a machine — the
computer — developed by the military and refined by business that has
made its way into classrooms which are inhabited by women and
children. I want to know what values of military and business cultures
are embedded in these machines and how those values might effect
children, teachers, and classroom environments.

Personal events that may have effected this study, especially the
early stages, were the deaths of my sister and my mother in August
1993 and October 1993, respectively. Members of my dissertation
committee were very understanding about my need to be away during
much of that time. I can't help but think that my focus on the research process was effected by these events.

**Ethics and Politics**

The major purpose of this study was to understand the process of integrating technology into the elementary curriculum by experienced teachers, especially experienced women teachers. However, I had other reasons for pursuing this study. Technology is often viewed as a mechanical manifestation of male power in our culture. Computers have been developed largely by and for the military, although computer technologies have found their way into almost every aspect of late twentieth century American life. I find the introduction of computer-based technologies into elementary schools, the domain of women and children, to be problematic if there is not a growing local awareness and discussion of the effects these computer-based technologies can have on the learning and teaching environment.

To establish consent and gain entree, I met with three of the five teachers at Briar Elementary on September 16, 1993. I explained the purposes of my study and the probable amount of their time that would be involved. The next day those three teachers and the two who were not present discussed whether they wanted to participate in the research project. As a group they agreed to participate.

The confidentiality of the participants' involvement in this study was a principal concern. All materials related to the study were kept in areas where I was the only person who had access to them. The names
of the participants were coded on all data and changed for reporting purposes.

At times during the interviews, the participants asked me to turn off the tape recorder and then related confidential or sensitive insights into building or district politics. I reconstructed those remarks later for my own purposes in keeping a thorough record of data sources but did not report any confidentialities that could compromise their positions within the district in this report.

Qualitative research recognizes the role of the researcher in gathering and analyzing the data. In my role as participant/observer at Briar Elementary School, I utilized the full continuum the role allows. At times, I was strictly an observer of classroom activities. At other times, I was a full participant in the classroom or computer lab with the "observation" portion of my role coming later during personal reflection. I feel my experiences as a participant in the daily life of the school helped to establish me as an insider and to give me insights into the dilemmas faced the teachers.

Having been an elementary teacher, I was very concerned about reciprocity. I know how stressful and time consuming teaching can be. To compensate the teachers of Briar Elementary for their time and cooperation, I helped supervise the computer lab (the school had no computer lab assistant), was a guest speaker whenever invited, and helped them and their students learn to use some of the new software during the autumn of 1994.
Trustworthiness

"When the domain of the social sciences is extended from the prediction of facts to also include the interpretation of meaning, the criteria and forms of validation change" (Kvale, 1989, p.88). While quantitative inquiry depends on reliability, validity, neutrality, and applicability, qualitative inquiry deals with issues of credibility, transferability, dependability and confirmability (Guba, 1981; Guba & Lincoln, 1989).

Credibility One of the means of establishing credibility is the documentation of the research techniques and methods. This was done above. Other means used to establish credibility in this study include prolonged engagement, triangulation, and member checks.

My prolonged engagement with the participants began in September 1993 and continued through December 1995, with follow-up for clarification occurring in February 1996. The teachers of Briar Elementary initially interacted with me as the instructional designer of the telecourse "Technology in the Curriculum." I appeared in videotaped segments of several programs and in two of the four one-hour long live teleconferences. I was available to take phone calls from students in the course one evening per week while the telecourse aired.

The participants also knew me as a researcher. In autumn 1993, midway through the telecourse, I conducted the group discussion with the teachers. A few days later I went to Briar Elementary intending to spend my time in a classroom observation. Instead, I supervised the
computer lab during the morning because the second grade teacher had a substitute who was uncomfortable with computers. The teachers' acceptance of me as an insider was augmented after that morning in November 1993. Even though it was unplanned, stepping in to fill an immediate need appears to have been interpreted as an indication that I was a "good" teacher; a peer who could be counted on when needed. When we started individual interviews in the winter, I felt very privileged to be given quite confidential information on the politics of the school and the district.

During winter 1994, I visited the school several times to conduct interviews with the teachers, to observe in the classrooms, and to talk with the third grade class about my home state of Washington. In the spring, I continued classroom observations and occasionally helped supervise the computer lab.

I offered to help the teachers learn to use their new computers and software as a means of reciprocity. When the computer lab was upgraded in autumn 1994, I worked with the teachers individually or in pairs on some new software. I also supervised students and assisted the teachers with their students in the computer lab.

Member checks also increase the credibility of qualitative inquiry. In early February 1996, I delivered copies of Chapter Three to all of the teachers and copies of Chapter Four to the teachers and principal. I asked the teachers to read and verify my data gathering methods and the amount of time I spent in the school as written in Chapter Three. I requested that the teachers and the principal read Chapter Four to

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make sure that those who had lived the experience had a chance to tell
me if they thought that I "got it right." I asked them to correct any
factual errors and to suggest additions and deletions to the two
chapters. I picked up the dissertation chapters eight days after leaving
them with the teachers. At that time, I asked each teacher for any
further feedback that had not been written in the chapters. They
requested no additional specific changes. Mac Favorite, the principal,
was not at Briar Elementary when I picked up the dissertation copies so
I was only able to obtain written feedback from him.

I made all factual corrections suggested for Chapter Four. There
were no suggestions of deletions or additions. Mr. Favorite
commented, "I thought this chapter did a good job of capturing the
"spirit" of the school especially the dedication that the staff has put
forth and the investment in time and energy they've made." At the
end of her biography, Lisa Redford wrote, "You made me sound like a
star!"

Patton (1990) suggests triangulation of data sources by "comparing
and cross-checking the consistency of information derived at different
times and by different means within qualitative methods" (p. 467,
emphasis in original). Triangulation of data sources has served to
cross-check information that was gathered at different times during
this study. The telecourse assignments were completed by the
participants in autumn 1993. These were used as part of the document
analysis. Interviews and observations, conducted in winter, spring,
and autumn 1994, helped to confirm information gathered during the

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group discussion in autumn 1993. Early observations, interviews and the grounded survey guided the observations and interviews that took place in autumn 1994. Finally, a faculty meeting with the district superintendent on my last day of formal observation, December 6, 1994, served to confirm data gathered by all earlier methods. In this study triangulation was used to confirm data gathered across time and methods and to guide interview questions as themes emerged.

**Transferability.** While quantitative research is concerned with generalizability, qualitative research is concerned with transferability. This is done through "thick description." By providing a thick description of the site, participants, data gathering techniques, and data analysis methods, the researcher leaves conclusions about transferability to the reader (Lincoln & Guba, 1985).

**Confirmability and Dependability.** Confirmability and dependability are also mentioned by Guba and Lincoln (1985) as means of establishing trustworthiness. Confirmability deals with the extent to which assertions about the data can be corroborated by the context and participants and not simply the interpretations of the researcher. Dependability verifies that the data collection methods were appropriate to the study. My concern was to ensure that both the process and product of this study could withstand the scrutiny of a third party audit. To these ends, I documented researcher assumptions shortly after beginning work with the participants; kept a researcher journal throughout the study, and archived all materials related to the study in my home. These materials include hard copies of documents

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used in the document analysis, hard copies of student assignments, audio taped, electronic, and hard copies of the group discussion and all interviews, electronic and hard copies of all field notes, and electronic copies of all early versions of dissertation chapters.
CHAPTER 4

CREATING A COMMUNITY OF PRACTICE

- Children guide their parents through an examination of their personal electronic portfolios.
- In November, first graders create word processed documents to inform their parents about what they have enjoyed in their school experiences.
- Computer-generated holiday cards are sent to children in a local hospital.
- Students in first through fifth grades plan and help build a courtyard accommodating the needs of local wildlife.

What characterizes a school in which events such as this are typical? Several factors: community, school resources, staff, and the ways in which all of these come together. In this chapter, I first describe the site and participants in my study. I then review the constructs of legitimate peripheral participation (Lave & Wenger, 1991) as a lens for looking at the data. The data analysis follows. In those sections, I
provide a chronology of events at Briar Elementary School and examine the data as evidence of the creation of a community of practice. Lave states that "'Cognition' observed in everyday practice is distributed—stretched over, not divided among—mind, body, activity and culturally organized setting (which include other actors)" (1988, p. 1). In this chapter, I examine how the everyday practice of integrating computers "stretched over" the community of practice known as Briar Elementary School.

The Setting and the Participants

The Community of Bedford Falls

Bedford Falls is a suburb of a large Midwestern city. The first European settlers arrived in 1806. A men's seminary was begun in 1840. In 1847, this became a university that admitted both men and women of all races. This institution of higher learning is now a small four-year liberal arts college. Bedford Fall's rich history includes involvement in many important social movements. The community is proud of having supported Abraham Lincoln, having been a stop on the Underground Railroad, and having played a major role in the Temperance Movement. Like so many other American towns, Bedford Falls sent its young men off to war, enjoyed prosperity, and suffered adversity.

In the mid-1990's, the quality of life in Bedford Falls was enhanced by many sports and recreation facilities, two libraries, twenty-two local parks, four metropolitan parks, several community theaters, a local
symphony and band, three small museums, fifty-five churches, and seventy-two service clubs.

Although many Bedford Falls residents commuted into the city, the community offered local employment in banking, health care, light industry, and education. At the time of this study, the community enjoyed an unemployment rate between two and three percent with approximately three percent of the population living below the poverty level. Post-secondary educational opportunities included the liberal arts college and a branch campus of the metropolitan community college that offered two-year technical and transfer degree programs.

Bedford Falls was young, white, and growing. A community document based on United States census records for 1990, the most recent comprehensive community information available, showed the population of Bedford Falls to be 30,269. Several new subdivisions were constructed in the early 1990's adding to the population. This community document also revealed that in 1990 the median age in Bedford Falls was 33.3 years with nearly seventy-one percent of Bedford Falls residents being over 18 years old. Forty-seven percent of the population was male and fifty-three percent of the population was female. Family backgrounds reported in the 1990 census indicated that in Bedford Falls just over ninety-six percent of the population self-identified as white, one and three-quarters percent as African American, slightly over one percent as Asian, one-tenth of one percent as First Peoples, and less than one-tenth of one percent as other races.
The Lakeside School District

The Lakeside School District served the entire community of Bedford Falls and a small portion of a neighboring community. The student population of nearly 13,000 students attended fourteen elementary schools, three middle schools, and two high schools. The per-pupil per-year expenditure for the 1994-95 school year was approximately $5,200. Standardized test scores were consistently above state averages at all grade levels. Ninety-nine percent of the district's seniors graduated, and seventy-nine percent went on to post-secondary schooling.

The Lakeside School District had a six-day rotation of classes in lieu of the more common five-day rotation. The days were lettered A, B, C, D, E, and F. The first day of the school year was designated an "A day." Each day that school was in session after that followed the A-F pattern. For example, if the first day of the school year was on the Wednesday preceding the Labor Day holiday, the three days of school for that shortened week were A, B, and C days. The Tuesday immediately following the Labor Day holiday was a D day. When school was not held due to state inservice days, snow days, holidays, or parent-teacher conferences, the rotation of days flowed around the break in routine by beginning classes with the next day, A-F, in the six-day cycle. Special classes, such as physical education, art, music, and library were scheduled using this six day rotation. The specialist schedule for a class might be: A-physical education, B-library, C-no special class, D-physical education, E-art, and F-music. This schedule
insured that all students received equal instruction from the district specialists.

**Briar Elementary School**

During the 1988-89 school year, the Lakeside School District was faced with a shortage of space. Despite having built two new elementary schools, two older buildings had to be used to provide classrooms for the growing number of elementary-aged students in the district. How could students, parents and teachers be enticed into these older buildings? The district administrators decided to create magnet schools. Originally the schools were to be literature-based magnet schools, but some district administrators were unsure of the definition of a "literature-based" curriculum. They also worried that a literature-based curriculum would not attract enough students to fill the two schools. Technology, in the form of computers, was added to the magnet schools' programs and the term "literature-based" was changed to the more generic "language arts." According to one veteran teacher, this was how Briar Elementary School and Northwood Elementary School became "language arts and computer magnet schools" (AG-I1)\(^4^1\). The teachers of Briar Elementary did not use a basal reading series. Reading and language arts were based on a wide variety of fiction and non-fiction children's literature with a whole-language approach to instruction.

\(^4^1\) See Appendix E for data codes
During this study, Briar Elementary School served five classrooms of students—one in each of grades one through five, or approximately 135 students in the entire school. Students were selected using a lottery. During the kindergarten year, parents entered their child's name in the drawing for the following year's first grade class. Thirteen girls and thirteen boys were chosen by lottery for the first grade class. Other children were placed on a waiting list in the event that a place opened. While I was at Briar Elementary, wait-listed students entered at all grade levels. A publication\textsuperscript{4.2} of the Lakeside district indicated that,

The Language Arts and Computer Magnet Schools are regular full-time elementary schools where students attend all day and study all subjects. The instructional program in the schools emphasizes the use of literature in lieu of basal reading texts and the use of the computer as a tool in the learning process. A variety of flexible groupings are utilized by the teachers for students to complete assignments and share what they have learned. Cooperative learning activities enhance the cognitive and social development of the students. Written Composition plays a big part in the program as students complete reading logs, react to their readings or compose original pieces of writing ...

and

We believe the Language Arts and Computer Magnet School will foster and nurture the personal, academic, and social development of each child. Further, we believe that an integrated literature based program, together with enhanced computer technology will provide the

\textsuperscript{4.2} This document was titled "The Magnet Schools Programs, 1993-1994." It contained information about the magnet schools' curricula, their philosophies, a description of the student attendance policy, and a student application form.
foundation upon which to build on each child's potential to be a responsible, knowledgeable, life-long learner.

In autumn 1993 when I began collecting data for this study, the communal technology at Briar Elementary school consisted of 2 television monitors with VCR's, a computer lab with fifteen Macintosh Classic computers and two dot matrix printers, a file server housed in the secretary's office, and a recently- liberated laser disc player.4.3

In autumn 1994, the computer lab was upgraded to 15 student work stations networked to a file server in the lab. These work stations were Macintosh 550's; three of which had CD-ROM capabilities. The two original dot matrix printers remained networked to the student workstations and a laser printer was added to the local area network. A teacher workstation consisting of a Power Macintosh networked to the student workstations, a color liquid crystal display panel, a color flatbed scanner, and a modem linked to the school's phone line were also added.

By the autumn of 1995, the district had funded a digital still camera and a parent had donated a color inkjet printer. The new district science program included the use of many laser discs so the laser disc player with a color monitor was set up in the school's library.

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4.3 The laser disc player had sat in its box for over two years. The teachers had been instructed not to take it out, and begin the warranty time period, until the district could send someone to train them in using the laser disc player. The teachers eventually decided that the only way they were going to learn to use the player was to set it up and use it, which they did (GR)
where all students would have access to it even when the computer lab was in use.

The computers were the dominant form of technology integrated into the Briar Elementary School curriculum although the video camera, the VCR's, and the laser disc player were also used. Therefore, in this study, the terms "technology" and "computers" are used interchangeably unless otherwise designated.

Computers were only a part of the rich learning environment provided for the students of Briar Elementary. The school was also a "Tribes school." The Tribes Program combines group processes with cooperative learning. One of the aspects of this program that sets it apart from other cooperative learning programs is the emphasis on building trust and inclusion before tasks are assigned. The intention is to create a "safe caring environment" in small groups and the whole classroom (Gibbs, 1987, p. 22). The focus on students' social development is meant to increase academic achievement and to encourage "respect for and acceptance of individual differences" (Gibbs, 1987, p. 23).

The Participants

I met the teachers from Briar Elementary School in the autumn of 1993. At that time, I was a graduate research assistant for a telecourse that focused on the integration of technology in the K-12 curriculum. This telecourse was state funded and developed by the public television station affiliated with the university and my program area in the
College of Education with support from a regional technology agency. Delivery of course content was via television broadcast of 12 pre-produced half-hour programs on technology integration in various areas of the curriculum and of 4 live one-hour teleconferences. Students also purchased a packet of information that included required readings. The broadcast area for the telecourse was approximately eighty miles by one hundred seventy miles. The telecourse was open to anyone but the target audience consisted of the educators in the broadcasts' region. The telecourse was conducted during autumn quarter 1993.

The one hundred sixty-nine students in the telecourse, generally teachers, received 2 graduate credits for watching the 12 half-hour programs, participating in the 4 live teleconferences, writing responses to 4 of 5 readings, and completing a final project on technology integration in their own classrooms, buildings, or districts. All 5 of the Briar Elementary School teachers were students in the telecourse (Cambre, Erdman & Hall, 1996).

The Faculty of Briar Elementary School. Four of the five participants in this study were members of the original faculty at Briar Elementary School in autumn 1989. Each admitted that the attraction of Briar Elementary was the language arts component, although all had some experience with computers before beginning their Briar Elementary School teaching assignments. The fifth participant, the first grade teacher, joined the faculty in autumn 1991. All were women
over the age of forty who, by the end of this study in 1995, had 16-24 years of teaching experience.

The teachers at Briar Elementary served on a number of districtwide committees. The district often requested one committee member from each school. With only five faculty members to call upon, the number of committee assignments for the Briar Elementary teachers was higher than that of other teachers in the Lakeside District. The number of grant proposals that each of the Briar teacher's had authored was also unusually high. This indicated to me the faculty's deep commitment to enhance the learning environment of Briar Elementary through alternative sources of funding.

Each of the teachers brought unique experiences and perspectives to the Briar Elementary community of practice. These were based on individual efforts to learn to use computers, differences in post-secondary education, varying stages in child-rearing, and different levels of comfort with risk-taking, especially in regard to computers.

**Lisa Redford, First Grade Teacher.** In autumn 1995, Lisa Redford began her twenty-third year of teaching. She joined the faculty of Briar Elementary School as the first grade teacher in autumn 1991. Ms. Redford had a master's degree in reading, which she received in 1980, and computer certification, which she received from a local university. Lisa Redford was named Lakeside Teacher of the Year in 1988. In autumn 1993, she reported that she took an average of one college course during each academic year and two during the summer. She reported using technology several times per week in her teaching (LR-
S1). In autumn 1994, Ms. Redford attended an intradistrict HyperStudio workshop that lasted several weeks. The same year, Ms. Redford also began sharing the duties of systems operator for Briar Elementary's local area network with Amelia Kelly, Briar's third grade teacher.

Ms. Redford and a Northwood Elementary teacher co-authored a grant that was funded by GTE through Pioneering Partners™ (GP1) during the 1994-95 school year. The implementation of this grant included a "Showcase Night" hosted in the two language arts/computer magnet schools. Students from each school presented their work to parents, district administrators, community members, and others in an effort to "educate stakeholders about the use of technology in support of learning in the elementary classroom" (GP1). Lisa Redford and the co-author of the grant planned and organized "Showcase Night" in the two schools.

Implementation of the Pioneering Partners™ grant also included bringing teachers from both within and outside the Lakeside School District to the two language arts/computer magnet schools. These teachers visited the schools on two occasions. During the first visit in the winter of 1994-95, they observed students and teachers from Briar and Northwood Elementary Schools in computer- and technology-related activities and then brainstormed how they could use their new insights in their own classrooms. In spring 1995, the group reconvened to discuss how the visiting teachers had used technology as a result of their earlier observations. Lisa Redford and her co-author were the
teacher-leaders who planned, organized, and conducted the two one-day working sessions.

In addition to her professional duties, Lisa Redford juggled the duties of wife, mother, and athlete. She entertained family and friends at home as well as attending various social functions. In autumn 1993, Ms. Redford estimated that she took a child to lessons or practice of some sort an average of twenty-five times per month and attended events with her children an average of eight times per month (LR-S1). As an athlete, Ms. Redford participated in an adult soccer league and doubles tennis where her partner was Dicey Tillerman, the fifth grade teacher at Briar Elementary School.

**Cybill Servant, Second Grade Teacher.** Cybill Servant, a petite, ebullient woman in her early fifties, was in her twenty-second year of teaching during the 1995-96 school year. She received her master's degree in early and middle childhood education in 1980. Ms. Servant had led intradistrict workshops in social studies and the Tribes program which encourages academic achievement and respect for individual differences. Cybill Servant wrote and received funding for three Service Learning Grants. In addition, she had served on district-wide committees and participated in at least three other grant writing efforts. One of these grant proposals resulted in the three magnet elementary schools receiving state funds to enhance the technology skills of their faculties.
In autumn 1993, Ms. Servant completed a demographic survey for the telecourse described earlier. She was not very confident in her technology skills or in her knowledge of integrating technology in the curriculum. Cybill Servant rated herself as a 2 on a 5 point scale, with 5 being *very confident*, in the areas of confidence with her technical skills and knowledge of integrating technology. These self-ratings were surprising since she had taken one technology-related class and one technology-related workshop, and had also used technology several times per week in her teaching since 1989. She cited lack of planning time and lack of class time as the two things that stood in the way of her integration of technology (CS-TD).

I found Cybill Servant's self-reporting of her confidence compared with her technical skills and her knowledge of integrating technology to be interesting. Ms. Servant was the least aggressive in exploring software and in troubleshooting when her peers were present during my two-year involvement with Briar Elementary. In conversations, she was often apologetic or self-deprecating about her computer skills. Yet, I observed Ms. Servant integrating the computer creatively into her second grade curriculum and demonstrating a commitment to learning more about the computers and various software programs. Ms. Servant attended a HyperStudio workshop for several weeks in autumn 1994. She also decided to purchase a new Power Mac for her home like the computer in the new teacher work-station to have compatibility with the school's hardware and to learn the new software installed in the computer lab. She chose and purchased all of the
software for her home computer. In addition, Cybill Servant used her new home computer to explore the education area of a commercial on-line service to which she and her husband subscribed.

Outside of school Cybill Servant was involved with her family—her husband and three adult children, church activities, and aerobics classes.

**Amelia Kelly, Third Grade Teacher.** Amelia Kelly, in her mid-forties, was the youngest member of the Briar Elementary School faculty. She began her sixteenth year of teaching in autumn 1995. Ms. Kelly reported being moderately confident in her technology skills and in her knowledge of integrating technology in the curriculum on a telecourse questionnaire in autumn 1993. She rated her confidence in both of these areas as a 3 on a 5 point scale, with 5 being *very confident* (AK-TD). I found Ms. Kelly’s self-assessment curious because she was quite adventurous in her personal pursuit of technology experiences. She took a summer course in multimedia at the local college and was the teacher who had spent the most time investigating the school’s laser disc player and collection of laser discs.

When the computer lab at Briar was upgraded in autumn 1994, Amelia Kelly assumed the role of co-systems operator for Briar Elementary’s local area network with Lisa Redford, the first grade teacher. The duties of this position included, but were not limited to: serving as contact person, troubleshooting minor problems, fixing those problems, contacting the appropriate vendor to obtain needed
service, adding and deleting programs to the network and individual work stations, ensuring that any software installed was properly licensed, maintaining records of software installation and network repairs, and performing daily, quarterly, and annual maintenance tasks (AK-S2). In an interview in November 1994, Ms. Kelly talked about her position as systems operator, "I figured it would be one way to really learn it. To be forced to learn it. And, I do enjoy it some" (AK-I2).

In autumn 1994, Ms. Kelly also purchased a new Macintosh computer with CD-ROM capabilities for home use so she would have compatibility with Briar's computer lab. She, like Cybill Servant, personally chose and purchased all of the software for her home computer. The Macintosh computer that Ms. Kelly purchased when Briar Elementary opened as a magnet school in 1989 went to college with her daughter.

Among her colleagues, Amelia Kelly was and is highly regarded for her organizational skills, her efficiency, and her calmness in the classroom. She received her master's degree in education in 1988. At least once a year Ms. Kelly conducted intradistrict workshops on using a whole language reading and language arts program. She wrote, "I was chosen because I teach at a language arts magnet school where these types of programs are piloted" (AK-S2). Amelia Kelly participated in writing the grant proposals for the magnet schools' venture capital grant and a Serve America grant.
In addition to her work at Briar Elementary School, Ms. Kelly was a wife and mother. Her son was in high school; one adult daughter was away at college. Her other adult daughter was a part-time college student and, in January 1995, had the family's first grandchild. Involvement with her family and her church kept Ms. Kelly very busy.

**Amber Geddes, Fourth Grade Teacher.** Amber Geddes was a warm, open, relaxed woman who was the senior member of the Briar Elementary faculty both in teaching experience and age. She quietly but skillfully led in interdisciplinary teaching and in integrating new pieces of software.

Amber Geddes was quite comfortable with the computer technology in the school and set herself the task of learning to use the school's new computers and software in autumn 1994 with a healthy dose of humor. In fact, Ms. Geddes and her husband, an engineer, decided that they would purchase a new home computer so she would have compatibility with the new computers at school. They kept waiting for the new Power Macintosh computers so they could buy one computer that would meet all of their needs. "[F]inally we just decided, why don't we just get two computers that do exactly what each of us wants and not wait for this one that's going to solve all of our problems. Because we thought, well, what if I wanted it and he wanted it at the same time. We'd have to share. So when we came to that realization, then Bob just said, 'Get the one you want and I'll get the one I want'" (AG-I2). Ms. Geddes gave her daughter the Macintosh
computer she purchased in 1989 when Briar Elementary opened as a magnet school.

In autumn 1993, Amber Geddes rated herself as moderately confident (3 on a 5 point scale) with her technical skills and with her knowledge of integrating technology in the curriculum. She reported using computers several times per week in her teaching (AG-TD). Ms. Geddes defined the integration of technology into the curriculum as "weaving technology into the curriculum already being taught" (AG-S1).

In 1985, Amber Geddes began leading intradistrict workshops. When asked why she thought she was chosen to lead workshops, Ms. Geddes stated that she was "viewed by supervisors or principals as having something to share" (AG-S2). Three to five times a year she worked with other teachers in the areas of language arts, science, or the Tribes program for developing positive peer relationships among students. Dicey Tillerman, the fifth grade teacher at Briar Elementary, described Amber Geddes as "a real master teacher." Ms. Geddes also reviewed science and math materials for a national clearinghouse. In 1992, she completed her master's degree in education with a concentration in the area of portfolios as a form of assessment. She served on districtwide committees and had also been involved in several grant writing efforts including a state venture capital grant, a Jennings Scholar grant, and a Serve America Grant.

A wife, mother of two adult children, and grandmother of three, Amber Geddes had a busy personal and professional life.
**Dicey Tillerman, Fifth Grade Teacher.** In autumn 1995, Dicey Tillerman, the fifth grade teacher at Briar Elementary School, began her seventeenth year of teaching. I view Ms. Tillerman as a deeply thoughtful and reflective teacher. In 1985, she received her masters degree in reading supervision. During the 1980's, Ms. Tillerman was asked to be one of two teachers and two administrators who served as district facilitators for the TESA (Teacher Expectations for Student Achievement) Program. More recently she led one or two intradistrict workshops in science and Tribes per year.

Dicey Tillerman was an early user of computers in her personal work. She purchased an Atari computer for work on her master's degree in the early 1980's. In autumn 1993, while taking a distance education course on the integration of computers in the K-12 classroom, she reported having previously participated in two workshops and one course related to technology. She also reported that she used technology in her teaching several times per week (DT-S1).

Ms. Tillerman's grant writing experiences had resulted in receiving Jennings Scholar grant funds for "gardening in the classroom, a grow lab, class field trips to the local zoo and an international horticulture exhibit held in the city" (DT-S2).

Dicey Tillerman was a wife and mother of two adult children who lived out of state. Her husband had a successful professional practice in the city. They owned a small business in a nearby city that she helped
to run. Ms. Tillerman's other activities included rollerblading and playing tennis.

**Mack Favorite, Principal.** Mack Favorite, the principal of Briar Elementary School, spent five years in the classroom. Two of those years were as a seventh grade science teacher and three years were as an elementary reading specialist. Mr. Favorite had an administrative certificate and a master's degree in education with an emphasis on reading. He worked for the state department of education before joining the Lakeside School District as a central office administrator (SP-I2).

The 1995-96 school year was Mack Favorite's seventh year as a building administrator and his third year as the principal serving halftime at Briar Elementary School and Willa Cather Elementary School. These were two of the three magnet elementary schools in the Lakeside School District. The emphasis at Willa Cather Elementary was on technology, math, and science (SP-I2).

Mr. Favorite became interested in educational technology when he worked for the state department of education, which had some Macintosh computers. He could see the educational advantages that the computers offered. As a central office administrator for the Lakeside School District, Mack Favorite was involved in getting Macintosh computers for the schools. Technology became an integral part of the curriculum for the magnet elementary schools when they were established in 1989 (SP-I2).
Mr. Favorite served on several district and regional committees dealing with educational technology. He also appeared on a live teleconference for the telecourse on integrating technology in the K-12 classroom in autumn 1993. The teleconference featured a panel of teachers and principals of teachers who were using educational technology in generative ways.

In autumn 1995, Mack Favorite stated that he had never taken a course on computers and had attended only two one-day workshops—one on Excel and one on PageMaker. His expertise with computers came from on-the-job-training when wiring, troubleshooting, or software installation were needed. Some of Mr. Favorite's expertise came from installing and maintaining his home computer system (SP-I2).

Although a proponent of educational technology, Mack Favorite still had some questions. "We don't know what impact this has as far as 'Does it improve student achievement?' I couldn't tell you that. I think it provides another strategy for kids for learning and another way to create things. But will that make them any better than the student who doesn't have the computer, as far as standardized scores? I have no idea. I don't know" (SP-I1).

When talking about the reasons parents choose Briar Elementary School over their neighborhood schools, Mr. Favorite said, "Well, a couple of things. I think certainly the staff. The reputation of the staff sells it. We have a different approach. It's small. I think parents are
concerned about a safe learning environment. And certainly the technology we have helps, too" (SP-I1).

Mack Favorite and his wife had 2 teenage children who attended school in the Lakeside School District. "I have 2 kids at home and they can probably be on the computer 3 or 4 hours by themselves. And when they go to school they don't have a computer at all, other than when they're scheduled in there (the computer lab), or when the teacher can get one of the floaters that's available for class. So as a parent I'd love to see the schools get more" (SP-I1).

Mr. Favorite's experiences with educational technology and his easy-going manner helped to maintain and foster a climate conducive to computer integration at Briar Elementary.

**Leslie Hall, Researcher.** My early experiences with computers were typical of the experiences of millions of classroom teachers. During the 1984-85 school year, a Commodore 64 computer was wheeled into my fifth grade classroom; no inservice was provided in operating the computer or in integrating it into classroom practice. I occasionally had students use drill-and-practice programs from the school's very limited supply. I felt guilty about the small amount of use such an expensive piece of hardware received in my classroom.

In about 1986, the district switched to Apple IIe computers. Again, there was no inservice on operating the computer or on integrating it into classroom practice. From 1986 to 1988, I often arranged for a computer afternoon by borrowing computers from 3 or 4 other
teachers. This allowed teams of 5 to 6 students an extended amount of
time to use simulation software such as Odell Lake and The Oregon
Trail. During this same time period, I attended a district-sponsored
class in AppleWorks. I didn't teach my fifth grade students to use this
program, but I did start using it for my own work, to communicate
with parents, and to create worksheets for student assignments.

The administrative emphasis in my school district, among the
poorest in Washington state, was on basic skills. In this small rural
school district, nearly eighty-five percent of the students were Hispanic.
Most were the children of farm laborers and many were migrants. The
majority of the students were limited- or non-English speakers. The
students' scores on standardized tests were among the lowest in the
state. The administrators and many teachers viewed the students as
deficient and in need of skills that would move them out of a cycle of
poverty. Officially the district policies professed respect for the life-
styles and cultures of all students. Casual conversation indicated that
many administrators and teachers put little time or effort into
understanding either of these important aspects of the students' lives.

During the 1989-90 school year, the elementary school began using
an Integrated Learning System for reading and language arts. This
particular ILS was recommended by the Chapter I reading teacher,
investigated by the assistant superintendent, and purchased from a
national vendor. The system included pre-K through high school
reading and language arts software, record-keeping software, teachers'
manuals, and several student workbooks at each level. The district
purchased a file server and thirty Apple IIe computers for a computer lab.

The teachers generally started out with misgivings about teaching reading from the ILS manuals and the basal reading series and teaching language arts from the ILS manuals and the district approved textbooks. I had some of those same misgivings but was willing to give the system a chance. The students were very enthusiastic about using the computer lab for two forty-five minute periods per week. But, by spring 1990, students and teachers alike dreaded going to the computer lab to work on boring electronic worksheets. When I left the district in 1991, the Integrated Learning System was still in use. The dramatic increases in standardized test scores envisioned by the district administrators had not become a reality.

I was not in agreement with the philosophy of education that drove the ILS. I had felt for several years that there had to be a creative way to use computers in the classroom. I imagined there must be a school climate that would foster creative ways to use computers. In autumn 1991, I entered graduate school at The Ohio State University and began to discover that I was right. The majority of my teaching at the university was in a course on the integration of computers in the classroom for pre-service teachers. This course evolved over time but remained focused on helping pre-service teachers understand how computers can be used in a learning environment based on constructivist theories of teaching and learning.
In autumn 1993, I was fortunate in meeting the teachers at Briar Elementary School when they were enrolled in a telecourse on the integration of technology in the K-12 classroom. Here were teachers using computers in the creative, generative ways that I had been teaching to pre-service teachers. I had to find out what in the environment, and in the teachers, had made this possible.

Questions

- How did these unique teachers create a community of practice?
- How did they become computer-using teachers?
- What frustrations did they encounter along the way?
- How did they use the computer as a creative/constructivist tool for teaching and learning?

Lave and Wenger's (1991) constructs of legitimate peripheral participation will be used as a lens to examine these issues.

The Constructs of Legitimate Peripheral Participation:

A Lens for Reading the Data

The preceding sections have provided some background information on the site and participants for this study. My experiences with Briar Elementary School led me to view this school as a continuously forming community of practice that integrated
technology into teaching and learning. In this section, I review the constructs *legitimate peripheral participation, community of practice, learning curriculum, continuity, displacement, technology of practice, transparency, visibility, invisibility* and *identity* (Lave & Wenger 1991, Wenger 1990) discussed in Chapter Two. In the next section of this chapter, I use these constructs to analyze Briar Elementary School as a community of practice.

**Legitimate Peripheral Participation.** In a social interaction theory of learning, learning is said to be a situated activity. This means that the setting and the learning are inextricably joined. The learning that goes on in any particular setting is unique due to the singular experiences of the participants. Legitimate peripheral participation is the phrase used by Lave and Wenger (1991) to describe the continuous folding in of both the individual and the common experiences of newcomers and old-timers as learning takes place. The decision to create a new situation, a language arts/computer magnet school at Briar Elementary, and the unique individual and common experiences of those involved make legitimate peripheral participation an interesting lens with which to examine the integration of computers in this elementary school.

**Community of Practice.** A community of practice is the "set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991, p. 98). All five of the Briar Elementary teachers had long histories with the "tangential and overlapping communities of
practice" in the Lakeside School District and the community of Bedford Falls. As members of a community of practice, "they share a way of 'going about doing some things' ... because they have come in contact with each other ... " (Wenger, 1990, p. 145, emphasis in original). The development of the community of practice, and with it the ways of integrating computers, is critical to the story of Briar Elementary School.

**Learning Curriculum.** The teachers of Briar Elementary created the learning curriculum, or "field of learning resources in everyday practice," (Lave & Wenger, 1991, p. 97) that led to the integration of computers examined in this dissertation. Lave and Wenger state that the learning curriculum must be "viewed from the perspective of learners" (Lave & Wenger, 1991, p. 97, emphasis in original) and cannot be examined except in situ. As a newcomer to the community of practice, the learning curriculum could become clearer to me only as I engaged with the old-timers in the community.

**Continuity and Displacement.** Newcomers, upon entering a community of practice, develop their identities through interactions with old-timers and other newcomers. These evolving identities and the continuous folding in of unique individual experiences and common experiences alter the practices of a community. These are regularly interrupted and supplanted by the most recent community practices. The Briar Elementary School practices were interrupted several times by the departure of old-timers and the entrance of newcomers. The principalship changed hands four times during Briar
Elementary's first five years as a language arts/computer magnet school. One of the original teachers left the community, as did the school clerk, who was integral to the development of the learning curriculum. Lisa Redford joined the community as it began its third year. And, for two years, I was a member of this community. All of these departures and entrances into the community of practice effected the continuity and displacement of practices. The questions which emerge are: In what ways did those who left the community effect the practice before they departed? How were their departures felt within the community? What did newcomers add to the community? How did practices change as a result of the entrances of newcomers?

Technologies of Practice. Lave and Wenger state that "understanding the technology of practice is more than learning to use tools; it is a way to connect with the history of the practice and to participate more directly in its cultural life" (Lave & Wenger, 1991, p. 101). The technologies of practice used at Briar Elementary School included, but were not limited to, the district approved course of study, routines of each classroom, textbooks, literature and reference books, VCRs, videotapes, software, and computers. As noted above, the individuals who comprised the Briar Elementary community of practice had previous experiences with some versions of all of these technologies of practice. One of the reasons for embarking on this study was to gain some understanding of the interactions of the teachers' philosophies and common experiences in learning to integrate computers as tools of everyday practice. I was particularly
interested in connecting with the history of the practice by listening to
the teachers talk about their perceptions of the effects computers had
had on the district approved course of study and on their own daily
practices.

**Transparency, Visibility and Invisibility.** The term *transparency*
has to do with "knowing in practice" (Wenger, 1990, p. 102). It is a
composite of the two characteristics *visibility* and *invisibility* in that
"these two crucial characteristics compose transparency by a complex
interplay, their relation being one of both mutual exclusion and
mutual implication" (Wenger, 1990, p. 103).

The Briar Elementary teachers’ professional experiences with
many of the technologies of practice, i.e. the course of study, classroom
routines, and books, meant that these tools had both extended visibility
and increased invisibility. The extended visibility came from
understanding the functions of these technologies in a school setting.
The increased invisibility of the tools made it less complicated for them
to adapt these technologies to specific situations at Briar Elementary.
As a former classroom teacher, the visible and invisible functions of
these common technologies of practice are also known to me. I wanted
to understand if and how these teachers had gained an extended
visibility of computers as a technology of practice in an elementary
school. I also wanted to know if and how this extended visibility
helped to increase the invisibility of the computer in their planning for
teaching and learning activities at Briar Elementary School.
Identity. Lave and Wenger state that learning "implies becoming a different person with respect to the possibilities enabled by" systems of relations created in social communities (1991, p. 53) and that "learning and a sense of identity are inseparable: They are aspects of the same phenomenon" (Lave & Wenger, 1991, p. 115). In what ways did the teachers at Briar Elementary change their professional identities as their continuous interactions with computers gave this technology extended visibility and increased invisibility? As noted above, several of the teachers ratings of their confidence with computers seemed contrary to their apparent confidence in the computer lab. To what extent did their perceptions of their mastery of the computer as an educational technology slide back and forth along a continuum of more and less expert as the extended visibility and increased invisibility of each new piece of hardware and software became more evident?

These constructs — legitimate peripheral participation, community of practice, learning curriculum, continuity, displacement, technology of practice, transparency, visibility, invisibility and identity (Lave & Wenger 1991, Wenger 1990) — are useful in examining just how Briar Elementary School became an innovative community of practice that went far beyond the original visions of the district administrators.
Analysis of the Briar Elementary School Community of Practice

I begin this analysis with a summary of the chronology of events in the history of Briar Elementary School as a language arts/computer magnet school. I then discuss transparency, visibility, and invisibility of computers in the lives of the teachers and students of Briar Elementary School. The development of a learning curriculum, legitimate peripheral participation at Briar Elementary, and the construction of identities are then examined. I follow that discussion with a look at how the teachers of Briar Elementary created a new community of practice whose mission was to integrate a new technology of everyday practice.

A Chronology of Events

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<th>Event</th>
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<tr>
<td>Au 1988/W 1989</td>
<td>Administrators in the Lakeside School District made the decision to create two language arts/computer magnet elementary schools.</td>
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<tr>
<td>Spring 1989</td>
<td>The five initial Briar Elementary teachers met for one week to plan their program.</td>
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<tr>
<td>Autumn 1989</td>
<td>Briar Elementary opened with Ivy Harrison as the first half-time principal and 15 Macintosh Classic computers in a lab. Lillian Moss, school clerk, actively helped the teachers learn to use the computers and software.</td>
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<tr>
<td>Autumn 1990</td>
<td>Mike Foster joined Briar Elementary as the half-time principal. Lillian Moss, school clerk, became less involved with the computers.</td>
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Spring 1991  Greta Downing, first grade teacher, and Lillian Moss, school clerk, left Briar Elementary.

Autumn 1991  Lisa Redford joined Briar Elementary as the first grade teacher.

Autumn 1992  Ray Oakes joined Briar Elementary as the half-time principal.

Autumn 1993  Mack Favorite joined Briar Elementary as the half-time principal. All five teachers completed the telecourse on the integration of technology in K-12 classrooms. I began my membership in the school community.

Autumn 1994  The computer lab at Briar Elementary was upgraded to Macintosh LC's, a Power Mac teacher workstation, a flatbed scanner, and a laser printer. Briar Elementary and Northwood Elementary received grant funds to share their expertise on the integration of computers. I was in the school three to four days per week gathering data and participating as a member of the community.

November 17, 1994  Showcase Night—parents, district administrators, university professors, and state department of education officials were invited to Briar Elementary and Northwood Elementary to view computer-based work done by students.

January 1995  Teachers visited Briar Elementary and Northwood Elementary in compliance with the grant to share computer expertise.

Spring 1995  Teachers returned to Briar Elementary and Northwood Elementary to share their experiences with computers in compliance with the grant to share computer expertise.
Visibility, Invisibility, and Transparency at Briar Elementary

The five teachers at Briar Elementary School began their personal experiences with computers years before they accepted the task of integrating computers in a language arts/computer magnet school. Some of these experiences included using computers for personal correspondence, writing papers for college courses, and keeping family accounts. Their school experiences with computers included preprogrammed educational software such as drill-and-practice, tutorials, and simulations.

Prior Computer Experiences of Briar Elementary Teachers. Lisa Redford was one of Lakeside School District's computer pioneers. She was a member of a small group of computer enthusiasts who attended after-school classes and workshops and then taught the new skills to others in the group or any other faculty members who were interested. Ms. Redford also taught her elementary students to program in BASIC and Logo.

Many school librarians have been the school personnel initially in charge of computers at the building level. This relieves individual teachers of some of the responsibilities but it also makes their movement toward the visibility and invisibility of computers more difficult. In Amber Geddes' case, the librarian at her previous school
was the gatekeeper of the computers. She said, "[T]he kids would go
down with the librarian. I really had very little contact with the kids
using computers. It was mostly handled through the librarian, and it
was really mostly just math drill ... And I was really excited when I first
heard about it, but then when I saw what they were doing — it was
more like a workbook. It was like, 'Fill in a verb. Fill in a noun' ... I
almost have the feeling, now that I think back about it, it was kind of
hands-off with the teachers" (AG-I2).

Amelia Kelly also reported that the librarian at her previous
school had made the decisions regarding hardware and software. Most
of the programs were drill-and-practice with no word processing
available for students. Dicey Tillerman recalled that in her previous
school, "We were just taking those kids in there because we were
supposed to once a week ... I'm not sure they became more computer
literate. They became more game literate" (DT-I1). A statement made
by Cybill Servant reflected the general attitude of these teachers toward
early attempts to use computers, "There didn't seem to be any good
way to utilize them. There were so few of them and the capabilities
were so limited" (CS-I2).

All four of the original Briar Elementary teachers (Lisa Redford
joined the faculty in autumn 1991) reported having been dissatisfied
with the learning opportunities afforded by preprogrammed drill-and-
practice, tutorial, and simulation software. Sharing these feelings, in
spring 1989 they decided to use only application (word processing,
database, and spreadsheet) software at Briar Elementary School. These
two approaches to using educational software are akin to Damarin's (1993) descriptions of 'travelers' and 'tourists.' In 1989, the Briar Elementary teachers were ready to leave behind the role of 'tourist,' and the encumbering drill-and-practice, tutorial, and simulation software, in the educational computing domain. The decision to use only application software started these teachers down the road to becoming 'travelers' immersed in the educational computing domain.

**Moving Toward Transparency at Briar Elementary School**

The process of becoming a 'traveler' in an educational environment that included computers became intense for the teachers of Briar Elementary in autumn 1989 and was continuing when this study ended in autumn 1995. Having been provided little inservice or release time to learn to use the new hardware and software, the teachers sought their own occasions for gaining computer expertise. They spent many hours with computers before school, after school, on weekends, and during summer breaks. Even with her computer certification, it took Lisa Redford a full year to become comfortable with the hardware and software at Briar Elementary. After she joined the staff in autumn 1991, Ms. Redford made screen dumps as she progressed through programs and taped these pages to the walls of the computer lab in a makeshift linear computer manual (LR-II). Ms. Servant learned the nuances of MicroSoft Works, the school's application software, from her husband (CS-I2). In 1982, Ms. Tillerman used the owner's manual to teach herself word processing on an Atari.
She transferred those skills to the Apple IIc in 1987 and to the Macintosh in 1989 when Briar Elementary School opened as a magnet school (DT-I2). The teachers at Briar Elementary School also sought out a colleague from another elementary school and had "mini-lessons" from him. They learned from observing parents who came to help out in the computer lab; they learned from their students; they learned from their building administrators; and they learned from each other. Through these examples and related efforts, the tenacity of the Briar Elementary teachers was rewarded; they became 'travelers' in the educational computing domain.

Another key to the successful integration of computers at Briar Elementary was Lillian Moss, the school clerk. During the first year, 1989-90, Ms. Moss was allowed to spend a great deal of time in the computer lab learning to use the computers and the software. A dialogue from the group discussion illustrates the role she played.

Dicey Tillerman: She really got us started when we didn't have the time.

Amber Geddes: When you didn't have the time, she figured it out and taught you ... And she would put it on a kind of menu of do this, do this, do this with the kids.

Dicey Tillerman: And take us in before school started and say, "OK, this is how you do it. I've got it figured out." After she would spend four hours figuring it out!

Amber Geddes: And she could show us in ten or fifteen minutes.

Amelia Kelly: And that's how we really got started.
Lillian Moss, like the teachers, was a computer novice. She learned to use the hardware and software as a full participant in the community of practice at Briar Elementary. Her new-found expertise helped the community to accelerate the integration of computers by contributing to the process of the extended visibility/increased invisibility of the technology.

This anecdote provides an example of the relational nature of visibility and invisibility. Lillian Moss taught the teachers key skills for using various pieces of software. This new knowledge helped the teachers to envision and plan learning opportunities for their students. The visibility of the computers continued as the teachers taught the necessary skills to students. The computers then faded into invisibility as they became just another tool for learning. This cycle was repeated as the nuances of various pieces of software were learned, taught to students, and incorporated into activities.

Each of the teachers had taken more than one computer or technology course but failed to find any of them completely satisfying. Ms. Kelly took a multimedia class in the summer of 1993 and encountered glitch after glitch in the hardware and software. She was never able to use what she had learned with her peers or with her students (AK-II). Ms. Tillerman attended a one day workshop on HyperCard and said, "I'm so frustrated because I've never used any of it. I went home and tried to use it. Some of the things I could do there, I couldn't do at home. I didn't know if it was me or my computer or
what. Couldn't do any of it here (at school). It was just very frustrating and so I've never been able to use that or show the kids how to do it" (DT-11). As a group, the faculty took a distance education course on the integration of technology in the K-12 classroom during autumn 1993. They voiced disappointment in the lack of specific 'how-to' activities. The teachers also mentioned feeling frustrated in not seeing more hardware and software troubleshooting tips that they could use immediately in their classrooms. Cybill Servant commented during one interview, "I can't sit and watch somebody do it. I have to do it. And, to me that's a good lesson, though. It reinforced to me that the kids have to do it. There's no way they could sit and watch somebody do something" (CS-11).

The Briar Elementary School teachers felt obligated to begin using the computers with students as soon as school started in autumn 1989, in spite of their own lack of expertise. They jumped right in with the students setting a pattern of allowing themselves no lead time to become comfortable with a piece of software before introducing it to students. "I learned it with them. It was really scary ... We didn't have any lead time. We just — boom — in the fall with them. That's how we learned" (AK-12). This pattern was repeated in autumn 1994 when the computer lab was upgraded. The teachers took an intradistrict workshop on HyperStudio. Cybill Servant and Amber Geddes immediately had their students collaborate in second/fourth grade pairs on HyperStudio projects.
When discussing her evolution as a computer using teacher, Amelia Kelly said, "Well, I feel like I spend more hours here at school, almost, than I do at home. And I want those hours at school to be valuable hours, too. So I feel like what we do here has to be really worthwhile and valuable. If it means spending a little extra time planning something involving technology you just plan on that time. A lot of it is just second nature now, though" (AK-I2). On the same subject Lisa Redford said, "We're still growing. We're still learning. There's so much I don't know. It's scary. You just try to stay a half-step ahead" (LR-I1).

The Briar Elementary teachers were comfortable with what Olson (1988) termed the classroom activities "computers are best able to support ... independent learning, open-ended problems, flexible curriculum" (p. 5). When I entered the community of practice in autumn 1993, the teachers had begun to understand the depth of the educational affordances (Gibson, 1979) offered by computers. They could see that changes in the power, speed, and versatility of computers would offer them and their students more and different opportunities for learning. These opportunities included cross-grade level projects, interdisciplinary learning, and the expansion of the "classroom" to encompass the whole school. At times the five teachers found this understanding overwhelming because they felt they had so much to learn.
Computers in Teachers' Planning and Thinking

The visibility, invisibility, and transparency of the computers in the Briar Elementary School community of practice became more apparent when the teachers discussed ways in which they had each changed their teaching or thinking. Ms. Geddes talked about the adjustments she had made in allowing each technology or piece of software to work its way into her subconscious thinking when planning learning opportunities for the students. "Now I think, all right how are we going to use the computer? In what way can the computer or technology play a part? ... So, it's just a way of thinking. I see that as the major change, that in my thinking I provide those opportunities ... It's not a question of, 'Do I?' It's just automatic" (AG-I1).

Ms. Geddes also explained how she talked about computers when giving workshops for other teachers, "I've said the hardest part for me was right here (tapped her head). And, I tell them it was all the thinking, all the planning, all the emotional strain. It was all here (tapped her head again). And, to me, that's where it was for a long time. It wasn't so much just the implementing. It was kind of like I knew what I wanted to do but it was getting it all put together! That was the thinking part" (AG-I1).

When Ms. Servant talked about planning for her second grade students she said, "When they're writing, I'm very aware of what is possible for them to go ahead and type as a finished product using the word processor, and what would be way too overwhelming for them to
type ... I think a lot about it when I'm planning ... So it has made me very much aware of things that are possible to do as long as they're in the realm of my possibilities!" (CS-I1)

In a conversation about planning for technology integration, Amelia Kelly said, "Whatever we do dovetails right into whatever we're studying. I guess I take the topic and then I try to see how I can plug in the computer. Or plug in the video. Or what I can do to enhance the topic ... I don't think of it as really new right now. I guess it's time to start looking for new things because it's seeming pretty normal" (AK-I1).

Lisa Redford designed partner projects in the computer lab for her first graders "because then I don't lose out on all the verbal interchange that goes on ... There's an awful lot of communication that goes on" (LR-I1).

A great deal of the frustration regarding computers voiced by the teachers of Briar Elementary had to do with the issues of visibility and invisibility. Initially the computer was very visible to them in their planning as they focused on the curriculum and learning outcomes. However, when computers malfunctioned or the software sent unfamiliar error messages during a class activity, the computers became all too visible when they were supposed to be invisible. The design of computers and software are important in the interplay between their visibility and invisibility as teachers and students incorporate computers into everyday practice.
Examples of Computer Integration

Briar Elementary offered rich examples of computer integration in an elementary curriculum. The emphasis on activity and on the social nature of learning are evident in the following.

**The Heritage Unit.** In autumn 1994, the computer lab at Briar Elementary was upgraded and an intradistrict workshop on HyperStudio was offered. Cybill Servant and Amber Geddes began planning and implementing a unit on heritage with their second and fourth grade students shortly after beginning the HyperStudio workshop. The interdisciplinary unit entailed a variety of activities. Computers were integrated in the Heritage unit through the creation of HyperStudio stacks by second- and fourth-grade buddies.

In Ms. Servant's class, the second graders researched the flags of the countries of origin of up to four of their ancestors and then drew and colored one or two of those flags. As a group, the students located the countries of origin on a large world map in a classroom display. Cybill Servant read the class a book about an immigrant girl in the 1850's. Each day the students listened to a part of the story. Then, each student used that day's portion of the story to write a diary entry from the immigrant girl's point of view. A class survey was conducted to determine which second graders had moved to a new house, a new city, a new state, or a new country. These data were used to create graphs. The students conducted family history interviews with parents, grandparents, or other older relatives. As a class, the students produced a timeline and placed their immigrant ancestors on it. The
students asked their parents for the times of day of their births. Ms. Servant and the students then used these times to construct a class chart plotting the times of the students' births.

Ms. Geddes taught a small group of fourth grade students to create a stack, to link cards, and to add new cards, color, and card effects. Each of these students then taught their newly learned skills to two or three others. After all fourth grade students were somewhat proficient with HyperStudio, each was given a second grade buddy. They then taught the second grade students the same basic HyperStudio skills. Together the second grade/fourth grade buddies created a HyperStudio stack that reflected their expertise with the program and the heritage of each. All HyperStudio stacks included a title card, digital photographs of the two students, a card with a scrolling field containing information about each student's heritage, similar cards containing information about each student's family and interests, and a card for credits and acknowledgments. The second and fourth grade classes held an open house to share these projects with their parents.

Many of the second grade activities could have been done using the computers, however, most were completed with paper and pencil. When the unit was repeated in autumn 1996, the second grade students created their HyperStudio stacks without the assistance of a fourth grade buddy; and the graphing of birth times was done in a spreadsheet program.

**Surveys and Graphing Project.** Another example of computer integration at Briar Elementary came from the third grade class of
Amelia Kelly. The students were studying charts and graphs and the various ways in which data can be displayed. Each third grade student created a survey with four or five choices. The person taking the survey had to choose a favorite from among the choices, i.e. sports: basketball, volleyball, tennis, football, hockey or movie: *Flintstones, Lasie* [sic.], *Homeword* [sic.] *Bound, Lion King*. The surveys were conducted in the third grade classroom. Each student then went to the computer lab and entered his/her data into a spreadsheet program. The data were charted using the various charts and graphs available in the MicroSoft Works program. Each student had to decide which visual display best depicted the data. Printouts were made showing the raw data and the chart or graph selected.

A Revolutionary Project. In the fifth grade, Dicey Tillerman’s students contracted with her to read between one and four of Jean Fritz’s books on important figures of the Revolutionary War. A worksheet accompanied each book read. Each student then chose one person to study in depth. The final product was a handbill about the person. This was created using KidWorks. The requirements for the handbill were three columns of equal width with information in five categories: early life, activities related to the Revolutionary War, basic facts, occupation, and interesting information. The students were encouraged to use clip art or original drawings to add interest to the handbills. Because the students were not familiar with the software, there was a great deal of collaboration and problem solving in the
computer lab as they worked to meet the requirements of the assignment and to make their handbills visually appealing.

**Magnets and Circuitry Unit.** In autumn 1995, Amelia Kelly and Amber Geddes collaborated on a Magnets and Circuitry unit using AIMS (Activities in Math and Science) Education Foundation materials. The teachers used computers to create a small booklet entitled "My Discovery Journal." The students studied magnets and circuitry through hands-on discovery activities and used their booklets to keep personal reflections on the activities completed. Posters, games involving simple circuits, and short reports were all products created by the students. Ms. Kelly and Ms. Geddes videotaped many of the activities.

KidPix, which had been added to the software in the computer lab in autumn 1994, became a tool for the Magnets and Circuitry unit. The students had used KidPix for some projects during the 1994-95 school year but had not made use of the slide-show feature of the software in school projects. In early autumn 1995, Amber Geddes discovered that many of the third and fourth grade students had KidPix on their home computers. She took advantage of their knowledge by having these students teach others to create slide-shows. After all third- and fourth-grade students had some basic skills in creating slide-shows, pairs of third grade students and individual fourth grade students chose one concept from the magnets and circuitry unit to explain using a KidPix slide-show.
In the evening on December 5, 1995, the third- and fourth-grade students held an open house to demonstrated their knowledge of magnets and circuitry for their families and other invited guests. Each student had created a multiple choice game or activity wired to light a small bulb when the correct answers were chosen. These games were on the students' desks in the third- and fourth-grade classrooms and on the tables in the computer lab. These games were available to be explored by visitors. Students showed their KidPix slide-shows on the computers in the lab. Amelia Kelly and Amber Geddes had edited a twenty-minute video tape from over two hours of raw footage of the third- and fourth-grade students involved in magnet and circuitry discovery activities. Copies of this tape were continually showing at each end of the hallway. Families and visitors were impressed with the students' products and the students' abilities to explain the concepts of magnetism and circuitry.

Integration of computers in the Briar Elementary curriculum occurred in multiple ways. The integration resulted in the blurring of distinctions between subjects, grade levels, and "teachers' and "students."

Computers in Students' Planning and Thinking

Since most students at Briar Elementary came to the school as first graders, technology, and especially computer-based technology, became a part of student planning in their own activities and projects. For example, groups of fourth grade students were planning resources to
use in a presentation on the animals pioneers would have encountered during the westward movement. One of the fourth graders remembered that the school had a laser disc on dinosaurs and wondered if there might also be one on bears. In another group a student suggested that they ask the librarian for help in finding videos that could be used as sources of information. One student tried to convince his group to choose a specific animal for study because he had a CD-ROM at home and, "I can print us out thirty sheets!" Ms. Geddes remarked that students were thinking about making graphs on the computer and creating their text on the computer, "They're real comfortable with it. So for them it is a way of thinking" (AG-I1).

Students with computers at home served as resources for other students and the teachers. Cybill Servant and Lisa Redford both mentioned the sharing of information and troubleshooting that went on in the computer lab. Lisa Redford said, "Some of them do (have computers at home) and they bring to the room a lot of knowledge. And they'll tell you little things that you didn't know. I'm forever finding stuff out from kids" (LR-I1).

**Benefits to Students.** These teachers had a number of years of teaching experience on which to make comparisons; and they had some high praise for the curriculum they had developed at Briar Elementary School. Dicey Tillerman saw her students extending themselves and learning at a level that was deeper than when she taught fifth grade without extensive computer integration (DT-I1). Amber Geddes admitted to being skeptical about technology at first,
"but after the first year I was 100% behind it without any qualms because I saw the effectiveness. Kids became better communicators, better learners" (AG-I). Later she said, "They just become more effective learners. And, I feel like they're learning, oh—I suppose it's not just technology, but I really feel that ... it stays with them, they apply it back to their real life. So, I think it is very important. It's important to them" (AG-I1).

Regarding her second grade students, Cybill Servant noted "their willingness to take risks, to try new things on the computer. And I think that carries over into other areas. They are willing to try things ... And, I think, too, it's been really good in that it teaches them that it's OK to make mistakes because there's very little that you can do on a computer that you can't fix" (CS-I1).

On several occasions during lunchtime conversations, the teachers indicated the belief that standardized tests do not show evidence of the kinds of learning valued at Briar Elementary. Nevertheless, they were pleased that students at Briar Elementary did well on standardized tests. The students in the Lakeside School District averaged one year above the national average on tests conducted in spring 1994. Briar Elementary School first grade students had scored three months above the district first grade average on those standardized tests. Briar Elementary fifth grade students had scored one year above the district fifth grade average (LR conversation, October 5, 1994).
Amber Geddes stated her views on the role of technology in the Briar Elementary School curriculum this way, "I think that without technology I could pretty much do what I do whole language-wise and integrating-wise. But, to me, it's like there's a whole big component left out, which is technology ... I see technology as what pulls it all together" (AG-II).

Mack Favorie said, "The key is still going to be getting computers used in the classroom and used effectively. At some point I'm sure kids will see the computer as, hopefully, another tool and be very, very comfortable with it. I think most kids would do that today" (SP-II). He later added, "People always wrestle with, 'Are we using it (educational technology) and is it effective?' We have to recognize that it can have a real impact on education if used appropriately and if teachers recognize that it's part of the learning strategy. It's a monumental task. We've come a long way in three or four years. We see it, that it's made an impact, but we've also made a commitment" (SP-II).

These last two comments by Amber Geddes and Mack Favorie emphasize the importance of the immersion of teachers in the domain of educational technology. Teachers who do not experience this immersion will find it difficult to become 'travelers' (Damarin, 1993) in the domain.

**Hindrances to Computer Integration**

The community spirit at Briar Elementary School could not prevent the occurrence of hindrances to integrating computers into the
curriculum. During early interviews and discussions with the teachers, the conditions that recurred as hindrances to computer integration were lack of time, lack of support staff, and frustration with the hardware.

**Time.** In November 1993, Lisa Redford said, "[T]here's not enough physical time to learn it ... [I]t takes probably a year before you're good enough at it that it starts saving you time ... It does take a lot of time up front and they [administrators] don't build that time in. You don't have that time built in to learn how to do it" (LR-G1). In a later interview, Ms. Redford remarked, "So I didn't bother learning it. It's like given x amount of minutes in a day, I only bother to learn what I— You know it would be nice to have enough time to do the other, but I really only bother to learn what I need to know" (LR-I1).

During the first year, only one half-day of release time was set aside for the teachers to learn to operate the computers in the school's lab. Until autumn 1995, they were given little school time to learn the nuances of the hardware and software or to meet with computer-using mentors from other buildings. In autumn 1995, the elementary magnet schools in the Lakeside School District were granted state funds to connect the schools via telecommunications and to provide professional development in the area of technology skills for the administrators and teachers. The teachers chose to participate in this professional development after school and in the summer to limit the number of days they were out of the classroom. This decision was partially due to the fact that teachers from these small magnet schools
served on many districtwide committees which sometimes took them out of their classrooms during school hours.

The quandary of scheduling professional development is ongoing. Teachers want and need to stay current in their profession, but trade-offs in the timing of professional development are often undesirable.

**Support Staff.** From autumn 1989 to autumn 1994, the building principal was the entire technical support staff for Briar Elementary School. Each of the principals at Briar had some degree of expertise in maintaining the local area network and troubleshooting with hardware and software. In the late summer and autumn of 1994, Lisa Redford and Amelia Kelly took on the duties of systems operators for the local area network. The duties of these positions included: serving as contact person, troubleshooting minor problems, fixing those problems, contacting the appropriate vendor to obtain needed service, adding and deleting programs to the network and individual work stations, ensuring that any software installed is properly licensed, maintaining records of software installation and network repairs, and performing daily, quarterly, and annual maintenance tasks (SO-JD). Ms. Redford and Ms. Kelly were each provided approximately thirty hours of training to prepare them for these positions. When they had exhausted their collective expertise, they called on either Mr. Favorite or the local Apple computer representative. Amelia Kelly and Lisa Redford received supplemental contracts and additional pay for performing these duties.
During this study, the library-media specialist was in Briar Elementary School only one and one-half days out of every six-day rotation of school days. Although the library-media specialist is frequently sited as the gatekeeper to their previous school's computers (see earlier accounts from Amelia Kelly, Amber Geddes, and Dicey Tillerman), she was not mentioned as a technology resource person or technology mentor by any of the teachers. In their previous teaching assignments, library-media specialists had introduced these teachers to educational computing but, once the technology became both focal and transparent for them, they no longer needed or relied on the library-media specialist.

The Construction of Identities

The identities of the Briar Elementary teachers and school were (and are) multiple and overlapping. In some cases these identities were cultivated, in other cases the identities resulted from professional and social interaction.

Public Rhetoric and Professional Self-Perceptions. A document analysis revealed the public rhetoric and the professional self-perceptions of the teachers at Briar Elementary School. The documents examined included two grant proposals written or co-authored by the faculty of Briar Elementary in 1993 and 1994, a proposal to a regional profession development center to become a language arts demonstration site, magnet school documents, and assignments completed in autumn 1993 by the five teachers as part of the
coursework for the telecourse on the integration of technology in the K-12 classroom. The analysis of the grant proposals, the proposal to become a language arts demonstration site, and the magnet school documents revealed a great deal concerning the ways in which Briar Elementary School teachers presented the school to other agencies and organizations. The grant proposals, the language arts demonstration site proposal, and the telecourse assignments indicated the professional self-perceptions and philosophies of the Briar Elementary School faculty as well as their perceptions of the niche the school filled in the Lakeside School District. The stilted rhetoric obligatory in these documents failed to capture the vitality and energy of the teachers, students, and atmosphere of Briar Elementary School.

**Public Rhetoric.** The Lakeside School District and the teachers of Briar Elementary viewed the magnet schools as sites for the implementation and refinement of innovation. Some of the goals of the two language arts/computer magnet schools were to develop:

- an awareness of the importance of education
- an acceptance of self and others
- proficiency in expressive and receptive communication
- skills in problem solving and decision making
- mastery of essential skills in all subject areas
- creativity
- social skills" (MSG)

Technology held a prominent place in the public rhetoric concerning Briar Elementary School. The goal of the language arts/computer magnet schools concerning technology was "to develop
an understanding of the computer as a tool for learning through the use of relevant curricula, word processing, desk-top publishing, and electronic communication" (MSG). A grant proposal submitted jointly by the three elementary magnet schools in 1994 requested funds to create a virtual community by linking the schools via telecommunications and to provide teachers and administrators with professional development in the area of technology. In autumn 1995, Briar Elementary School and the other two elementary magnet schools (Northwood Elementary School and Willa Cather Elementary School, the science and technology magnet school) received the first year's $25,000 from this five-year grant. The abstract of the proposal stated, "[T]he mission of the Magnet schools has been to provide exemplary instruction in which technology is used for thematic instruction and to share these techniques with other elementary schools within the [Lakeside School District]" (GP2).

The grant proposal further stated that:

Linking with additional students and adults will increase student achievement in the following ways: increased knowledge resource base; applied and creative uses of technology; enhanced critical thinking; encouragement of cooperative learning through cross age and peer tutoring; and a wider audience for authentic assessment (GP2),

and that the magnet schools were:

established with the intention of being alternative models to the existing elementary education program ... [They] continue to introduce new and innovative curriculum designs and teaching strategies as well as integrating new technologies. These successful changes in restructuring curriculum and educational delivery systems at these
schools are being achieved through collaborative team decision making. This fundamental change in the decision making process has and is producing a high degree of teacher ownership which, in turn, continues to foster a stronger teacher commitment to new efforts (GP2).

The faculty presented themselves as "teachers who have a shared vision supported by qualities of risk-taking, openness, collaboration and interest in continued professional growth" (GP2). Recognizing rapid changes in technology and the redefinition of the roles of students and teachers, the faculty stated a commitment "to the improvement of education provided to [their] students through the use of technology in the classroom" (GP2). Technology also provided "one important vehicle by which student work is produced, then assessed collaboratively by students and teachers, and ultimately shared with various audiences" (GP2). Computer technology allowed "students opportunities to integrate data, graphics and text relevant to the content explored" (GP2). Composition activities utilized word processing software while database and spreadsheet software were used for the analysis and construction of charts and graphs. The teachers pointed out that at Briar Elementary "we routinely provide opportunities for our students to use technology to produce their work, carry their ideas to completion, and then share their new knowledge and products with appropriate audiences" (GP1).

**Professional Self-Perceptions and Philosophies.** One official statement concerning philosophies of education came from the grant proposal submitted in autumn 1994, "Students are viewed as a part of the instructional process rather than as mere recipients of knowledge".
(GP2). The language arts demonstration site proposal noted a consideration for different learning styles and cooperative learning environments when developing lessons that would enhance the integration of content areas (P1).

Another grant proposal pointed out:

[Briar Elementary] and [Northwood Elementary] have established a reputation as schools where innovative education happens. On the average of once a week, we host professionals from other school districts, and local colleges and universities regularly place pre-service teachers in our buildings ...

Teachers from both buildings have been recognized for exemplary teaching practices and professional leadership. They share their knowledge extensively through presentations at professional meetings and in-services in our own district. In this way, teachers model the behaviors we want our students to achieve (GP1).

The teachers' 1993 telecourse assignments contained personal statements revealing their professional self-perceptions and philosophies of education. A question on the first telecourse assignment concerned the views of teaching and learning held at Briar Elementary. Lisa Redford responded by saying, "Collaboration is very important. We are process oriented. We hold problem solving and thinking in high regard [sic]. We encourage group work, authentic assessment and choice by students and teachers. Everyone is a learner" (LR-A1). In the same vein, Amber Geddes wrote, "We value authentic work and integration of the curriculum" (AG-A1). Cybill Servant, responding to the same question, stated "Learning is a life-long process.
It is important to teach children how to learn and to accept some responsibility for their learning" (CS-A1). "A real emphasis at our school is learning to live and work collaboratively so that as adults our students can use those same problem solving skills to deal with daily situations," was Amelia Kelly's reply (AK-A1).

For another telecourse assignment in autumn 1993, the teachers were asked to reflect on why they had become technology-using teachers when many others had not. These are their responses:

I'm always learning — to stay the same is to let the world pass you by. Students (as well as myself) need to grow to stay current. Technology is the future way. I have confidence in myself to try something I'm not perfect at. I enjoy a change. (LR-A2)

I think it was mainly because our staff went that direction and I could see how it would be used from first through fifth grades. (CS-A2)

I personally learn best by "doing," and so the computers have always intrigued me. I enjoy being an active learner and get much more out of it than if I must be passive. (AK-A2)

I like a challenge. I'm a risk taker, and I see a real need for students to have technology literacy." (AG-A2)

I taught myself to use my old Atari 800 word processor (Atari Writer) to write my master's practicum. Once I mastered it, I knew there would be no going back. I am a believer in the benefits technology offers. (DT-A2)

Their responses affirm that these women were, and are, curious, life-long learners. They came to view technology as a valuable
teaching and learning tool as a result of their personal explorations of technology coupled with their many years of teaching experience.

**Individual Identities.** Within the community of practice at Briar Elementary School, the teachers constructed individual identities as well as a group identity. Amber Geddes was very committed to the creativity the computer afforded her fourth grade students. "My biggest nightmare is that I'll be reassigned to a different school. What if I have to go back to a more traditional school? I don't know how I would function. I really don't" (AG-I1).

Although still the least confident with computers, Cybill Servant was less apprehensive than when she began extensively using computers in 1989. "I don't find it scary any more. I guess maybe I never did really find it scary, except that first year when I was afraid maybe the kids knew more than I did about it. But, that's another thing, they sometimes can show me and that's OK. That's fine" (CS-I1).

Lisa Redford remained true to her earlier pioneering efforts with computers. One day she talked about finding a box of computer parts in the school's lab. "I did find something upstairs. Some little boxes and wires that I haven't tried yet. It was an archaic way of doing things. It was left over from a life-time ago and everybody goes, "Ah, this doesn't work." But, I haven't tried it myself so I don't know that to be true. So, we'll see" (LR-I1).

Amelia Kelly was a dedicated teacher, always willing to learn something new if it would benefit her students. However, her
technology explorations seemed to be limited to her professional life. "I still don't know how to program my VCR at home. That's just something that's not my job and I don't do it. If I had to do it here, I'd probably learn it" (AK-I1).

Dicey Tillerman contrasted computer use at Briar Elementary to her previous teaching assignment. She stressed the importance she personally placed on students engaging in purposeful activity. "[E]ven though I find computer-lab day to be the most exhausting day here, too — I mean definitely because I'm stretched beyond stretched. But at least here I feel that it's productive. The problems are real problems. They're not — dumb problems!" (DT-I1).

The Cutting Edge. The teachers at Briar Elementary School took pride in being on the "cutting edge" both locally and nationally. "We are a magnet school and have more flexibility than traditional classrooms. This freedom fosters change and growth. We are always reaching — trying something new" (LR-G1).

In one interview, Lisa Redford said, "Late last year (1992-93) we all got together with Northwood, which is our sister school, which is also the other language arts school, and we looked at the new course of study. And we said, 'What do we do in the computer lab that fits into the course of study?'—not the computer course of study but the language arts course of study ... And what we really found was that we're already there. We're doing this stuff already" (LR-I1). Later in the same interview Ms. Redford revealed, "We wanted to look for a new avenue ... because we really feel that our school has matured now
... Now that sort of task of our building, which is kind of why the magnet schools were set up—to lead the way, to be that cutting edge—that's sort of fulfilled. Now we're ready to move on. We need to chart some new frontier. We're all the kind of people who don't like to sit still. You know, I'm just real lucky to be involved with people that want to create change, want to be on the cutting edge trying new things...

... Now we're looking to interactive kinds of things" (LR-II).

In October 1994, Lisa Redford and a teacher from Northwood Elementary School, the other language arts/computer magnet school, attended a conference in Washington, DC. One of the goals of the conference was to explore exemplary uses of technology in science education. Ms. Redford took along examples of several special projects done to illustrate Briar Elementary's use of technology in creating an interdisciplinary curriculum.

**The Identity of Briar Elementary School.** As a magnet school, Briar Elementary had to project an identity in order to attract students. I asked Mack Favorite if he thought more parents were interested in the language arts focus of the school’s curriculum or the computer focus. He answered, "I think what sells the school is the staff itself. I think the reputation the teachers have, probably even more so than being literature-based or the computers, to be honest with you. I've noticed parents being very impressed with what's available (in the computer lab). I think for those who have been here for a while they recognize what was and what now is (in the computer lab). I think they're really pleased with that" (SP-I1). Later Mr. Favorite said, "I
know parents have almost felt an obligation, now that their kids have
this equipment, that their equipment at home is comparable. I don't
know about putting parents in debt," he chuckled, "but I see them
wanting to support their children" (SP-I1). Other "key selling points"
that Mr. Favorite mentioned were the types of projects done by
students, the cooperative atmosphere among the classes, the ways the
teachers utilized the computer lab, and Briar Elementary's safe learning
environment (SP-I1).

Like the teachers, Mack Favorite saw the identity of Briar
Elementary School as unique within the Lakeside School District. "Part
of the approach of the magnet schools is that we're going to begin to
look at innovative things. Not necessarily technology, but pursue
ideas, experiment a little bit with them, get a feel for them ... I think
the teachers recognize that, because the question we constantly ask
ourselves is, 'How are we different?'" (SP-II).

At Briar Elementary School, the identities of the teachers and the
school were very closely tied to the use of technology. I was present at a
staff meeting which included Lisa Redford, Cybill Servant, Amelia
Kelly, Amber Geddes, Dicey Tillerman, Mack Favorite, and Edward
Heilman, the superintendent of the Lakeside School District. This staff
meeting took place on the last day of my 2 1/2 month period of
concentrated observation at Briar Elementary. Throughout that time I
had done some informal, preliminary analysis of the ways the teachers
viewed the niche filled by Briar Elementary in the Lakeside District and
the role of technology in their individual identities. On December 6,
1994, the conversation repeatedly confirmed my preliminary analysis. The story I have just told describes the community of practice at Briar Elementary School. Some critical conditions fostered the teachers' growth into the close-knit community that I observed and participated in from autumn 1993 through autumn 1995. Those conditions are related below.

First Steps

In spring 1989, prior to the opening of Briar Elementary as a language arts/computer magnet school, the five teachers who were the original faculty members of Briar Elementary were given a week to design their program. Amber Geddes described those five days as "crucial" because they gave the teachers time to discuss teaching philosophies, to bond, and to discover that they were more similar than different, although each had her own strengths and weaknesses. "It was a wonderful time and I think it set the tone for part of our success" (AG-II). Lave and Wenger have noted that "apprentices gradually assemble a general idea of what constitutes the practice of the community" (1991, p. 95). During these early days, the teachers were beginning to use their expertise in pedagogy to define their community of practice, which would include computers.

One important decision made that spring concerned the ways in which students would use the computers. All of the teachers had

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4.4 See Appendix F for a transcription of this meeting.
previously been in schools where drill-and-practice, tutorial, and simulation software were dominant. They wanted the Briar Elementary students to have a more creative experience with computers. The teachers decided to use only application software: word processing, database and spreadsheet. "We said, 'We want kids to be able to internalize the use of a computer so that they can make a product or go through a process and have it be meaningful for what's going on in the classroom'" (AG-I2).

**Students and Evidence of Community.** During my involvement with Briar Elementary School from September 1993 through December 1995, the atmosphere was one of a caring, nurturing community; the students, staff and faculty knew one another well. The Tribes program, described earlier, was evident in all of the classrooms. Signs, posters, and activities acknowledged the Tribes goals of positive peer relationships and cooperative learning skills. Each morning a group of four or five students from one of the classes would lead the Pledge of Allegiance over the intercom. Mack Favorite or Shannon Decker, the school secretary, made the announcements for the day. "Today we are celebrating the birthday of —, please come to the office after the Pledge for your birthday surprise," and "We have a guest teacher in grade — today. She is Mrs. —; please make her feel welcome," were items commonly included in the daily announcements.

In early November 1994, Ms. Decker announced, "Today is an E day. We have gym today. Boys and girls, the weather is getting colder. You need to take your coats to Alcott (Elementary School for gym) and
then be responsible and bring them back to Briar. You will be hot and sweaty after P. E., but be sure to wear your coats on the bus. We don't want anybody getting sick. At any rate, all of your coats, hats, and mittens should have your name in them."

Students at Briar Elementary were treated with the utmost respect. For example, teachers always sought permission before using a child's work as an example for the entire class. Typically, one day Ms. Geddes did not have all of the materials she needed at her fingertips for a demonstration for her fourth grade students. After retrieving the missing items from her desk, she apologized to the class for making them wait.

In late October 1994, Mack Favorite, the principal, received a note from several fifth grade students protesting the elimination of Halloween parties. It had been decided to have a Fall Festival on a date other than October 31 to avoid conflict with some students' religious beliefs. One morning he went to the fifth grade classroom and joined Ms. Tillerman and the students in their Tribes circle on the floor. After saying that he had come to discuss their concerns, Mr. Favorite said, "I'm glad you feel free to express your opinions. Your opinions are very important. When you express an opinion you don't always get the answer you want. Would anyone like to express an opinion now?"

A thirty minute discussion ensued with students speaking out in favor of both the Halloween party and the Fall Festival. Throughout the discussion Mr. Favorite and Ms. Tillerman emphasized the importance of building a community where all students felt comfortable.
Teachers, Parents, and Evidence of Community. Lisa Redford stated some examples of cooperation and camaraderie among the teachers, "[W]e're real flexible around here. If there's something that you want to do (in the computer lab), then you just switch with somebody" (LR-I1). Later she said, "[A]lthough I have computer certification and have some background, you know, everything in every situation is new and different. And, so, (that first year) I constantly went across the hall to Amelia or down the hall to Amber or whatever and said 'Can you help me?' ... [E]verybody's real good about that ... I feel real comfortable popping into their rooms. And, you know, we just share all the way around" (LR-I1).

Another community building activity was described by Ms. Redford when she said, "We go in the office everyday after school and we debrief. We just spend twenty minutes calming down. And, we share stuff that happened during the day. And, we talk about kids. And, we just talk about us. And, we talk about our families. And, it's just a wind-down time" (LR-I1)

Briar Elementary enjoyed an amazing amount of parental support for a school with approximately one hundred thirty students. Parents contributed nearly three thousand hours of volunteer time during the 1993-94 school year. Parents were often seen tutoring students, putting up bulletin boards, or bringing in food for the staff. During October 1994, the PTA placed a low-fat cookbook in the staff room and invited each teacher, the principal, and the secretary to choose a main dish and a date in November when they would be especially busy. PTA
members then delivered a full meal to Briar Elementary before the end of the school day on the date selected. The parent organization was also responsible for providing the birthday surprises and school spirit items such as hats, pins, and bumper stickers. These incidents were indicative of the ways a caring communal atmosphere was nurtured at Briar Elementary School. They are also indicative of the ways in which the full community created this atmosphere even though Briar Elementary was not a neighborhood school.

An Administrator's View of the Community. In November 1994, I had a lengthy conversation/interview with Mack Favorite. In discussing the characteristics of Briar Elementary that made it an attractive environment for teachers, parents, and students, Mr. Favorite offered several insights from an administrator's point of view. He felt the key to a good school was the staff because "they are the ones who are going to be the constants" (SP-I1). Mr. Favorite saw the staff at Briar as cooperative in nature and working as a team. He said they got along well, helped each other, were in agreement on the goals of the school, and recognized that by working together they would be stronger than they would be individually. Mack Favorite saw the teachers at Briar Elementary as risk-takers who enjoyed the challenge of doing things differently and who were comfortable with change.
Individual Influences on the Community of Practice

The Briar Elementary School community of practice was not static from 1989 until 1995. Several members entered and/or left the community, thus influencing the integration of computers and the learning curriculum.

Ivy Harrison, Briar Elementary's first half-time principal, established the ways in which future building administrators would influence the learning curriculum by allowing the teachers to have autonomy. Ms. Harrison retired after Briar Elementary's first year as a magnet school but the atmosphere she nurtured was very important. The teachers appreciated the trust Ms. Harrison had in them. Dicey Tillerman said, "She trusted us, and we probably needed that that year more than ever" (DT-I3).

"—because computer wasn't the only thing new. Everything we were doing was new," added Cybill Servant (CS-I3)

Mike Foster, Briar Elementary School's second half-time principal from autumn 1990 through spring 1992, brought computer knowledge to the community of practice. He served as a resource to the teachers. Although they commented that he was personally good at troubleshooting, the teachers did not see Mr. Foster as someone who taught them a lot about computers or troubleshooting.

Ray Oakes was the half-time principal during the 1992-93 school year. He came directly from teaching at Willa Cather Elementary, the Lakeside School District's science, math, and technology magnet school. Mr. Oakes was much younger than all of the teachers at Briar
Elementary. Dicey Tillerman and Cybill Servant felt that his age and his inexperience as a principal effected the ways in which Ray Oakes interacted with the teachers.

"Here we were. We were pretty confident, pretty sure of what we were doing — knew it worked. He didn't know how it could work, probably. He was not a language arts person. He came from a science and math building. It was a real shock," said Dicey Tillerman (DT-I3).

"I think he probably knew quite a bit about computers because I think they did a lot then at Willa Cather. But, I can't for the life of me remember even talking about computers with him," commented Cybill Servant (CS-I3).

"I can't either," added Dicey Tillerman (DT-I3).

The teachers didn't think that Ray Oakes had contributed very much to their computer use. In summing up his influence, though, they added that he didn't try to change any practices that they had established.

The influence of Lillian Moss, the school clerk during Briar Elementary's first two years as a computer/language arts magnet school, was mentioned earlier. The first year she contributed to the community of practice by learning to use the hardware and software and then showing the teachers what she had learned. Ms. Moss served as a resource person for the teachers during the second year.

Greta Downing, who was the first grade teacher at Briar Elementary from autumn 1989 until spring 1991, was also not seen as
having greatly influenced computer use or the learning curriculum. Her departure, however, created an opening for Lisa Redford.

Ms. Redford modeled computer use with students for the other teachers. She was the first to have a class keypal for her students. This was a young man in Australia who regularly communicated with Briar Elementary's first grade students. Lisa Redford was involved in bringing other teachers to Briar Elementary through the Pioneering Partners grant. She also organized an afternoon parent workshop where students served as assistants and mentors to parents who wanted to learn more about the computers and software in the school's lab.

Dicey Tillerman commented on Lisa Redford's enthusiasm, knowledge, and confidence when working with computers, "She's a real technical person who tries many things on the computer without worrying about the consequences." Ms. Tillerman went on to add what a good team Lisa Redford and Amelia Kelly made as the school's systems operators. "Lisa will go ahead and bulldoze through ... Amelia, on the other hand, is very methodical. She will write out step-by-step how to do it, and share that with us ... So it's good to have both of them" (DT-I3).

From autumn 1993 until autumn 1995, I was a member of the Briar Elementary School community of practice. I spent great deal of time in the school during autumn 1994 conducting interviews and making observations. This was a time of reintensified learning for the teachers because the computer lab had just been upgraded. In the
computer lab, I was both a participant and an observer. I watched the teachers and students interact as well as helping to troubleshoot. The teachers commented that they and the students had learned a lot from my presence in the lab. They also felt comfortable asking me to help them individually or with their classes because I "didn't have other responsibilities in the school" (CS-I3).

According to Dicey Tillerman, "Having you here made me really think about what I was doing ... Just talking to you or listening to you prompted exploration on my part and generated ideas. So, it was like having somebody to brainstorm with. It was helpful. It made me think more about what I was doing with computers" (DT-I3).

Each arrival and departure left an impression on the community of practice because each person had unique individual experiences to add to the learning curriculum.

Legitimate Peripheral Participation

Teaching at Briar Elementary was a social enterprise in which the teachers learned from one another. The continuous folding in of the previous and new experiences of the teachers helped them learn to use the hardware and software. This process is an example of legitimate peripheral participation leading to what Lave and Wenger have termed "full participation". "[P]eripherality, when it is enabled, suggests an opening, a way of gaining access to sources for understanding through growing involvement" (Lave and Wenger, 1991, p. 37).
The first principal at Briar, Ivy Harrison, helped to set the tone that allowed the teachers freedom to create a community of practice that integrated the computers. Amber Geddes described Ms. Harrison as a "no hands-on" administrator. She knew exactly what was going on and if she thought it was good and sound, she never interfered" (AG-I1). Ms. Harrison knew very little about computers as a teaching and learning tool but she had confidence in the teachers. "She knew we'd figure out what to do. She knew we'd make it work. And so, none of us were really made uptight about what we didn't know" (AG-I1).

The teachers reported other elements in the environment of Briar Elementary School that enabled them to be legitimate peripheral participants in the process of learning to use the computers and the software. Computer-literate parents came in to help in the computer lab, thus allowing teachers opportunities for legitimate peripheral participation while the parents were helping students. Teachers had access to the building on evenings and weekends. This gave them opportunities to use their free time to gain expertise in using the hardware and software at Briar Elementary. Flexibility in scheduling and using the computer lab allowed the teachers to integrate the computers as they became the obvious tool of choice for student projects. The computer lab and the third, fourth, and fifth grade classes were housed on the second floor of the older section of the school building. Ms. Kelly, Ms. Geddes, and Ms. Tillerman found the proximity of the computer lab to be beneficial when having students
use the computers as they were needed. These three teachers often sent students into the lab to work on projects if the computer lab was not being used by one of the other classes or if one or two computers were free and the teacher using the lab gave the student permission to work.

The smallness of the school encouraged a camaraderie that was conducive to sharing ideas for integrating technology and for peer tutoring in learning to use the hardware and software.

**Need for More Legitimate Peripheral Participation.** "I feel very fragmented trying to do it all ... I mean, the planning is just overwhelming on top of everything else" (DT-I1). Each of the five teachers, during separate interviews, suggested that the district hire a technology specialist. The interviews were conducted before the positions of systems operator for the local area network were created in autumn 1994.

The teachers felt the technology specialist should be responsible for maintaining computers and networks, planning and presenting professional development involving computers, and working with classroom teachers to plan computer-based activities that would compliment other classroom activities. Cybill Servant thought it would probably take at least two people to fill these positions, one technician and one educator who understood the integration of computers and who had time to learn new software in order to pass that knowledge along to the classroom teachers (CS-I1).

Amber Geddes felt the district needed a technology coordinator because "[e]verybody kind of does their own thing. Nobody really
knows what anybody else is doing. We're not learning from one another. And I see that as number one. We need somebody that knows what our district is about and technology and a direction. I don't think we have a direction" (AG-I1). Ms. Geddes was referring to the Lakeside School District and not Briar Elementary. She indicated that she had learned a great deal from her peers at Briar but did not have opportunities to learn from her peers in other schools or to pass on the technology insights she had gained.

It could be said that the Briar Elementary teachers were seeking new educational affordances of the computer, using Gibson's (1979) terminology. Gibson said, "What we perceive when we look at objects are their affordances, not their qualities ... " (1979, p. 134); and, "Affordances are properties taken with reference to the observer" (1979, p. 143). The teachers' experiences and expertise in teaching with computers had given them the insights needed to grasp and use additional educational affordances. A technology coordinator, who had time to explore software, could help these teachers see additional educational affordances of computers and educational software. This is related to Lave and Wenger's (1991) contention that knowledge resides in the community of practice where it is continually transformed through negotiation.

**Hindrances to Legitimate Peripheral Participation.** Mack Favorite mentioned some of the conditions at Briar Elementary that could be interpreted as hindrances to legitimate peripheral participation. These conditions were the lack of regular technical support from the district
and the problems this sometimes caused, the unreliability of the original equipment in the computer lab, the smallness of the staff and the care that had to be taken not to "burn the staff out," the physical facilities of Briar Elementary, which limited long-term science projects, and the lack of adequate computers in the middle schools so students could continue to have production tools of the same quality that they had enjoyed at Briar Elementary (SP-II).

"Technologies of Everyday Practice"

The importance of engaging with the technologies used everyday is central to the process of becoming a full participant in a community of practice. The tools and technologies of a community of practice embody much of the history of the community. As the Briar Elementary teachers learned to use the hardware and software and integrated these into daily activities, they created a history of practice. These personal connections to the history of computer use in the community resulted in a deeper understanding of the tradition of practice at Briar Elementary.

Learning to Use the Hardware. Each of the five teachers in this study had purchased a computer for home use in the early- to mid-1980's. They came to Briar Elementary with varying degrees of computer experience and confidence in their abilities.

When asked how they learned to use the Macintosh computers in the school's computer lab that first year, the unanimous response was, "We all went out and bought our own computers" (GR1). Amelia
Kelly added, "We learned it by using it for our own personal things at home" (AK-G1). These personal uses included correspondence, college coursework, and family accounting, but the major use was for preparing worksheets and parent-teacher conference reports for school.

In September 1994, when the school's computer lab was upgraded, Cybill Servant, Amelia Kelly, and Amber Geddes purchased new Macintosh computers for home use in order to have compatibility with the school's hardware. They used their new computers to learn the recently installed software in the computer lab. Each of the teachers at Briar Elementary was the major decision-maker in choosing the home computer she used at the time of this study. Each also chose and purchased her own software for home use.

**Frustration.** The frustrations of working with computers were well known to the teachers of Briar Elementary. Before the computer lab was upgraded in 1994, the teachers talked about the feelings of frustration they felt when computers went unrepaired for days or weeks. They also found it exasperating when a classroom full of children waited while they used their limited troubleshooting skills to make the computer work like it had before school when they prepared a lesson or demonstration. Another aggravation was the loss of a child's work because the teacher had not observed the child's computer error and did not know how to retrieve the work from the disk or hard drive. The file server, which was kept in the office before the upgrade, was locked away on evenings and weekends which meant the teachers couldn't practice with some of the software. Often the manuals
weren't available for the hardware or software so the teachers had to learn by trial and error. Another early frustration for the teachers at Briar Elementary was the longer amount of planning time that computer-based activities took in comparison to more familiar traditional lessons. The teachers found it very stressful to facilitate activities in the computer lab. Amelia Kelly talked about how harried she felt in the lab because when "they have computer problems there are fourteen different computer problems and they are all someplace else at different times" (AK-I1).

The teachers also commented on their own and their students' lack of expertise with the hardware and software. They felt this precluded them from taking full advantage of the computer lab. The physical conditions in the computer lab in the autumn and spring were also mentioned as hampering computer use. At these times, the room became too uncomfortably hot to use. The distance to the computer lab for the first and second grades made it difficult for Ms. Redford and Ms. Servant to use the lab like a learning center as the other teachers did.

**Observations from an Insider**

Mack Favorite had very high praise for the teachers' expertise with the hardware and software. "I think when you recognize what they've had available to them, they've done a good job within the limitations of what they've had" (SP-I1). He felt the teachers' self-expectations had changed as they gained new skills and used equipment more sophisticated than the "Apple IIe types of things that
were just a glorified typewriter" (SP-I1). Mr. Favorite thought keeping a log of technical problems was helpful, too. This log left a history of recurring problems so the staff and the parent volunteers could look back to see how someone else had managed troubleshooting.

I commented to Mr. Favorite that, in spite of his own fairly extensive technical skills, I had often observed him staying out of troubleshooting situations in the computer lab while Lisa Redford and/or Amelia Kelly worked on a problem. I also noted that this was not stereotypical of interactions involving men, women, and technology. He answered, "Well, part of it is the fact that I'm not here all of the time, so to depend on me to be here is unrealistic because half of the time I'm not here. And, the other thing is that unless you actually go in and solve some of the problems, you don't really learn how the technology operates. I have to compliment them. They've accepted that task or challenge and in many cases are independent enough to do it themselves. They only come back after they've tried, which I think is good ... I'm not needed as often as before. I think, just like anybody else, if you don't allow them to do it, it's not going to happen and they're going to be too dependent" (SP-I1).

After just three months with the new hardware in place, Mr. Favorite said that he had seen the use of the lab increase from the previous year with the old system that was "very unreliable." He felt that one unique feature of the school that added to this increased use was its smallness, which meant the technology was readily available and accessible. About the new computer lab Mack Favorite said,
"We're blessed in the sense of what we have here. I really would wish that all of the elementary schools would have the same opportunity we do, probably more so because they have more students" (SP-I1). Later he added, "Unless the district puts the dollars behind it, I don't think they will get to what we have" (SP-I1).

Mr. Favorite said that assessment of the success of the new computer lab would examine the "teacher growth in the use of computers" and "the products that are being put out by kids." He also felt that, as a staff, everyone at Briar Elementary was "wrestling" with expectations of outcomes for students. As students became more familiar with the new hardware and software in the school's computer lab, expectations would rise, but "we've not formalized that."

Of educational technology in general Mack Favorite stated, "We're at such an early state of this notion of technology, at least in the form that it is now." He felt there was a lack of research in the area of educational technology for guiding teachers and principals in the limits of technology use by children based on their cognitive growth.

Mr. Favorite said he would like to see "five or six computers in each classroom as opposed to a computer lab. Especially in the bigger schools because if they set up a lab schedule these kids will be in it only once every two weeks. That's not good for anything" (SP-I1). He believed that placing several computers in each classroom would foster one of the most important uses of educational technology — making informed judgments about information. "[T]he thing that we need to teach kids the importance of is how to access information effectively
and make critical decisions of what's good information and what's bad information because there is just so much available to you at your finger tips. You just don't even know where to go. It's overwhelming. Just because it's out there and because it's in print form doesn't mean it's good information" (SP-I1).

A Learning Curriculum

A learning curriculum (Lave and Wenger, 1991) focuses on the processes of learning through a guided rather than strictly prescribed curriculum. Newcomers have many opportunities to learn under the tutelage of a master. In a learning curriculum, the practice of newcomers may approximate that of the masters in the community but is changed by the newcomers' innovations. These changes add to the vitality and growth of the community. A teaching curriculum, in contrast, is prescribed, often by those outside the community of practice. Prescription limits newcomers' possibilities for learning. Prescription also limits the role of the master or teacher to one of simply mediating the newcomers' learning activities.

Traditional Learning Curricula. In established communities of practice, the learning curriculum has varying degrees of formality and informality. For example, in the more formal learning curriculum of Vai tailors, (Lave & Wenger, 1991) apprentices and masters make formal agreements before the apprenticeship begins. Apprentices live the working life of a tailor. Before they can start their own businesses, apprentices must receive the blessing of their master tailor. Yucatan
midwives have a more informal apprenticeship. This practice is generally handed down in families. Apprentices learn the practice by being in daily contact with a master, usually a mother or grandmother. They are immersed in the culture of midwifery from childhood. When a woman receives her calling to become a midwife, most of the practice is already known to her.

The Learning Curriculum at Briar Elementary School. The learning curriculum at Briar Elementary School was unlike those examined by Lave and Wenger (1991) because there was no community of practice that included computers in place when the magnet school was established in 1989. No teaching curriculum or learning curriculum existed. In many ways, this lack of a teaching or learning curriculum influenced the creation of the community of practice at Briar Elementary. A teaching curriculum would have limited the learning of the members of the community. The informal learning curriculum that developed at Briar Elementary allowed each teacher to determine her own partial participation in the complex practice of integrating computers into classroom practices. Lave and Wenger (1991) noted that, in all of the communities of practice they examined, apprentices were given opportunities to begin with partial participation in activities at each stage of learning. The teachers at Briar Elementary know their personal comfort levels with computers and particular pieces of software. Each determined her own partial participation by deciding how she would integrate computers and software at each stage of learning.

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District expectations also shaped the learning curriculum at Briar Elementary. The teachers related feeling that they were expected to use the technology right away in autumn 1989. Because of these perceived expectations, the teachers started the practice of using new hardware and software with little or no lead time to learn it themselves. In the group discussion, all four of the original teachers emphasized having learned the hardware and software along with the students. However, they were learning with the eyes of teachers and with the eyes of students. The teachers were simultaneously learning about the hardware and software, teaching students about the hardware and software, and teaching concepts with the hardware and software.

During this process, the teachers weighed the evidence of learning in this environment that integrated open-ended application programs. They compared this evidence to evidence of learning observed in their previous teaching assignments where more limiting software, or no software at all, was part of the learning environment. This evidence of learning continuously informed and influenced the teachers’ learning curriculum as it developed over time. The Briar Elementary community of practice developed a learning curriculum that smoothly related learning to integrate computers to the daily work of teaching.

In an established community of practice, apprentices have opportunities to reflect on the ways that previous steps in the process, coupled with the present step, bring their work closer to that of the masters. There were no masters at Briar Elementary School modeling the integration of computers. Therefore, each teacher's experience and
understanding of teaching was vital as they struggled together to become masters. The daily debriefings mentioned by Lisa Redford gave the teachers an opportunity to use their individual and common experiences to reflect on integrating computers into the daily practice.

Lave and Wenger used the phrase "benign community neglect" (1991, p. 93) in a discussion of allowing apprentices some space to shape their learning relationships with one another. The Lakeside School District — the larger community of practice — and the early building administrators provided this "benign community neglect" for the teachers at Briar Elementary. The five original teachers were given one week to plan their program before Briar Elementary opened in autumn 1989. Amber Geddes commented that the first principal, Ivy Harrison, allowed the teachers autonomy in computer integration activities because she trusted their professional experience and expertise.

Communities of practice go through developmental cycles (Lave & Wenger, 1991). Indications of these cycles at Briar Elementary were found in teachers' comments. In the group discussion in November 1993, Amelia Kelly said, "I feel like I haven't moved any farther than I did that first year" (AK-G1). She commented in an interview two months later, "I don't think of it (computer integration) as really new right now. I guess it's time to start looking for new things because it's seeming pretty normal" (AK-I1). When talking about her computer aspirations, Amber Geddes said, "I'd really like to be at that level where Mel is — to be able to seize it and understand it" (AG-G1). The computer lab upgrade in autumn 1994 launched a new developmental
cycle. The Heritage Unit, uses of new software and clip art in student projects, and the Magnets and Circuitry Unit described earlier in this chapter all occurred in the first stages of this new developmental cycle.

The learning curriculum at Briar Elementary was allowed to grow and thrive because the trajectories of the teachers and the Lakeside School District were parallel. "Trajectory" is a term used by Wenger (1990) to indicate dimensions of time and space. Membership in a community of practice takes place over time. Individual memberships in multiple communities of practice take place in space. The two local communities of practice, as well as parts of an even larger community of practice, the field of education, held some common philosophies of teaching and learning. The learning curriculum at Briar Elementary had evolved as a result of these common trajectories. At the end of this study, the learning curriculum continued to foster a thriving community of practice.

Conclusions

This chapter has fulfilled several of my purposes. First I brought to life the people and the environment of Briar Elementary School as I experienced them. Then, I used the lens of Lave and Wenger's work to examine the creation of a community of practice in an elementary school. This particular community of practice was interesting to me because the teachers were mandated to integrate computers into daily classroom practices. I believe the decision to begin this community with experienced teachers was critical to the growth of this community
of practice. In the next chapter, I will discuss some of the implications of investing time, money, and effort in the professional development of experienced teachers in the area of technology integration.
CHAPTER 5

THINKING ABOUT PRACTICE

This chapter contains two related sections. In the first section, I discuss the findings from my research at Briar Elementary School. Here I emphasize the importance of the teaching experience brought to the new community by the five women who participated in this study. In the second section, I discuss how an uninvited technology, in the form of computers, has entered the working lives of women teachers. The cyborg work of Donna Haraway and Suzanne Damarin are used to look into the future of women who are computer-using teachers.

The Importance of Experience

I began this research with the intention of finding out what conditions encourage experienced teachers to integrate computers into an elementary curriculum. As a result of various qualitative data gathering methods and the data analysis discussed above, I now have a clearer understanding of how this particular group of veteran teachers
went about the process of integrating computers into the Briar Elementary School curriculum.

**Multiple Communities**

Several communities existed at Briar Elementary School. Computers were intertwined, to some extent, in all of these communities. The community encompassing parents, administrators, teachers, and students developed around the district mandate to integrate computers into the magnet school's curriculum. This focus on computers influenced the decisions of many parents to enroll their children in the school. The building community was influenced by computers as the teachers, students, staff, and administrators learned, reciprocally, to use and implement hardware and software. The computer influenced the teachers' community of practice because at the outset they had a common task — to learn to integrate computers. These teachers were experienced and confident in their teaching abilities when the Lakeside School District chose them to form the new magnet school in 1989. The computer was a catalyst in their bonding. Schools are both nested and tangential communities. It is not possible to completely untangle the ways in which computers effected the development of this particular school. It is only possible to know that they did.

The Lakeside School District magnet elementary schools were created, in part, to provide a niche for experimenting with various parts of the curriculum. The district and building administrators' trust
in these experienced teachers enabled them to thrive in their efforts to create an interdisciplinary curriculum that integrated computers. The teachers at Briar Elementary gained status with district administrators as they developed their learning curriculum. They enjoyed their self-perceptions as teachers on the cutting edge of technology integration. The Lakeside School District, through the building administrators, fostered the community of practice by allowing the teachers autonomy in engaging with the technology and in creating their own learning curriculum. The district also provided much more technology per capita for the students and teachers of Briar Elementary than for other elementary schools in the district. In many ways, Briar Elementary School was a computer integration incubator.

**Tooled Environments**

Tools are characteristic of a community of practice, and in some ways define it. The examples of communities of practice provided by Lave and Wenger (1991) are of tooled environments. However, in their examples, no new tool is introduced into the working environment. Computers are not currently common tools in schools in the same ways that sewing machines are common tools in tailors' shops, or cleavers are in butchers' shops. In autumn 1989, the teachers, the principal, and the staff of Briar Elementary School were given the task of creating a community of practice in which computers would become common tools in teaching and learning. The computer played
a non-verbal but powerful role in defining this new community of practice.

Lave and Wenger (1991) recount how apprentices, through legitimate peripheral participation in established communities of practice, became full participants in their crafts. Even with masters in residence, learning the skills needed in these communities takes time. Creating a curriculum where computers are used for constructing knowledge, as advocated by Streibel (1993), Damarin (1993, 1994, 1995), Olson (1988), Kerr, (1991) and others, without modeling by computer-using master teachers is very complex.

Visibility, Invisibility, and Transparency

Like many prior technologies of the twentieth century, the computer is touted as the machine that will reform American educational practices. Computers may now be powerful, flexible, and versatile enough to fulfill this promise. What will keep computers from living up to their promise? The answer could be their power, flexibility, and versatility — if classroom teachers are not provided the necessary opportunities to understand the educational affordances offered by computers. Teachers need a great deal of interaction with computers in order to begin to understand the transparency, visibility, and invisibility of these machines. As Lave and Wenger stated, "[T]ransparency ... cannot be viewed as a feature of an artifact in itself but as a process that involves specific forms of participation, in which the technology fulfills a mediating function" (1991, p. 102).
In an educational environment, the ideas of visibility, invisibility, and transparency surrounding the computer appear to be four-fold: teachers must learn about computers as machines; teachers must teach about computers as machines; teachers must learn with computers; teachers must teach with computers. Learning about computers as machines can help to demystify them as teachers begin to understand the internal workings of the machine. This would also encourage teachers to learn more troubleshooting skills so they would not have to rely so heavily on technicians. Learning about computers would provide teachers with extended visibility of the technology. Teaching about computers as machines would give teachers opportunities to provide students a sense of the history of computers and the environments in which they have developed. Students would also learn some basic troubleshooting skills so they would not be so reliant on teachers. Teaching about computers would provide students with extended visibility of the technology. Inservice and preservice teachers learning with computers could begin to understand the unique learning opportunities afforded by a computer environment. Learning with computers would provide teachers increased invisibility of the technology. Teaching with computers would allow teachers to reflect on their own learning with computers. Having learned with computers, teachers would have a better understanding of the skills needed by students to use computers as tools. Teaching with computers would also invite inservice and preservice teachers to
reconstruct their ideas of pedagogy. *Teaching with* computers would provide students increased invisibility of the technology.

Teachers who have a thorough understanding of computers, or extended visibility, are free to concentrate on the subject matter rather than on their own anxieties. Teachers for whom the affordances of computers are highly apparent can concentrate on planning and encouraging unique learning opportunities. As Lave and Wenger (1991) stated, "Invisibility of mediating technologies is necessary for allowing focus on, and thus supporting visibility of, the subject matter. Conversely, visibility of the significance of the technology is necessary for allowing its unproblematic — invisible — use" (p. 103).

The implications of the data analysis from Briar Elementary School lie in the area of professional development. The issue of the transparency of technology is complex but seldom addressed in the literature dealing with the integration of computers in the curriculum. Also of importance is the notion of the learning curriculum and its relevance to the integration of computers in a particular school setting.

**Hallmark Studies and Briar Elementary School**

Teachers become full participants in their community of practice as they gain expertise with the technologies of practice: textbooks, chalkboards, overhead projectors, and the course of study. In the case of the computer, an attempt is being made to introduce a new technology of practice that has the potential to fundamentally change what Lave and Wenger refer to as "everyday practices, ...social
relations, production processes, and other activities of the community of practice" (Lave & Wenger, 1991, p. 101). However, there are few experienced teachers who are experts in the integration of the computer into teaching and learning practices. These few experts are often alone in their school buildings or school districts. Administrative support for making their expertise available to novices is generally lacking. In most cases the community of computer using teachers can hardly be called a community; even within a district the computer using teachers often have little contact with one another.

Two hallmark studies in the area of teachers and computers provided a backdrop for my study. Kerr (1990) discussed the conditions in a learning environment that make computer integration more likely to occur. In his study, the district supported the teachers' efforts to integrate computers. District policies regarding computer use were flexible enough to allow teachers to integrate computers in ways that were compatible with their individual teaching styles. The teachers in Kerr's study had time to reflect on the ways in which computers would be used in their classrooms. These teachers also had a long-term commitment to learning to use computers and to integrating them into the curriculum.

Hadley and Sheingold (1993) discussed factors that allow teachers to become computer-using teachers. The significant factors that allowed the teachers in their study to continue to use computers, and thus to be identified as computer-using teachers, were: motivation to learn to use computers and various types of software; a commitment to
making learning fun and relevant for students; support from colleagues within their schools or districts; and access to enough computers to allow students and themselves the time needed to work with the technology. Hadley and Sheingold found teachers who use computers regularly to be very comfortable with the use of computers in the classroom. Such teachers make multiple uses of computers, often being willing to take risks by experimenting with unfamiliar hardware and software. The emphasis for the teachers in the study was on students: the products they create, their learning activities, the conditions for their learning.

Considering the teachers and the environment of Briar Elementary in relation to these earlier studies shows that many of the same conditions existed at Briar Elementary School. Like the teachers in Kerr's study, the Briar Elementary teachers had time to consider how to use computers in the classroom when they met in spring 1989 to plan their curriculum. They expected that learning to use the hardware and software would involve a long term association with computers. The Lakeside School District was willing to support the teachers' computer integration efforts. Flexible district policies regarding computer use allowed the teachers to adapt computer technologies to their teaching styles.

Many of the factors significant in the Hadley and Sheingold study were also present at Briar Elementary School. The teachers were motivated by the recognition they received from district and building administrators and by their own self-perceptions of being on the
cutting edge of technology integration. They were committed to their students' learning and to their own professional development. These teachers had support from colleagues within the building and from colleagues in the other computer magnet schools.

There were enough computers at Briar Elementary to allow students and teachers the time needed to work with the technology. The computer lab schedule was divided into time blocks that ranged from ninety minutes to one hundred five minutes. There were eighteen blocks of time available in a six-day rotation. At the very least, each Briar Elementary class could have used the fifteen computers in the lab four and one-half hours in each six-day rotation. The extended and frequent blocks of time available allowed the teachers and students to plan for computer integration in project-oriented tasks.

Like the computer-using teachers in Hadley and Sheingold's study, the Briar Elementary teachers were comfortable with the computers, made multiple uses of them, and often took risks by experimenting with new uses. The emphasis at Briar Elementary was also on the students: the products they created, their learning activities, and the conditions of their learning. The computer-using teachers in the Hadley and Sheingold study reported that it took them five to six years to develop a teaching style that included computers. At the end of this study, in autumn 1995, the teachers at Briar Elementary School were in the seventh year of creating a community of practice that integrated computers in teaching and learning.
The notion of computer-using teachers is evolving. Computer-using teachers, in the 1970's and 1980's, were teachers who taught their students to program in BASIC or Logo or who provided computer-assisted instruction for their students. More recently, the term computer-using teachers has been associated with teachers who plan and encourage computer use for interdisciplinary study, research on the Internet, or multimedia projects. So, the expectations of computer-using teachers become more complex as the hardware and software become more and more powerful.

Importance of Experience

I believe the decision to begin the Briar Elementary magnet school with experienced teachers was critical to the growth of this community of practice. Currently the emphasis in the field of education seems to be on graduating new teachers who are computer-using teachers. I contend that this emphasis is misplaced. Inexperienced teachers are not comfortable enough with classroom management or the course of study to put the time and energy needed into becoming computer-using teachers. In my experiences with preservice teachers, I have observed that most are not familiar enough with the ways in which students learn to begin to grasp the affordances (Gibson, 1979) of computers.

There seems to be the perception in colleges of education that preservice teachers have had experiences with computers as elementary, middle school, high school, and college students, thus
making them inherently more comfortable with computers and familiar with their uses. I would label this a misperception. In five years of working with preservice teachers in the area of computers in K-8 education, I have found it rare to have more than three or four students in a class of forty who are familiar with computer applications beyond word processing. Evaluating commercially produced software, creating and integrating databases and spreadsheets, telecommunications, and multimedia are all unfamiliar to them. These students can and do learn all of these applications of computers. But, the applications are learned out of context by preservice teachers who do not yet have experiences with teaching that can be linked to computer applications.

A community of practice that included both computer-based technologies and experienced teachers was created at Briar Elementary. Given the current scarcity of computer-using teachers in the schools, experienced teachers like those at Briar Elementary School would seem to be a better choice for our investments of time and resources. Experienced teachers will grasp the affordances of computers more quickly. They also will be part of established networks for bringing other teachers into their schools, including preservice teachers, to learn and share expertise in integrating computers. Through legitimate peripheral participation their expertise could help others with computer integration.
Looking Toward the Future

Many elementary women teachers are enthusiasts of children's literature, a common "technology" in their classrooms. It is not unusual to see these teachers surrounded by their students as all share a picture book. How will these same women deal with computers, a new, salient, and omnipresent technology, in their classrooms?

Elementary Teaching: A Woman's Profession

In the United States, teaching is a woman's profession. In 1993-94, women accounted for 73 percent of K-12 public school teachers. About 75 percent of the 378,000 full-time or part-time private school teachers were women. Fifty-two percent of K-12 public school teachers were over 40 years old (Digest of Education Statistics 1995, p. 43). In the movement to integrate computers into the curriculum, women, many of whom are middle-aged, are expected to use computers in a profession that has previously relied upon books as its major form of tangible technology. It is, therefore, important to examine how women have been socialized to deal with technology in general and computers in particular.

Carol Gilligan (1982) differentiated women's and men's organizations of their experiences in the world as the difference between 'a web' and 'a hierarchy.' In their 'web' view of the world, women feel the need to be at the center of an interconnected network of human relationships. In most cultures, women, rather than men,
are assigned greater responsibility for both the physical comfort and emotional needs of others. Tensions arise in women's lives because of conflicting obligations and ties, facts and emotions (Benston, 1992). In the worlds they inhabit, women use less powerful machines that were created for reasons other than gaining total control over the environment.

Even though people vary within the broad categories of 'women' and 'men' as much as they vary across categories, these two patterns of relating to the world and organizing experiences — a webbed view and a hierarchical view — have been observed within the two groups across many cultures. The complex roots of these ways of organizing experiences are not totally understood, but it has been shown that schools reinforce these views. Women's webbed view of the world is an issue of multiple importances as it relates to technologies themselves, women's interactions with technologies, women's confidence in using technologies, women's histories with technologies, and women's expectations for using technologies. One of the complexities that relates to women teachers and computers is the gendering of technologies.

Gendered Technologies

How do technologies become gendered? The gendering of technologies comes about through common use. Earth movers, missiles, and chain saws are associated with men. Vacuum cleaners, dishwashers, and typewriters are associated with women. In American
culture, computers have been associated with men due to their early uses in the military, science, and math — all traditionally male domains.

Cornelia Brunner (1992) discusses a study in which male and female technology experts were asked to fantasize about the future of their work and the technologies that they might use. Differences are evident in the ways these men and women foresaw technologies functioning. The men's fantasies have grand proportions and focus on using speed and knowledge to extend their powers of control over the universe. "The kinds of fantasies produced by the men in this study were in keeping with the values and belief systems that our mainstream culture considers masculine" (Brunner, 1992, p. 4). The technologies envisioned by the women in Brunner's study tend to deal with communication and connection. Smaller, less conspicuous, and portable, these technologies help to integrate women's public and private lives and to extend personal relationships by allowing women to share their lives with distant friends and family. I see these fantasies as manifestations of Gilligan's (1982) hierarchical view and webbed view of the world.

Research on women and technology tells us that women and men have quite different experiences with technology throughout their lives. Sherry Turkle (1984) discusses the ways in which the world views of women and men are evidenced in their interactions with computers. She observes two styles of computer programming which she termed 'hard mastery' and 'soft mastery.' Those who practice hard
mastery are decisive in their actions and intent on bringing the computer under their control. They define their goals very precisely and develop an orderly systematic way of reaching those goals. In Turkle's study, they are mostly boys. Those who practice soft mastery are just as competent in their programming as those who practice hard mastery but they are not as interested in control. They often use trial and error and are more interested in the final results of their programs than in a clearly outlined plan to achieve the results. Turkle describes their work as 'artistic' and 'aesthetic.' And, they are mostly girls.

Soft masters are similar to programmers that Turkle & Papert (1990) described as "bricoleurs," a term borrowed from Claude Levi-Strauss. Turkle and Papert use the term to describe programmers who take a more concrete approach to programming rather than a more formal, rule-driven approach. "Bricoleurs" prefer to interact with the computer and manipulate the elements of the program. Turkle and Papert find that more girls than boys employ a "bricoleur" style in programming and that "bricoleurs" often become discouraged and drop out of programming when the formal, rule-driven approach is promoted by computer teachers. "[C]omputer reticence, wanting to stay away because the computer becomes a personal and cultural symbol of what a woman is not" (Turkle, 1988, p. 41) is more of a problem for the future of women in computing than is computerphobia.

Autumn Stanley's (1983) work is often cited as evidence that women have historically produced and used technology. "[W]e can see that there is no necessary antagonism between women and technology;
and that women's relationship to technology is not necessarily that of passive victims" (p. 128, emphasis in original). Women are not the inventors of computers. Women teachers are not responsible for inviting computers into their classrooms, but they are finding that computers are now a part of their chosen profession. How do they choose to use them?

At Briar Elementary School, the teachers integrate computers as tools in various ways. Cybill Servant and Amber Geddes used computers in their Heritage Unit to foster the children's understanding of their personal and collective family histories. Each child had to interview family members and search through family photograph albums to gather information for the HyperStudio stacks. In the classroom, the second grade and fourth grade students compared the family information they had uncovered. Amelia Kelly's third grade students discovered information about one another as their classmates completed the surveys they had each created. In the fifth grade, Dicey Tillerman's students used the computers to create handbills about famous Americans from the Revolutionary War period. This project helped the students connect to the past through a better understanding of the ways in which people communicated in the eighteenth century. The handbill activity also encouraged the students to communicate with one another in the computer lab. They were using a piece of software that was new to all of them so they had to share troubleshooting skills. The experienced women teachers of Briar
Elementary School used the computer as a tool to sustain the community of practice they created.

**Women Teachers and Communities of Practice**

As Judith Lanier stated in an AERA session in 1995, "Elementary teachers love their students. High school teachers love their subjects. College professors love themselves."\(^5\)

But, who loves technology? All are called upon to use it. It takes a great deal of time to become a proficient and confident technology using teacher. Michael Apple (1989) has noted that it is often the male teachers who have the time to learn the technologies well enough to promote themselves as technology leaders. This is due to the disproportionate obligations that women have to family. Most women teachers must rely on prepackaged programs and attempt creatively to adapt these programs to their own needs (Apple, 1989).

The majority of elementary school teachers are women. As a group, they have little experience with computer-based technology and often little confidence in their ability to learn to use these technologies. Besides this personal reluctance to embark on gaining expertise with computers, many teachers are professionally resistant to the very presence of computers in their classrooms. Before they adopt any new approach to teaching and learning, elementary teachers must be convinced that the changes will benefit their students. The tongue-in-

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\(^5\) American Educational Research Association, annual meeting, San Francisco, California, April 20, 1995, Session 27.03--Legitimating and Educating Professionals in Postpositivist Times or "Has Anybody Seen My Knowledge Base?"
cheek commentary by Lanier on the loves of various groups of teachers is, nonetheless, grounded in some behaviors and attitudes of the groups mentioned. In the case of women elementary teachers, the needs of their students generally determine the areas in which these teachers focus their attention and energy. And so, we have this dilemma. How can the computer be used as a tool for nurturing children? The experienced women teachers of Briar Elementary School found many ways to integrate computers that encouraged student interaction, involved families in school activities, and built a community atmosphere in the school.

Nannerl Keohane (1990) suggested that at some point in their educational experiences "it is important for women to learn from other women and in the company of other women" (p.10). I feel this is especially true in the area of educational technology. The experienced women teachers of Briar Elementary School serve as an example of how women can encourage and bolster one another as they deal with reconciling their understandings of practice with their new computer skills. Learning from and with other women can encourage women elementary teachers to see themselves as technology users. Their views of their capabilities can be enhanced while they gain appreciation for their co-learners. Community, connectedness, acknowledgment of personal experiences, and benefits to be gained by their students would become prominent parts of technology courses designed for women elementary teachers. These technology courses contribute to the larger learning curriculum developed by the teachers themselves.
Procedural and Cultural Transparency

In his doctoral dissertation, Etienne Wenger (1990) made the distinction between *procedural transparency* and *cultural transparency*. Lave and Wenger (1991) collapsed these terms into the word *transparency*. Their discussions of legitimate peripheral participation in communities of practice dealt with the processes of procedural transparency and cultural transparency without distinguishing one from the other. I think it is important to bring that distinction back into the discussion.

Procedural transparency is the process in which the visibility and invisibility of tools of everyday practice emerge and submerge in the apprentice's consciousness as the tools becomes familiar. Procedural transparency, visibility, and invisibility are undeniably part of teachers' professional development whether addressed or not. In the past, most professional development in the area of educational technology focused on learning to use specific pieces of software. Teachers have been provided few opportunities to discuss the integration of the software in computer workshops. Teachers had no long-term support for the process of procedural transparency.

Transparent tools of everyday practice are familiar to the user. The properties of the tools are known but it is the uses of the tools that are the focus. In reference to this relationship between the tools of everyday practice and apprentices, Wenger (1990) stated, "Invisibility of mediating devices is necessary for allowing focus on, and thus
supporting visibility of, the subject matter" (p. 103). I have documented here the ways in which the experienced teachers of Briar Elementary School dealt successfully with the issues of procedural transparency. This study has added dimensionality to the contributions that experienced teachers can make as they use their understandings of pedagogy and epistemology in the process of integrating computers into the elementary curriculum.

In many ways, the issues of cultural transparency of computer-based technologies are more troubling than the issues surrounding procedural transparency in professional development in the area of technology integration. Wenger stated that, "The cultural significance of artifacts is much broader than their own structure and even the simplest artifact gives rise to a vast and complex field of meanings" (Wenger, 1990, p. 102, emphasis in original).

These fields of meanings are multilayered and are composed of multiple interrelated viewpoints ... They are textured further by the differences in legitimacy and universality claimed for the perspectives of various communities. Fields of meaning ... are not something that exist "out there" but relations that situate knowing persons and artifacts in the world as constituted by the combined production of multiple practices. (Wenger, 1990, p. 102)

Cultural transparency, then, is "the degree to which fields of meanings in specific circumstances become realized as understanding" (Wenger, 1990, p. 102). Using Damarin's (1993) metaphor or traveler and tourist, a traveler in a domain would have more opportunities to become a "knowing person," thus gaining a sense of the ways in which
the domain is "multilayered" and "composed of multiple interrelated viewpoints." A tourist would presumably miss the conjoined nature of the visibility and invisibility that constitute the cultural transparency of an artifact or technology. But, even a traveler could miss the "interrelated viewpoints" that come together to create a particular piece of technology if these "relations that situate knowing persons and artifacts in the world as constituted by the combined production of multiple practices" are not pointed out and studied. I am concerned that when we celebrate teachers who have become travelers in the domain of educational technology we are focusing simply on their understandings of procedural transparency.

Computers have entered elementary classrooms, the provinces of women and children, after development by the military and business. I found no evidence that the teachers at Briar Elementary School had given any thought to the environments from which computers have evolved or how those environments might influence their classroom practices. When teachers focus on the visible learning affordances of computers are they denying, or simply unaware of, the cultural transparency or the invisible "multiple interrelated viewpoints" embedded in computers? What are the "fields of meaning" that computers bring to the classroom? How are "differences in legitimacy and universality claimed for the perspectives of various communities" through computers as artifacts of military and business communities? What are the implications of teachers not being "knowing persons" — not knowing or understanding the fields
of meaning that computers bring to the classroom? Are teachers aware that using computers as classroom tools is revealing-mediating-embedding the military and business culture in the classroom? In what ways is this military and business culture translated into classroom practice? These are questions for a future research agenda.

**Into the Future**

Computers in elementary classrooms demand a share of the teacher's attention and love if they are going to become tools for nurturing children. What types of teachers and classroom practices might come about if women elementary teachers acknowledge and embrace both the procedural and the cultural transparency of computers? Donna Haraway (1991) has written about the interactions and dependencies between humans and machines. She provides a vision to consider in her definition of the cyborg.

The cyborg is resolutely committed to partiality, irony, intimacy, and perversity. It is oppositional, utopian, and completely without innocence. No longer structured by the polarity of public and private, the cyborg defines a technological polis based partly on a revolution of social relations in the oikos, the household ... The main trouble with cyborgs, of course, is that they are the illegitimate offspring of militarism and patriarchal capitalism, not to mention state socialism. But illegitimate offspring are often exceedingly unfaithful to their origins. Their fathers, after all, are inessential" (p. 151).

Playing with modern visions of women teachers as nurturing, unworlrdly goddesses and with Haraway's vision of the cyborg,
Suzanne Damarin (1995) asks teachers, "Would you rather be a cyborg or a goddess?" Taking Haraway's a-legal vision of the cyborg, Damarin suggests profiles of women teachers who, I hope, would emerge out of professional development involving computer integration designed for women. This professional development would address and embrace both the procedural transparency and the cultural transparency of computers. "The postmodern witch-teacher ... seeks the elemental aspects of technologies which make them vulnerable and invokes elemental powers against them" (Damarin, 1995, p. 58). She learns the inner workings of the technologies and demystifies them for and with her students. Together the witch-teacher and her students pursue opportunities and sites for discovering the forbidden. Another possible role for the cyborgian teacher is that of "laughing teacher ... [who] splashes with her students in the simulated seas of an unnamed planet, as they feel the warm equatorial waters on the bio-cyber bodies still back in the wintry midwest" (p. 59). Her classroom and her students are filled with joy and laughter. Together they go "for long excursions into exciting worlds unchartable and yet unknown" (p. 59). Finally, Damarin suggests the "alone standing teacher" (p. 59) who, with her ever-present broom, is always sweeping. "Sometimes she is a feminist pedagogue sweeping new patterns, sweeping the margins into the center of educational practice and attention; sometimes she is a multicultural teacher sweeping away the detritus of scientific racism" (p. 59). This border-dwelling teacher and her students search out
remnants of business, government, military, and science in order to banish them.

Experienced, middle-aged, women elementary teachers can become very adept at integrating computers into the curriculum. The teachers of Briar Elementary School have shown how computers can become tools for constructing knowledge when teachers are allowed and encouraged to create their own learning curriculum. Would these teachers become "postmodern witch-teachers," "laughing teachers," or "alone standing teachers" if cultural transparency became as important to them as procedural transparency?
BIBLIOGRAPHY


Bachelis, Gregory; Maxim, Bruce; James, David, & Stout, Quentin (1994). Bringing algorithms to life: cooperative computing activities using students as processors. School Science and Mathematics, 94(4), 176-86.


Beneson, Wayne; Braun, Joseph & Klass, Patricia (1992). Did you ever have to make up your mind?: decision making in the social studies classroom. *Illinois School Research and Development Journal*, **29**(2), 8-10.


Damarin, in prep. Margins to mainstream: legitimation and peripheral participation.


APPENDIX A

CHRONOLOGY OF DATA ANALYSIS
Chronology of Data Analysis

November 1993
Group discussion — analysis used to guide first round interviews

January 27 - March 3, 1994
First guided interviews — questions and topics based on analysis of group discussion, classroom participant/observation sessions, and telecourse assignments

February 1994
Grounded survey — questions and topics based on analysis of group discussion, classroom participant/observation sessions, telecourse assignments, and first interviews with Amelia Kelly, Dicey Tillerman, and Lisa Redford

November 15 - December 1, 1994
Second guided interviews — questions and topics based on all previous analyses and on numerous participant/observation sessions in autumn 1994
| Spring 1995 | Decision to use Theory of LPP  
| | — during synthesis of the  
| | literature on situated cognition,  
| | Lave and Wenger's theory of  
| | legitimate peripheral  
| | participation aided  
| | understanding of the data;  
| | decision made to use this theory  
| | to examine Briar Elementary as  
| | a community of practice  
| |  
| Spring 1995 - February 1996 | Data analysis continued — all  
| | data, including group  
| | discussion, interviews,  
| | grounded survey, documents,  
| | and observations analyzed  
| | using multiple constructs of  
| | Lave and Wenger's theory of  
| | legitimate peripheral  
| | participation  
| |  

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APPENDIX B
GROUP DISCUSSION QUESTIONS
Discussion Questions
November 10, 1993

1. What activities have you seen in the programs that you would like to try with your own students?

2. How comfortable do you feel about trying these new activities?

3. What do you need to integrate these activities that you don't have now?

4. How will you measure the success of the activities?

5. How do you feel about the "distance learning" aspect of this course?

6. In what ways is it better than a traditional (classroom setting) course?

7. What are the things you don't like about the "distance learning?"
APPENDIX C
GROUNDED SURVEY
Survey/Questionnaire  
Ed P&L 727.43

I feel that veteran women teachers are our most valuable resource in the field of elementary education. This survey/questionnaire is an attempt to gather information which will help me understand more about you and your teaching situation.

In Part 1, the questions about your personal life will provide data concerning the demands placed on your time. The questions about technology and teaching will provide data concerning choices you have made and some of the influences within your teaching environment. The final section includes follow up questions about the telecourse.

Thank you for your thoughtful answers.
Leslie

Part 1

1. ______ Number of people living in your household.  
   ______ Number who are under 18 years old.

2. Average number of times per month that you:
   ______ entertain family or friends at home.
   ______ attend social functions that are not business or school related.
   ______ take a child or grandchild to lessons or practice of some sort.
   ______ attend an event with a child(ren) or grandchild(ren).
   ______ attend a school function outside of your working hours.
   ______ attend a business function with your spouse.
       Doesn’t apply
3. _____ Average number of college courses that you take during the academic year.

4. _____ Average number of college courses that you take during the summer.

**Part 2**

5. Does your building administrator know that you are interested in learning to use technology as a teaching tool?  
   Yes  
   No  
   Not Sure

6. Do your district administrators know that you are interested in learning to use technology as a teaching tool?  
   Yes  
   No  
   Not Sure

7. _____ Number of technology related courses or workshops your district has offered or will offer you during the 1993-94 school year.

8. How do you personally define "integration of technology into the curriculum"?

9. There are many teaching tools and methodologies available to you as a teacher. Why do you choose to invest your time in learning to integrate technology into the curriculum?

10. Do you have a technology support group within your:  
    building?  
    Yes  
    No  
    district?  
    Yes  
    No

11. How has your access or lack of access to local technology support groups effected the integration of technology into your teaching?
12. Do you think your district and building administrators would like you to improve your skills with technology?  
   Yes  
   No  
   Not Sure  

13. On what evidence did you base your answer in number 12?

Part 3

14. Many activities using technology were shown during the telecourse. Explain how you have used those or other activities since the end of the course.

15. Since November 1993, have you tried integrating a piece of technology that you had not previously used with students?  
   Yes  
   No  
   a. If yes, please tell me about your experience.

16. What technology plans do you have for the remainder of the 1993-94 school year?
APPENDIX D

TELECOURSE ASSIGNMENTS
Assignment One—Due: October 5

If you say something in one of your assignments that we feel would be of benefit to others, do we have your permission to use your name, school, district, and observations on the air? ___ Yes ___ No

Read: 1. Aquila and Parish, “The Clash of Cultures: Instructional Technology and the Craft of Teaching”
   2. David, “Restructuring and Technology: Partners in Change”

1. What do Aquila and Parish mean when they describe teaching as a "craft culture?"

2. How would you correlate Aquila and Parish’s craft view of teaching to David’s ideas on the role of technology in restructuring education?

3. Each school is a unique example of a craft culture. Answer Aquila and Parish’s questions for your school.
   A. How do you do things at your school? ________________________________

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B. When you've changed things in the past, how has it occurred?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

C. What world views about teaching and learning are held at your school?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

D. What words do you use to describe your work and what do they mean?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. Considering your answer to number two above, what will be the strengths of technology in restructuring the craft culture of your school?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. Considering your answer to number two above, what will be the weaknesses of technology in restructuring the craft culture of your school?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

You're not done yet!!! Please turn the page.
Assignment Two--Due October 12

Read: Kerr, "Lever and Fulcrum: Educational Technology in Teachers' Thought and Practice"

1. What does Kerr mean when he describes educational technology as a "lever"?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

2. What does he mean when he describes educational technology as a "fulcrum"?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

3. Conduct an educational technology interview. If you integrate technology (other than an overhead projector) into your curriculum at least once a week, answer these questions yourself. If you do not, find a teacher who does and conduct an interview using the following questions.

Person answering questions:
- ☐ Self
- ☐ Other
  
  name ____________________________________________________________
  teaching assignment ____________________________________________
  school ____________________________ district ______________________

Interview situation:
- ☐ Face-to-face
- ☐ E-mail
- ☐ telephone

Interview questions
A. What elements in your school made it possible for you to integrate technology into your curriculum?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________
B. How did you reorganize your planning and classroom instruction to include technology?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

C. How has your role in the classroom changed as a result of your use of technology?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

D. Of the technologies available to you, what determines whether you integrate a technology or whether it gets put on the shelf?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

E. Why do you think you became a "technology using" teacher while others with similar backgrounds did not?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

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Assignment Three—Due: October 26

Read: “The Jasper Experiment: An Exploration of Issues in Learning and Instructional Design”

1. The authors discuss three models for teaching with the Jasper Woodbury Problem Solving Series. Which of the three most closely resembles the teaching model you generally use?

2. Why do you think you most often use that model?

3. What are the strengths of the teaching model you use most often?
4. What are the weaknesses of the teaching model you use most often? 

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

5. What information, skills, etc. do you feel you need to become more comfortable with model three, the "guided generation" model?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Assignment Four—Due: November 2

Read: Kozma, "Learning with Media"

What technology/technologies have you selected for integration as your final project?

________________________________________________________________________
________________________________________________________________________

Use information contained in the Kozma article to support your choice of educational technology to be integrated as your final project.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
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________________________________________________________________________

203
Assignment Five—Due: November 16

Read: Eriksson, "Thinking in visual images in the information age—the changing faces of the school"

In her article Eriksson answers the question, "Why use visual imagery in education?" with ten major points. Choose one of those points and elaborate on it in light of your own teaching and learning experiences.
APPENDIX E
DATA CODES
### Individual Data

**Amber Geddes, Fourth Grade Teacher**

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<td>November 10, 1993</td>
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<tr>
<td>AG-I1</td>
<td>Amber Geddes interview 1</td>
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**Amelia Kelly, Third Grade Teacher**

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Lisa Redford, First Grade Teacher

LR-G1  Lisa Redford group discussion  November 10, 1993
LR-I1  Lisa Redford interview 1  February 3, 1994
LR-I2  Lisa Redford interview 2  November 15, 1994
LR-S1  Lisa Redford survey 1  February 1994
LR-S2  Lisa Redford survey 2  October 1995
LR-TD  Lisa Redford-telecourse demographics  October 5, 1993
LR-A1  Lisa Redford assignment 1  October 5, 1993
LR-A2  Lisa Redford assignment 2  October 12, 1993
LR-A3  Lisa Redford assignment 3  October 26, 1993
LR-A5  Lisa Redford assignment 5  November 16, 1993
LR-FP  Lisa Redford final project  December 1, 1993

Mack Favorite, Principal

SP-I1  Mack Favorite interview  November 22, 1994
SP-I2  Mack Favorite telephone interview  December 18, 1995

Group Discussion

GR  Group discussion  November 10, 1993

Document Codes

P1  Regional professional development proposal to become a language arts site  Spring 1994

GP1  Grant proposal funded to share technology expertise  Funding began Early Autumn 1994
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APPENDIX F

A STAFF MEETING WITH THE SUPERINTENDENT
On Tuesday morning, December 6, 1994, the faculty of Briar Elementary School had a staff meeting with Dr. Edward Heilman, the superintendent of the Lakeside School District. The purpose of the meeting was to clarify the mission of the school in anticipation of writing a new mission statement. The meeting started at eight o'clock when Mack Favorite handed each teacher a packet of worksheets that would be used to clarify the mission of Briar Elementary School and eventually to generate a new mission statement for the school. Dr. Heilman had not yet arrived. The initial conversation among the teachers and Mr. Favorite centered around whether Briar Elementary should try to establish its difference from the other elementary schools in the district. When Dr. Heilman arrived a few minutes later, Mr. Favorite informed him of the topic under discussion.

Dr. Heilman responded, "You are different. The technology piece and the language piece make you different. What do we want parents to understand about this school? Your delivery of instruction and your focus of instruction make you different."

Lisa Redford mentioned that another elementary school in the district had a literature-based curriculum and a comparable computer lab. She wondered how Briar Elementary was different.

"The difference is choice. Who's here and why they're here. Your class size is constant. You are here by choice. The parent involvement at this school is different. We've had to make some changes this year because of bus schedules. But, as a faculty, you identify your own evolution. So you are not the same as (the other
school) just because of the literature-base and the computer lab," answered Dr. Heilman.

Mack Favorite added, "The types of products our students produce reflect what we do. We only hit a small number of parents on information night. The products that our students produce tell the community what we do here."

"I have a general overview of what I think you do," said Dr. Heilman. "But, you are in a better situation to identify what you do than I am."

Dicey Tillerman answered, "Our program is in-depth and enriched."

"And accelerated! But that's scary," added Lisa Redford.

Dr. Heilman remarked, "The size of Briar Elementary makes many things possible. If we opened one of the larger schools as a magnet it would probably be full, too. People like choice. We could set up a magnet middle school as a partner to the elementary schools."

"Immediate flexibility is one advantage of our smallness," declared Ms. Redford.

"Cross grade level work is another advantage," added Dicey Tillerman.

"You could almost do a non-graded curriculum here," observed Dr. Heilman. After a brief exchange about using telecommunications to link all of the magnet schools, he asked, "Does this help answer your questions?"
Ms. Tillerman answered, "Yes. Well, we know we're different. We wanted to know if we should say we're different."

"Sometimes we get in trouble for saying we're different," explained Amelia Kelly.

Dr. Heilman declared, "That's a marketing problem for the district."

Lisa Redford said, "Yes, we have to do a better job of marketing the school."

After a short digression Dr. Heilman remarked, "To get to your question—parents here feel good about you and this school. As you evolve you will take this school to a different arena that you will define. This is a great school. I don't think you can beat the instruction here. Sometimes people are negative about the magnets because their child didn't get in. Magnets in general are under attack. Some of that is jealousy from colleagues. You work hard. They think you are in a cake situation. But you work harder because of the expectations that are placed on you. You bought your own personal computers. That shows commitment. If you need some technology, let us know. The district has some money. Not a lot. This program is a pilot project. We have to make sure you have the technology."

Ms. Redford observed, "Our Internet connection ends at the end of this year."

"We'll look into that. We have applied for the internet," answered Dr. Heilman.
Ms. Redford then asked, "Can we stress our integrated curriculum?"

"That's where our enrichment comes in," Amber Geddes noted. Dr. Heilman commented, "The course of study encourages that."

"Our curriculum is so integrated we may not appear to have a strong science program but it is equal to the other parts of the curriculum," Dicey Tillerman observed.

Dr. Heilman declared, "You have far exceeded what we originally envisioned. Your whole focus has shifted and that should have been expected. Parents sign their children up here. You have a real intense instructional program. So children are going to excel. We may have to get more selective about who comes to Briar Elementary."

The next few minutes of the discussion centered on other schools in the Lakeside School District that might become magnet schools and what their focus might be.

Dicey Tillerman talked about me and how much she felt I had helped them with the new computer lab and software in the past few months. She suggested that they really needed someone who could help them with the hardware and software. Dr. Heilman said that the district would "evolve several of those positions."

Amber Geddes noted, "It is especially helpful during that start-up year."

"What we need are some floating teachers. Technology is an adjunct to you. It will never replace you," said Dr. Heilman. "We may have to go to external contracts to upgrade the technology."
Lisa Redford spoke up and said, "Sam is great! He gives us direction and allows us to be the strong women that we are."

"You have done, and do, an exceptionally good job with the boys and girls here. When things look easy it's because a lot of hard work has gone into it. I'm amazed at what some of these little ones can do," concluded Dr. Heilman.