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ABSTRACT

Classroom-based, real-time communication networks are in wide use for college-level reading and writing instruction and are now being adopted for use in elementary and secondary classes. Teachers use this network-based approach to literacy instruction (known as ENFI--Electronic Networks for Interaction) to support authentic reading and writing, collaboration, students-centered learning, writing across the curriculum, and the creation of classroom writing communities. A case study of network-based college classrooms at Gallaudet University identified great diversity in the realization of these goals. Nevertheless, common factors influenced all of the implementations: institutional goals, practices, and gateposts; prior theories, personalities, and established practices of teachers; student characteristics and expectations; features of the technology; and available resources. These factors suggest new ways of thinking about network-based classrooms and how to use them successfully. More generally, they inform educators' views of literacy and the support needed for innovations designed to foster literacy development. (Contains 80 references, 7 notes, and a figure representing an ENFI computer screen.) (Author/RS)

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Abstract

Classroom-based, real-time communication networks are in wide use for college-level reading and writing instruction and are now being adopted for use in elementary and secondary classes. Teachers use this network-based approach to literacy instruction to support authentic reading and writing, collaboration, student-centered learning, writing across the curriculum, and the creation of classroom writing communities. A case study of network-based college classrooms identified great diversity in the realizations of these goals. Nevertheless, common factors influenced all of the implementations: institutional goals, practices, and gateposts; prior theories, personalities, and established practices of teachers; student characteristics and expectations; features of the technology; and available resources. These factors suggest new ways of thinking about network-based classrooms and how to use them successfully. More generally, they inform our views of literacy and the support needed for innovations designed to foster literacy development.

LITERACY DEVELOPMENT IN NETWORK-BASED CLASSROOMS

Every year, new approaches to fostering literacy development appear in classrooms. These innovations--ideas, teaching strategies, methods, materials, assessment procedures, software--are reported at conferences and in journals, often being hailed as a better way to address some long-standing challenge in literacy education. Many of these innovations do represent valuable contributions to educational theory and practice. Others, however, appear to be new packages for old ideas. And some seem to have little evidence supporting their use. Regardless of the worth of any particular innovation, much of our discourse is organized around introducing, promoting, criticizing, comparing, examining, and otherwise discussing these innovations apart from their contexts of use.

When an innovation is discussed, some people focus on its strengths while others focus on its weaknesses. In either case, left unsaid is the assumption that the innovation in theory is different from its realization in practice. It is, of course, acknowledged that not every teacher uses a given approach in the same way. But this acknowledgment usually enters the discussion in the form of explanations about why certain deviations occurred (e.g., "Classroom B was not *really* a writing process classroom" or "Teacher X did not teach the reading strategies as they were intended."). Explanations such as these presuppose that the innovation has an existence prior to, and independent of its manifestations in social practices.

We believe there are good reasons to question this assumption. Doing so significantly alters our usual ways of talking about new approaches for literacy development, or for any area of education. For example, the typical question, "Does this approach work?" is reformulated to recognize the transactional[1] relationship between innovations and the social settings in which they are used. The creative and generative aspect of adopting innovations is recognized, rather than seeing innovations as completed, well-bounded entities.

To ground this argument, we discuss here an approach to literacy instruction that would appear to offer the greatest difficulty for our argument. The particular approach is built upon new technologies, specifically, computers and local-area networks; it has been described and defined in several articles, by a relatively small group of people; and it has been implemented by a group of people working together in a consortium with frequent meetings and communication. Thus, it serves as a paradigm case of a well-defined literacy innovation, more finely specified than ideas such as writing workshop, dialogue journals, collaborative learning, reader response, or even "basal reader program."

The approach is known as ENFI (Electronic Networks For Interaction), and involves using communications software on a local-area computer network to converse in writing. The goal of ENFI is to improve students' abilities to write, read, and engage in collaborative problem solving by immersing the students in a writing environment. We consider here the effect of the ENFI environment on students' and teachers' understanding of literacy and their approaches to literacy development. Throughout the discussion, several questions are considered: To what extent does it make sense to think of ENFI as an independent innovation? Why does even a finely specified innovation like ENFI become realized in such diverse ways? What can we learn from this study about the relationship between settings and innovations? How might these observations alter our discourse about literacy development and change?

Background

To proceed with our examination of ENFI, we need to consider its theoretical background and also to lay out the basis for our own approach to analyzing it. We have organized this background section into four parts: (a) a brief discussion of how new technologies are being used to foster literacy development; (b) a description of network-based classrooms, of which ENFI is an example; (c) a discussion of the

vision of writing in the classroom that motivated ENFI (and that is shared among many current approaches to writing instruction), and (d) a brief account of recent work on the study of innovation and social change.

New Technologies for Literacy Development

Technology can play a variety of roles in supporting the development of literacy (Bruce, 1991). Computers can aid when teacher time and attention are insufficient. They can facilitate the processes of generating ideas and organizing text. Unlike teachers, they can give feedback at any opportune moment. They can comment upon features of written texts. With the aid of a text editor, revision of text is more efficient and rewarding. Computers can increase the time spent actually engaged in literacy activities. They can thus create time and opportunity for teacher involvement with essential aspects of reading and writing processes, which are beyond the reach of the computer.

Computer technology has also opened up dynamic new possibilities for using written language (Soloway, 1993). Among these are the many ways students can share written text. Students across the country and even around the world send messages to each other, write newsletters together, and participate in collaborative science and social studies projects (Cohen & Miyake, 1986; Cummins, 1986; Levin, Riel, Miyake, & Cohen, 1987; Riel, 1983; Sayers, 1989). University students take classes long-distance by communicating with their professor and other students through electronic mail and computer conferences (Black, Levin, Mehan, & Quinn, 1983; Hilz, 1986; Kaye, 1987; Quinn, Mehan, Levin, & Black, 1983). Computer networks allow students and teachers to read and comment on-line on each other's texts in progress (Neuwirth, Kaufer, Keim, & Gillespie, 1988), share data files for collaborative research (Thompson, 1990) and, as they are writing, display portions of their texts to others in the class to observe their reactions (Thompson, 1989).

Network-Based Classrooms

Network-based classrooms are now being implemented in classroom settings at all grade levels, in a variety of subject areas, and in diverse educational institutions. Proponents hope to transform the traditional classroom by engaging students in more direct participation in their own learning, and network writing holds great promise for promoting literacy development. One type of computer network, ENFI, was developed in 1985 at Gallaudet University. Since its development, implementation, and evaluation at Gallaudet, similar approaches have been tried in basic writing classes for both hearing and deaf students, classes for students learning English as a second language, and advanced rhetoric classes. ENFI was adopted first by a small consortium of colleges and universities,[2] and has since spread to at least 100 other institutions, including elementary and secondary schools (Peyton et al., 1993). Like hypertext, ENFI is a concept, not a particular software program. In fact, several different types of software have been used to implement the basic idea.[3]

In most ENFI classrooms, the students and the teacher sit at individual computer terminals and compose messages in a private window at the bottom of the screen. When they press a key, their message is immediately transmitted to all the screens in the class. As users type and send messages, their messages scroll up the screen in a continuous dialogue tagged with the name of the sender (or with whatever name the sender logged on), as in the script of a play. While individuals are composing, the messages of the other class members continue to scroll visibly up the screen. Participants can scroll back to read previous messages they might have missed, but new messages continue to be received at the same time.

The computer stores the entire discussion, which can be reviewed at any point during the class session or printed out in its entirety at the end. Discussions occur on different network channels, each of which can carry discussions between two participants or among the entire class. Using a video switch, the

teacher can, at any time, view the writing of an individual student or of a group of students on a channel, or can display the writing or revising of one student or the teacher to the entire class.[4]

Figure 1 shows a student screen during a discussion at Gallaudet University.[5] The bottom window shows the student's draft message ("responsibility to deaf students. . ."). This message is private until the student decides to send it to the rest of the class. In the example shown here, the student has misspellings that may or may not be corrected before the message is sent. The upper window shows teacher and student messages as they have been produced over a span of perhaps a minute. This window is the same on all screens.

[Insert Figure 1 about here.]

This particular use of a local-area computer network was developed at Gallaudet to improve the literacy skills of deaf students (Peyton & Batson, 1986). Because deaf people have limited opportunities to use English for day-to-day communication and to interact with others, they often encounter difficulties reading and writing in English (Charrow, 1981; Quigley & Paul, 1984). With a computer network and software that allows for interactive writing, deaf students can use written English to communicate spontaneously their ideas to a community of other writers. When a competent English user (such as the teacher) writes on the network, students can observe models of correct writing in the context of genuine communication.

New Ways of Writing in the Classroom

As information about the Gallaudet ENFI Project spread, other colleges and universities became interested in the potential of real-time interactive writing for hearing students, for whom writing is also often difficult. A vision for ENFI took shape that reflected current thinking about effective writing pedagogy. ENFI was to provide a "total immersion method" of teaching writing to college students (Batson, 1987, p. 4), a writing environment that would transform and revolutionize the traditional classroom. This vision had five major threads, which were articulated by ENFI developers and teachers in various publications.

First, ENFI would create *new social dimensions in the writing classroom*, involving "entirely new pedagogical dynamics" (Batson, 1988, p. 32). The role of the writing teacher would shift from lecturer and director of discussion to that of facilitator and collaborator in writing. Student participation would be more equally distributed. It was hoped that traditional classroom interaction patterns would be radically altered when classes began to communicate in writing on a network. Although ENFI relied upon new forms of technology to achieve this goal, the ENFI vision resonates with much other recent work on the teaching of writing (e.g., Atwell, 1987; Calkins, 1983; Dyson, 1991; North; 1987).

Second, students using ENFI would *write for authentic purposes and for real audiences*. Whereas previously their sole purpose in writing was to be evaluated, it would now include all the purposes of speech: "to inform and persuade, to entertain and enlighten, to develop social relationships, to explain experience . . . and to create and develop ideas" (Batson, 1988, p. 15). Writing, therefore, would come alive for students; they would see it as an important means of lively communication, and not simply as an evaluated performance for others (Peyton & Batson, 1986). In this context, writing would become less formal and more conversational, and students' writing would move easily from one type of communication to another. Conversation and composed text would, in a sense, become merged (Langston & Batson, 1990).

Third, students would be *immersed in a writing community*. The original goal of ENFI at Gallaudet was to immerse deaf students in the English language. As ENFI practice expanded to include hearing

students, the goal was to immerse them in writing: their own, the teacher's, and other students'. The classroom would become not just a speech community, but a writing community as well.

Fourth, students would *write collaboratively*. "Most collaborative learning classes stop short of actual group writing. [Students] may think together and plan together and then, after they write individually, critique their writing together, but they probably won't write together. They don't observe each other's writing process. ENFI makes this last step possible" (Batson, 1987, p. 26). As with the other goals, ENFI provided a technology to enhance and extend practices widely advocated within current writing research and practice (e.g., Dyson, 1991).

Finally, students would *write across the curriculum*; English class would not be the only site for process writing. Although ENFI was first implemented in English classes, the hope was that it could be used to accomplish a range of purposes in other subject areas such as history, literature, mathematics, or science. Any area in which students might have difficulty expressing their ideas would be helped by collaboration in writing with the teacher and other students. Again, the goal of writing across the curriculum was not unique to ENFI (see Fulwiler & Biddle, 1992; Fulwiler & Young, 1982), but was one that the new technology seemed able to support.

Studies of Innovation and Change

A growing body of research in the last decade has examined the role of new technologies and their impact on social relationships in the workplace, family, and community settings. These studies have moved from a deterministic conception of the relation between innovations and change toward a view that integrates technological, social, cultural, economic, and political processes (Bijker, Hughes, & Pinch, 1987; MacKenzie & Wajcman, 1985; Star, 1988, 1989; Staudenmaier, 1989; Taylor, Kramarae, & Ebben, 1993).

But in education, new technologies, which may come in the form of high-tech hardware, curriculum materials, or new instructional practices, are often hailed as the solution to persistent problems--as if the technology alone would cause change to occur. In many cases, little thought is given to the influence of the social setting--the classroom, the school, the district--in which the innovation is to operate, despite compelling evidence that new practices are rarely adopted to the degree or in the manner that their originators envisioned.

Technologies in use take diverse forms, in part because when they are designed to bring about significant social changes, they necessarily challenge established beliefs, values, and practices. In response to these challenges, people create new practices that reflect complex and situation-specific compromises between the old ways of doing things and the new. Often, these new practices were not even envisioned in the original conception of the innovation. This property of the implementation process raises serious questions for models of educational change (see Cuban, 1986; Fullan & Stiegelbauer, 1991), for the evaluation of innovations (see Cronbach, 1982; Walberg & Haertel, 1990), for understanding the role of teachers in implementing innovations (see Hord, Rutherford, Huling-Austin, & Hall, 1987), and even the basic notion of what an innovation is (see Bruce, 1993).

These issues are relevant to diverse approaches to school-based literacy, including writing process models, writing across the curriculum, reading recovery, new basal reading programs, computer-based instruction, interactive video, phonics first, and integrated curriculum programs. As we begin to examine specific cases, it becomes clear that the change process cannot be easily circumscribed or described in a mechanistic fashion. The independence assumption--that any broad-based literacy approach can be productively conceptualized separate from its specific contexts of use--appears problematic and unlikely to lead to improved theory or practice.

Evaluating ENFI

In 1987, when ENFI was well-established at Gallaudet and in various stages of implementation at four other consortium sites--Carnegie Mellon University (CMU), University of Minnesota, New York Institute of Technology (NYIT), and Northern Virginia Community College (NVCC)--we were called on to evaluate its effectiveness. We decided our first task was to determine what people were doing when they said they were "doing ENFI." We read all of the published and unpublished papers written about ENFI, observed ENFI classes (and where possible, non-ENFI classes) at all of the sites, interviewed ENFI participants and surveyed them by questionnaire, and sought their feedback on our observations and analyses.

Methodology

After we had perused the ENFI literature and made preliminary visits to all of the ENFI classes at Gallaudet, we developed a series of research questions, ranging from basic ones regarding room layout and time spent on the network to more interpretive ones, such as how teachers and students interpret what ENFI is. Here we list those questions most directly concerned with literacy development (see Bruce & Peyton, 1990, for the complete list of questions).

- What kinds of literacy skills are practiced on the network?
- What kinds of literacy skills are not practiced?
- How do the students and teachers react to the use of the network for teaching and learning writing?
- How does network interaction relate to other writing for the class and other activities in the class?

We visited the five sites at least once, and when possible, twice. On these visits we observed, and in some cases participated in, at least two classes in which ENFI was well-established. Where possible, we also visited non-ENFI classes taught by the same teacher. During these observations, we took open-ended field notes. We conducted formal interviews with site directors, teachers, students, and lab aides, relying on a set of questions we had developed ahead of time, but also pursuing issues that came up during the interviews. These interviews were tape recorded and transcribed. Other interviews were more informal conversations with participants during classes, and for those we took notes. We collected transcripts of network interactions for all the classes we observed. In some cases, we were told about other interesting classes we were not able to observe, and were given illustrative transcripts. Where possible, we also collected other writing that accompanied the network interaction; for example, classes sometimes discussed pieces of student writing on the network or discussed a topic on the network and then wrote an extended piece about it.

To get a broader view of network use and the ongoing reactions to ENFI from students and teachers in all of the classes involved, we collected questionnaire data each semester, which included open-ended teacher reports of strengths and limitations of ENFI (the basis for many of the teacher quotes in this article). We also collected the conference papers, reports, and articles written by consortium teachers, administrators, and researchers; we participated in an electronic mail conference set up for ENFI teachers and site directors in the consortium in which activities, successes, problems, and solutions associated with ENFI use were regularly discussed.

Finally, we circulated drafts of our own reports and articles about ENFI for feedback from consortium members. By soliciting the concerns, issues, and critiques of participants in the study, we have attempted to conduct a "responsive" evaluation in the sense defined by Stake (1990).

ENFI Realizations

It soon became clear that although consortium members all called what they were doing "ENFI," ENFI took many different shapes. Four different software systems were in use. Student populations varied from precollege deaf students at Gallaudet to sophisticated college juniors and seniors at CMU. As we observed ENFI classrooms, we saw vast differences in implementation, which we began to describe and categorize as different "realizations." By the end of our observation period, we had identified 16 substantially different realizations, ranging from open-ended discussions among members of a whole class about topics the students brought up, to highly structured peer response to student papers done in pairs or groups of three. These realizations and our criteria for designating different realizations are described in detail in Bruce and Peyton (1990).

The realizations differed along such dimensions as (a) room layout, (b) hardware and software features, (c) physical proximity of participants (varying literally from campuses to shared chairs), (d) discussion-group size, (e) degree and manner of teacher involvement, (f) roles of participants in the interactions, (g) degree and nature of network interaction, (h) purpose for the network activity, (i) discussion topics, (j) formality of the discourse, and (k) relation of network discourse to other activities and texts. In many cases, they also differed considerably from the original visions for ENFI, articulated above.

Thus, we were faced with a key definitional problem: "What is ENFI?" This question arose because as ENFI was interpreted and realized in diverse settings, it appeared as a collection of social practices, rather than as a well-defined innovation that could be evaluated, measured, and compared to other approaches. This result undermines any answer to the question we were charged with addressing: "How well does ENFI work?"

Identifying Common Themes

In their individuality, the diverse implementations of ENFI suggested variation without limit--isolated phenomena from which no general observations could be drawn. And indeed, the contrasts between the implementations were what first captured our attention. Yet as we looked across the various sites, and the various shapes that ENFI took at those sites, we began to see common influencing factors, which included institutional constraints, existing pedagogical practices, student attitudes and values, features of the technology, and available resources. Each of these factors shaped, and were shaped by, this new pedagogical approach. This mutual shaping process is an important part of the implementation of any educational innovation. In this report, we describe the constraints that ENFI consortium members worked within as they implemented ENFI and examine the ways that ENFI evolved within those constraints. We hope that this description will also shed light on the processes that occur as other innovations to promote literacy development are implemented. Although our study focused on college and university classrooms, the themes identified are equally applicable to K-12 settings.

Institutional Goals, Practices, and Gateposts

At Gallaudet and all of the other consortium sites, ENFI was used primarily for writing courses, in the English department. The goal of the courses was to teach students to write extended prose--in some, personal narratives; in others, expository essays. In most cases, years had already been spent planning curricula, choosing materials to develop students' literacy, and developing exit tests to assess students' writing abilities. However, as is clear from the writings cited below, network writing is very different

from the "essayist prose" (Scollon & Scollon, 1981) traditionally expected in college English courses. In fact, it is less like solitary produced, extended text and more like conversation, or "talk story" (Boggs, 1985). The differences between network interaction and essayist prose contribute to both the excitement about network use and the conflicts in its implementation.

First, instead of one author, there are many "authors," each expressing ideas and building on or completely ignoring the ideas of others. Langston and Batson (1990) argue that network writing abolishes the notion of the original thinker, the solitary author producing a text, and gives rise instead to the image of "a precipitating solid in a supersaturated solution . . . the speck of dust around which crystals form" (p. 153). The individual is suspended in ideas and concepts that crystallize in a community. Sirc and Reynolds (1993) describe network interaction as *bricolage*, a construction of meaning built from "a blend of one's own ideas, others' ideas, and material one has read or heard in discussion" (p. 140).

Second, the writing does not result in a product in the traditional sense--a story, an essay, a term paper, or a dissertation. As DiMatteo (1990) points out:

> The product of such writing is a text that reaches no conclusion . . . . Not only does no one have the final say, but even the notion of a final say is brought into doubt. The text, traditionally understood as a stable place of organized and fixed language, disappears. (p. 76)

Third, the quality of students' network discussions often does not approximate what is normally considered literate discourse. In fact, students' network discourse has disappointed and shocked many teachers. The interactions are sometimes confused, focusing on everything but the topic at hand. Rather than writing complex thoughts or extended, logical, thoughtful prose, students trying to keep up with the constant flow of language scrolling up their screens, and suddenly in linguistic competition with their classmates, may fire off humorous zingers and "graffiti-like messages" (Kremers, 1990, p. 40) or vulgar wisecracks (Miller, 1993). Those who take the time to think and compose may be laughed at, criticized, or ignored and left behind.

Finally, network interaction seems to create an urge to engage in language play, to show off one's wit, to display one's verbal audacity. This dynamic can be valuable for students who are generally reluctant to express themselves in writing. In the early days of ENFI at Gallaudet, this was an unexpected but welcome occurrence. At the same time, the result can be *flaming*, the use of confrontational and insulting language (Sproull & Kiesler, 1991). A professor at NYIT, for example, found that students using the network for the first time began "to curse obsessively" in "a tidal wave of obscenity and puerility" (DiMatteo, 1990, pp. 79, 80). Another described her students' initial network behavior as a "combination of unbridled bigotry and heady power" that produced exchanges "less interactive than interinsultive" (George, 1990, p. 49).

Among consortium members, these qualities of network interaction raised serious questions about the network's role in the writing classroom and its viability as a way to help students do the kinds of writing expected of them.

> The bottom line, after all, is that this is a writing class, and no matter what anyone says about the theoretically collaborative, social side of writing, ultimately it becomes a solitary act. (Sirc, University of Minnesota)[6]

> The goal of writing as communication is not an expressed institutional one, while writing essays is, and ENFI does not have any very obvious impact on the writing of essays. (Thompson, NVCC)

> [Network writing] is so revolutionary that it isn't at all clear whether or not there is any way to link [it] with success on an exit exam. (Kremers, NYIT)

One professor even mentioned the possibility that network writing might have an adverse effect on students' school-based writing, especially for those students whose writing abilities are already weak:

> Unfortunately, my ENFI class may be in a weaker position than my non-ENFI class when it comes time to take the departmental final, which involves writing an essay. My ENFI class tries to incorporate conflicting perspectives on an issue in their essays, because these perspectives arise in the network prewriting sessions. My non-ENFI students concentrate on their own perspectives. Their single-minded approach makes more traditional sense than the multiple-perspective approach, because it leads to a clear thesis and topic sentence. The skills the network promotes are difficult to assess through the traditional essay format. (Kremers, NYIT)

These qualities of network writing also raise questions about evaluation of student writing. How is network writing to be evaluated if there is no single author and measures of writing competence are based on individual performance? If network writing itself does not yield a text that can be evaluated, do the skills acquired in network interaction transport effectively way to the essay and research writing required of students and for which they *are* evaluated?

The responses to these questions and the resulting ENFI practices that have been developed are very different. At CMU, a strong theory-based writing curriculum was already in place for freshman students, with the goal of promoting critical thinking, critical response to texts, and collaborative work. Thus, the CMU staff working on the ENFI project asked bluntly, "How will the practice of writing concurrently on a computer network facilitate the goals we already have in place?" It was clear from the beginning of the ENFI experimentation at CMU that if ENFI activities didn't facilitate those goals, ENFI would have no place in the program. The result of the work at CMU was a highly structured ENFI practice, with paired interactions and carefully delineated tasks (described in detail in teacher and student guidebooks; Neuwirth, Gillespie, & Palmquist, 1988; Neuwirth, Palmquist, & Gillespie, 1988). At this institution, ENFI was adapted to fit the writing theory and curriculum that were already in place.

At Gallaudet, the primary goal of all the English classes using ENFI was that students become proficient with written English, as demonstrated by performance on out-of-class essays and on a departmental exit exam at the end of the semester. Doug Miller, one of the first teachers to implement ENFI, had spent years developing curricula, materials, and activities to accomplish this goal in his freshman and sophomore English courses. His first use of ENFI was an attempt to transfer those activities, primarily structured writing exercises and drills, to the network (see Peyton, 1990 for a detailed account of the evolution of ENFI in Miller's classes). When he found that those activities did not seem to facilitate his goals, but rather seemed to hamper them, he stopped using the network entirely for a time. When he returned to ENFI, it was in a completely different form--for dramatic productions (which he called "script writing") in a more loosely structured summer course that had no pre-established curriculum and no exit exam. He then decided to design a course specifically to exploit the potential of network interaction. Thus, in Miller's case, ENFI was eventually transported to a course that would benefit from its qualities, rather than being made to adapt to an already existing course.

At the University of Minnesota, the dean, Terry Collins, and two professors, Geoff Sirc and Tom Reynolds, set up an ENFI lab to facilitate the writing curriculum already in place in their department (as did the ENFI team at Carnegie Mellon). This curriculum revolved around writing relatively brief texts about personal experiences. Through ENFI conversations among students about their compositions, they hoped to make visible the continual drafting and revising of text necessary to good writing and to encourage students to take greater ownership of their own and others' writing. In short,

they hoped to create a community of authors. However, as they worked with the students on the network and began to study the network transcripts, flaws in the curriculum became visible. Their past writing curriculum was no longer appropriate for their students, so they completely revamped it. In this case, ENFI brought to light problems with the established curriculum and turned out to be an ideal medium for accomplishing the goals of the new curriculum (see Sirc & Reynolds, 1993).

Although at these three institutions ENFI came to have different relationships to the writing curriculum, in each case its basic nature remained the same--it consisted of real-time written interaction within the classroom. At NVCC, even these basic features were altered. Diane Thompson believed that the institutional goal for her students, who were basic writers from working-class communities, was to teach them to "do school"--to function effectively within an academic environment and pass the school's required exit tests. She began her ENFI work by replicating as closely as possible what she had seen of ENFI at Gallaudet (Thompson, 1993). But the apparently similar real-time interaction on the network assumed a new meaning in her new context. Writing to each other within the classroom seemed both cumbersome and unnecessary when the students and teacher could speak and hear. Thus, the faithful replication of ENFI seemed literally impossible.

Extending the interaction to include a class at a distant NVCC campus made more sense intuitively, but it was even more difficult to orchestrate, and both teachers questioned ENFI's value for accomplishing institutional and their own objectives. Ultimately, Thompson stopped conducting any real-time network conversations, either within the class or across a distance, and developed practices involving the non-real-time sharing of extended texts: orally negotiated paragraphs sent from group to group within the class; a common text file to which students could contribute when writing a research report; and an asynchronous public journal in a distance learning course. In Thompson's case, the basic features of ENFI were changed, and "ENFI" came to mean something very general--computer communications that encourage writing for one another (Thompson, 1993).

The professors in each of these four settings started with the same body of information about ENFI conveyed at conferences, in papers, and in conversations with ENFI's developers at Gallaudet. But ENFI took four very different paths when it was merged with the constraints of their four institutions.

Teacher Theories, Personalities, and Established Practices

Teachers are never passive recipients of new ideas, approaches, or technologies; rather, they are active agents in determining the shape those new technologies take. The way a teacher makes sense of and shapes a new idea, technology, or approach is a complex process influenced by that teacher's theories of teaching and learning, the teacher's individual personality and preferences, and the pedagogical practices that he or she already has in place (Bussis, Chittenden, & Amarel, 1976; Cohen, 1988; Cuban, 1986; Elbaz, 1981; Fullan, 1982; Harste & Burke, 1977; Hord et al., 1987).

All teachers work within a theory or a set of theories about teaching and learning (Harste & Burke, 1977; Richardson, Anders, Tidwell, & Lloyd, 1991). The shape that ENFI took at the consortium sites was clearly influenced by the theories of those implementing it. For example, the original model of ENFI at Gallaudet grew out of language acquisition theory and the understanding that language--oral, signed, or written--is acquired through purposeful interaction with peers and more proficient language users (see Peyton & Batson, 1986; Peyton & Mackinson, 1989). This orientation shaped the initial goals for ENFI, understandings of what the teachers at Gallaudet were doing with ENFI, and, ultimately, the kinds of teachers who chose to work with ENFI. Those who shared this theoretical orientation became enthusiastic ENFI users; others, who followed more structural approaches to language acquisition (involving drill and practice, the desire for perfect performance and the need for constant correction, or the desire to deliver lectures) quickly became frustrated with ENFI and stopped using the network. This theoretical orientation also shaped understandings of what ENFI interactions were: They were

considered conversations, and ENFI's "success" was determined on the basis of whether a successful conversation had taken place.

When the ENFI project expanded to include institutions with hearing students, new theoretical perspectives were introduced. For example, project staff at CMU implemented ENFI and asked their questions about its effectiveness from the perspective of writing process theory (e.g., Flower & Hayes, 1981). They hoped that ENFI would promote the production of "reader-based" prose (Flower, 1979) and facilitate the use of peer-response groups (Freedman, 1987; Slavin, 1980). In short, the goal of network activities at CMU was to help individual writers produce better compositions.

For Kemp (1993) and his colleagues at the University of Texas, ENFI made sense within the collaborative theories of writing development espoused by Bizzell (1982), Bruffee (1984), Elbow (Elbow & Benaloff, 1989), Ruggles-Gere (1987), and others. Therefore, ENFI practices at Texas focused on the power of collaboration and group work in the development of students' writing and on the ability of the network to promote text sharing.

At the same time that teachers' implementations of new technologies are influenced by their theories, they are also influenced by the teachers' personalities and the educational practices they have worked years to develop. Doug Miller at Gallaudet, for example, had always assumed the role of a showman, an actor, in his composition classes. He was accustomed to standing at the front of the room, signing dynamically, walking around, using his body, and working with the blackboard and overhead projector in a kind of choreographed dance (Peyton, 1990). Over the years, he had developed a set of overhead slides, handouts, and exercises that he liked to use. When he started using ENFI, he felt deprived of the ability to orchestrate the class with his physical presence. He was stuck behind a computer, where he had to capture and maintain students' attention through print. He also found that his carefully prepared materials had become useless:

> What I've been doing is taking the materials for my regular freshman composition class and running to my ENFI class in the afternoon. I get them there and I think, "What am I going to do with these things?" I realize I can't even pass them out, because then the students will have to look at something else other than the computer screen. (p. 18)

The version of ENFI that Miller eventually developed involved creating dramatic productions on the network, in which participants adopted roles from plays they had read (such as *The Cherry Orchard*) or in plays they wrote themselves. This version of ENFI grew out of Miller's desire for showmanship, but now he shared the stage with his students, as a fellow actor in or director of their network scripts. He and his students together strutted on the stage, and once again he had the power to lead and influence the direction of the interactions.

When Diane Thompson tried to replicate Trent Batson's teaching style in her ENFI classes at NVCC, she discovered that her own preferred style was very different from his:

> I began to realize that whereas Trent was able to focus on the topic of the discussion, I was constantly trying to make sure that each and every student felt included and responded to. My personality and teaching style made it harder for me to facilitate ENFI discussions. (Thompson, 1993, p. 216)

After several frustrating attempts to conduct written discussions, both within her class and between classes at two different campuses, Thompson discontinued written discussion entirely and began having students send composed text to each other on the network, which they then discussed orally.

When Marshall Kremers first used ENFI at NYIT, he had to struggle seriously with issues of teacher authority and student power. His traditional, authoritative classroom style was challenged when his students took control of the network discussions and pushed him to the sidelines (Kremers, 1988). He was forced either to stop using the network entirely to maintain his authority, or to alter radically his teaching style to accommodate the new power the network interaction gave his students. He chose to do the latter, and has developed a series of ENFI activities in which students adopt roles and discuss current events, working in groups without teacher intervention. The version of ENFI that Kremers (1993) developed involved completely relinquishing the authority he had been so comfortable with for years and sharing it with his students.

Student Characteristics and Expectations

Just as their teachers did, students interpreted and shaped ENFI in accord with their own understandings of what teaching and learning involve. At every consortium institution, student reactions to ENFI were mixed. On the one hand, students were excited with the new technology and the new ways they could express themselves. In many classes, students started coming early and staying late, and in some cases had to be asked to leave at the end of a class so the next class could begin. At the same time, ENFI activities did not fit many students' understandings of what schooling involves, and students felt they weren't really learning. At Gallaudet, for example, where the opportunity for deaf students to interact in English seemed to ENFI's developers like an obvious benefit, ENFI seemed to the precollege students like playing around, a waste of time, a useless diversion from the real work of writing paragraphs, doing grammar drills, and practicing for the writing test they had to pass to enter freshman English. They expressed their frustrations frequently in network sessions (from Peyton, 1990)[7]:

> Will we do something different beside using the computer all the time??? I mean I would like to practicing our writing and to improve our vocabulary like some other classes do in Eng. 50.
>
> We talk to each other through computer which doesn't have helped us alot. This class seemed like one of class being offered as group discussion where we share our ideas not talking about our weakness in english grammar structure.
>
> How can the computer helps me with use proper english which i want to pass writing test. I wanna to pass it so badly.
>
> I want to write a paragraph often to improve my writing.
>
> could you give us to write more not in computer. i feel i learned nothing in this computer. if i write more i would learn more because it helps me to remember etc. in english.

At the other consortium sites, the students were hearing, and so, were immersed in English all the time. Why did they need to communicate on a computer network? Kremers (1993) points out that professors at NYIT embraced ENFI because they welcomed the opportunity to explore new writing approaches, to engage students in collaborative writing communities, and to promote among students a more active role in their own learning. After three years of working out his ENFI practice, Kremers was satisfied that he had developed a long overdue opportunity for real student growth. But even though his students "came to life in the ENFI classroom" (p. 116) and sat listlessly in the regular class, they still initially reacted to ENFI with "fear, confusion, anger, and distrust" (p. 116).

Some of the students at CMU did not see a connection between the informal ENFI interactions and the high-level academic papers they needed to write (Neuwirth et al., 1993 p. 194):

> I just printed out a copy [of the transcript] and gave it to the teacher. So, unless there's a memory benefit [to] seeing it on the screen--over hearing it--I don't know if there's really much of an advantage.
>
> I don't see why you have to use the program--why you can't just say it . . . I have a harder time typing--that's why . . . I'm not a good typists.

In interviews and written reports, teachers at all the consortium sites have reported that at least some of their students felt they were not doing real work:

> Some students said they didn't think they were learning anything from using the network. They wanted more lecture. . . . It's a battle to get them to see that writing on the network is learning English and that it will help them pass the test. (Markowicz--Gallaudet)
>
> The students' previous education in writing was so thoroughly grounded in drill that they . . . were initially disorient[ed] in the immersive, heuristic, freewriting environment of the ENFI course. (Collins--Minnesota)
>
> At first, some [students] take to it immediately, thinking it's fun. Some of those fun folk also see the writing-related value beyond the amusement. For the rest, the fun pales and they wonder why they're doing this, why they're taking time away from "real" writing. (Sirc-- Minnesota)
>
> [For many students] ENFI was not an exciting innovation, but a new and empty space into which we threw them without explaining why. Already upset at being placed in a remedial course, they were less than eager to participate in an experiment that had no apparent link to the exit exam. (Kremers--NYIT)

In each case, teachers and students had to work together to find a significant role for ENFI interactions, an adjustment that often took considerable energy and creative thought.

Features of the Technology

As ENFI use expanded to new institutions, it became associated with diverse hardware and software configurations. Technological capabilities, which in themselves reflected institutional resources and priorities, in turn shaped the forms of ENFI.

The different software interfaces, for example, influenced decisions about group size and changed the quality of class discussions. At the sites with a private composing window and group scrolling text, as described above, whole classes could communicate on the network. It was found early on at Gallaudet, however, that some teachers had problems managing more than 8 or 10 students, so early ENFI classes at Minnesota and NVCC were limited to 10 students. At NYIT, where class sizes were larger, students were grouped on separate channels.

At some of the sites, where participants were limited to 10 lines of text and had to enter their contributions into a continually scrolling text stream (to which many participants were contributing), messages tended to be short so they would not exceed the space limit and the writer did not lose the thread of the discussion. At CMU, where the CECE Talk software made available unlimited writing space and allowed students to see each others' messages as they were being composed, only two or three students communicated at a time. They tended to take turns, waiting until their partner was finished before they began to write. Thus, they tended to write longer messages.

In some settings, the Interchange software from the Daedalus Group in Texas tended to function more like non-real-time or e-mail writing. It encouraged writers to exit the constantly expanding stream of discourse, to write within an unlimited composing space, and to publish the text (enter it in the electronic discourse stream) before returning to the public screen. This was especially true for an early version of the software, in which text did not automatically scroll up the screen, and participants examined the group-written file at their own pace. This created the impression that there was more time for reflection, and messages tended to be longer.

Since the manner of network interaction differed with different software, it is not surprising to see different evaluations from network users as to its effectiveness as a learning tool. For example, whereas Diane Thompson stopped entirely using synchronous written discussion, Fred Kemp described it as "the most notable classroom action in network theory" (Kemp, 1993, p. 174). These contrasting evaluations were tempered by all the factors discussed here, of course, but the software used certainly played a role.

The layout of the lab also influenced how ENFI was implemented. When the ENFI lab was set up at Minnesota, great care was taken to create an environment in which it made more sense to write than talk to each other. The ten student stations were placed in carrels separated by walls. In contrast, NVCC students were crammed into a room that initially did not even have enough computers for each student. Thus, students were grouped at the computers, sometimes (if a relationship made it desirable) even sitting on each others' laps. In that situation, it made little sense to communicate in writing.

The layout of ENFI labs even influenced the extent to which the original vision for ENFI, that the role of the teacher as authority figure be diminished (Batson, 1988, 1993), was realized. At Texas, the computers faced the front of the room, and the teacher sat at the back of the room. At Gallaudet, NVCC, and Minnesota, the teacher sat at a computer station that looked no different from the students' stations and, in most cases, was not set apart in any way. At NYIT, however, the teacher sat on a raised platform at the front of the room. It is not surprising, therefore, that the most serious issues surrounding teacher authority were raised at NYIT (see for example Kremers, 1988, 1993; George, 1990).

Room layout may also have affected the success of ENFI, in terms of student perceptions and performance. Terry Collins, the initiator of ENFI in the General College at Minnesota, attributes much of ENFI's success there to the fact that the students, basic writers who had experienced failure throughout their high school and college careers and who were accustomed to getting second-rate treatment at school, were placed in a beautiful, well-lit room full of state-of-the art computer technology. They felt they were being taken seriously, and they reacted accordingly.

Available Resources

Implementing a computer technology like ENFI may require resources that previously were not necessary: a separate room for the computer lab, additional computers, time for teachers to develop new curricula, technical staff to support teachers and maintain the lab. Educational institutions may embrace a new technology because of purported pedagogical benefits and the desire to prepare students for a technological society, but may not be ready to provide the complex network of resources necessary to assure that the technology succeeds. Even though there is a clearly perceived need at the institution for a computer lab and for the kinds of writing activities that computers support, that perception can be accompanied by considerable challenges.

In the ENFI consortium, the resources available for implementing and maintaining the program had an impact on what ENFI became at each institution, as well as on perceptions of its success. When ENFI was introduced at CMU, a campus-wide network and sophisticated, fully equipped computer labs were already in place. ENFI software was simply added to the existing network links and other writing software already available. The activities that took place on the network and in the lab were a crucial

and respected part of the work of the writing program at CMU, and ENFI was easily added to the package.

In contrast, at the University of Texas, the 50 computers available to the English department were relegated to two small, windowless rooms in the basement of the undergraduate library and ignored by most of the department faculty. ENFI was discovered and shaped by a group of graduate students who were far-sighted enough to see its importance and technically sophisticated enough to carve a place for it in the curriculum, but this work was initially ignored and unsupported. Therefore, whereas at CMU, teachers and researchers carefully thought through the place of ENFI in the curriculum and wrote supporting manuals, the ENFI project staff at the University of Texas finally left the university to form their own company and develop their ENFI software and practice from the outside.

Adequate and appropriate space and computers to support ENFI work was another crucial, but often challenging, factor in the shape and success of the program. While ENFI instructors at the University of Minnesota were blessed with a supportive dean who developed a sheltered environment for ENFI (a carefully designed lab and classes that were half the department's customary size), instructors at other sites had to piece together a lab with minimal institutional support. At NVCC, Cathy Simpson began her ENFI practice with four computers in the corner of a library, and Diane Thompson began with seven networked computers for a class of 18 students. She had to divide the class into two sections, thus doubling her teaching load, and still the students had to work two to a computer.

A factor often not taken into consideration when implementing innovations involving computer technology is the technical support necessary to maintain computer labs once they are set up. When ENFI was implemented at CMU, the computer lab already had highly trained technical staff who printed and distributed transcripts of class discussions, maintained the computers, and helped the teachers when they had problems. When NVCC decided to set up networks at three of their five campuses, they did not realize the challenge they were undertaking and the demand for technical support they had created, "because we did not know that networks are complex, skittish, existing in a universe far beyond our technical capabilities" (Thompson, 1993, p. 212). It quickly became evident that the one computer person on the entire NVCC staff, who was responsible for supporting all of the computer work on all five campuses, could not possibly provide the kind of support that was needed. The two teachers collaborating to develop ENFI practices were continually frustrated by the lack of technical expertise needed to implement their plans. Likewise, the decision to install eight computer classrooms at NYIT, without careful coordination and without consideration of the tremendous technical support needed to maintain the complex technology on that scale, "led to a host of problems" (Spitzer, 1993, p. 229), and resulted in NYIT's inability to conduct ENFI classes or research for a year after they had intended to begin. In the end, NYIT's original plans for implementing ENFI were cut back significantly.

Finally, teachers need time to create new curricula appropriate for the technology. At some institutions time and financial support for teachers to work closely with project administrators and researchers was built in. The result (at CMU, for example), was a carefully developed and well-understood practice, with supporting materials. At other institutions, teachers had to find the time beyond their regular teaching load, and the result (at NVCC, for example, in the development of distance networking between two campuses) was frustration and, eventually, a decision to discontinue the practice.

Conclusion

We tend to think of innovations, particularly those built on new information technologies, such as ENFI, as having rather solid and precise definitions or specifications, as lending themselves to being described and evaluated in terms independent of particular implementations. Experiences with ENFI and other educational innovations (Bruce & Peyton, 1990; Bruce & Rubin, 1992; Cervantes, 1993; Harris, 1993;

Michaels & Bruce, 1989; Rubin & Bruce, 1990) show this conception to be simplistic and ultimately misleading.

Instead, once an innovation enters a community of practice, it takes many different forms, depending on the situation. The principles or tenets in its original conception may have little to do with its realizations. We found that the forms ENFI took were shaped by powerful institutional, technological, philosophical, personal, and economic factors, as we have described here. These forms did not remain fixed once they were in place, but rather, evolved in a continual process of creation and recreation.

Administrators and teachers embraced ENFI because they believed in the values and practices related to developing students' literacy that ENFI claimed to promote, but they were already working within a well-established set of values and practices. They started with what they understood about ENFI and believed to be its strengths for their students, and then inserted it into the program they had in place, sometimes with minor and sometimes with major changes. In most cases, their first version of ENFI was not completely satisfactory: (a) The existing curriculum did not promote the kinds of interactions they wanted; (b) they could not make the connection between ENFI and the requirements of their institution, or the other reading and writing their students were doing; (c) ENFI use conflicted with their own teaching styles; or (d) one of the basic features of ENFI--real-time written interaction within a classroom--did not seem reasonable for their student population or compatible with their goals for the class. This diversity, which applies to any innovation, has serious implications for all aspects of the implementation process, from deciding what the implementation is to designing an evaluation of it.

In deciding what an innovation is, we must consider the developers' vision for the innovation, not as an independent agent that acts upon the users or the setting, but as only one aspect of a complex and dynamic set of literacy practices. It is perhaps more meaningful to say that through these practices, students and teachers act upon the innovation, shaping it to fit their beliefs, values, and goals. Of course, in the process of shaping the innovation, the users may themselves change, and their changes, as well as those made to the innovation, need to be understood as part of the evolving system.

In our study of ENFI, we saw an elaborate set of activities, expectations, values, and assumed knowledge associated with the new technology. What we observed conforms with current definitions of technology that consider not only physical objects or artifacts, such as a computer, an automobile, or a power plant, but also the activities or processes that people engage in when they are said to be using the technology, and associated beliefs and values (e.g., MacKenzie & Wajcman, 1985; Star, 1988; Taylor, et al., 1993). A broad conception of ENFI that includes these new values and practices makes it easier to see why ENFI was realized in so many different ways. There was often a disparity between accepted and well-established classroom values and practices and the values and practices embodied in the developers' conception of the innovation; a disparity that presented a challenge for those who decided to adopt ENFI and led, ultimately, to strikingly different realizations.

The question "What is ENFI?" has significant ramifications for teacher preparation, institutional support, and curriculum development associated with ENFI. If this were an issue that concerned ENFI alone, it might deserve only a footnote in current educational debates, but we believe that the what-is-it question could reasonably be asked about virtually any current approach to literacy development. The transactional relationship between an innovation and a social setting cannot be meaningfully parceled out into a passive setting and active innovation, nor the other way around. Nor should it be viewed as a distortion, corruption, or misapplication of the idealized innovation.

If we hope to understand how change occurs, or could occur, we need to move beyond a conception of literacy innovations as fixed, causal agents to one that reflects the dynamic complexity of social relations in living classrooms. Such a move would call for a different sort of discourse about educational innovation and change. It would require us to ask how changes arise, what they mean for different

participants, and how they relate to other aspects in the life of a classroom. That kind of analysis is not easy, but it promises results more meaningful than those tied to an idealized conception of innovations.

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Footnotes

[1]We are using "transaction" here in the sense introduced by Dewey and Bentley (1949) in *Knowing and the Known*.

[2]The consortium, a 3-year project, funded in part by the Annenberg/CPB Project, included Gallaudet University, Carnegie-Mellon University, University of Minnesota, New York Institute of Technology, and Northern Virginia Community College. Researchers at The University of Texas at Austin and the National Technical Institute for the Deaf were informally associated with the consortium.

[3]The software used in the ENFI sites in this study included CB Utility (DCA), Realtime Writer (Realtime Learning Systems, Washington, DC), Interchange (Daedalus Group, Austin, TX), and CECE Talk (Carnegie Mellon University, Pittsburgh).

[4]Specifics of this basic process vary depending on the particular software used. We have described the process with Realtime Writer, but the other ENFI programs support similar activities.

[5]The texts are shown as produced by the students.

[6]The quotes in this article not attributed to a publication come from interviews with and questionnaires completed by ENFI consortium members.

[7]Entries here are presented as typed by students using the network.

Figure Caption

Figure 1. ENFI computer screen at Gallaudet.

Figure 1

Teacher:	She talks more about being a teacher for the deaf on page 136. Do you know why she decided to be a teacher of the deaf? Is it common for hearing children of deaf parents to work as teachers of the deaf or as interpreters?
Bobby:	duty and obligition
Bridget:	due to duty and obligatioon.
Light:	She said she got nowhere to go so she got the feeling the only way to teaching deaf.
Teacher:	Good, now what does 'duty and obligation' mean to you?
Bobby:	Sense of responsibility
Teacher:	Not quite what Lou Ann said, Light, look again. Fine, Bobby. But tell us responsibility for what or to whom? What Lou Ann said is that a teaching career leads nowhere, Light.
Light:	Nah, I got the off the point. I better look up again.

responsibility to deaf students... rteaching them talk and sign language and feeding them the school edcuation