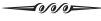


CHAPTER ONE

Introduction

 Schools in the United States are often characterized as highly resistant to change. They are held up as bastions of stasis and traditionalism in the midst of a society that has experienced profound and ceaseless change during the past century. Yet schools have changed dramatically in recent years in at least one area: the pervasiveness of computer technology within their walls. As little as twenty years ago, computers for student instruction were rather uncommon in most U.S. schools. But in the early 1980s, a sea change occurred and schools rushed to acquire computer technology for their classrooms. For example, between 1981 and 1987, the proportion of U.S. schools with one or more computers intended for instruction more than quintupled, from 18 percent to 95 percent (U.S. Congress, Office of Technology Assessment, 1988). In addition, the average number of computers available in schools that had them rose swiftly, increasing nearly tenfold between 1981 and 1985 (“Teachers Feel Computer Gap,” 1989). Thus, computers went from being a relatively rare sight in schools during the late 1970s to appearing routinely on lists of suggested materials for schools, right alongside rulers, bulletin boards, and pencils, by the mid-1980s (Frederick, 1986; Pate, 1986). This trend

continued in the 1990s; by the year 2000, the average school in the United States had one computer for every five students (Cattagni & Farris Westat, 2001). In fact, serious proposals have been made in Texas and elsewhere to replace textbooks with laptop computers, which suggests that some now see computers as absolutely central to the educational process. Just how central is made clear by the fact that more money is now spent on computer technology for U.S. schools than on books and other printed materials (Organization for Economic Co-Operation and Development, 1999).

Just as the 1980s saw computers begin to enter the schools in large numbers, the 1990s, especially the later half of that decade, saw a remarkably rapid trend toward linking these computers together, sometimes in networks within schools, sometimes in local or statewide networks, but most strikingly as part of the huge network of computer networks known as the Internet. By way of this network, schools, educators, and students have the potential to access just about any kind of material that can be stored in an electronic file. They can, for example, communicate with and work cooperatively with other individuals with Internet access by e-mail, chat, or other messaging and file transfer systems; participate in virtual reality environments; investigate scientific, literary, geographical, artistic, and historical reference materials in both text and multimedia; engage in activities from games to simulations, experiments to work sheets; and create and make widely available to others materials reflecting their interests and accomplishments through activities such as the creation of Web pages. When we speak of *Internet use*, we mean all these things and any others that students and teachers are able to dream up.

The rapidity of the Internet's arrival in schools is apparent when we consider the fact that whereas in 1994 roughly 3 percent of the country's instructional rooms had access to the Internet and its opportunities that number shot up to 77 percent by 2000 (Cattagni & Farris Westat, 2001). The rapidity of the Internet's migration into the schools is especially surprising in light of the glacial pace at which other much more basic and less expensive communication technologies, such as the telephone, have spread into classrooms.

Of course, the Internet did not arrive in schools through happenstance. Its quick spread into classrooms has been the result of many factors, including government policy, business interests, and community enthusiasm. In his State of the Union address in 1996, President

Clinton set out a policy of connecting every classroom in the country to the Internet. This policy was consistent with a slew of federal initiatives undertaken during his administration to foster such an outcome. Prominent among these was the E-rate policy, under which the Universal Service Fund subsidizes Internet connections for schools and libraries (<http://www.ed.gov/Technology/eratemenu.html>). The E-rate cost roughly \$6 billion in its first three annual funding cycles. In addition, states and school districts across the country have begun additional major initiatives designed to link schools to the Internet.

Business interests played an important role in bringing the Internet to schools (Shade, 1999) in at least two ways. First, for many years, business leaders have been important participants in the production of widely publicized reports, such as *A Nation at Risk* (National Commission on Educational Excellence, 1983) and the *SCANS Report* (U.S. Department of Labor, 1991), that argued that technology could play a major role in solving education's problems and preparing the nation's workforce to be competitive in the increasingly global economy (Education Commission of the States, 1983). Such reports encouraged educators, policymakers, and parents to see technology as essential to effective schooling and as an engine that could power needed education reform. Second, numerous technology-based companies, including AT&T, IBM, Apple, and Pacific Bell, made schools offers designed to encourage connection to and use of the Internet that seemed too good to refuse (Lagemann & Shulman, 1999). The companies' hope was that once schools were connected to the Internet their Internet usage would yield the companies a profit.

Community enthusiasm to promote Internet use in the schools reinforced government and business efforts for the same goal. All three factors were apparent in the series of NetDays held across the United States in the mid-1990s. On NetDay in California, for example, the country's president and vice president joined more than twenty thousand volunteers, including parents and individuals representing many technology producers, in an effort to lay the more than six million feet of cable necessary to connect many of that state's schools to the Internet. More broadly, in 1996, over a quarter of a million volunteers from all around the country joined in the first NetDay to wire fifty thousand classrooms (Lagemann & Shulman, 1999). Similar efforts around the globe have helped to bring schools on-line in many other countries ranging from Finland to Singapore to Australia.

GOALS AND CONCEPTUAL UNDERPINNINGS OF THIS BOOK

Although there is no doubt that Internet access is now commonplace in U.S. schools and that the trend toward connecting more and more individual classrooms in these schools is continuing apace, the consequences of this change are far from clear. There is considerable lack of clarity about two fundamentally important issues. First, we still do not know the actual significance for education of this change. The questions of how Internet use is likely to influence classroom structure and functioning and how it will ultimately affect students and teachers are still largely to be answered. Because of the substantial cost of providing Internet access in classrooms, understanding its impact on classrooms, educators, and students seems essential.

Second, although prior research suggests that both the nature and extent of computer use in an institution are strongly shaped by the culture and structure of that institution, we know relatively little about how the social organization of schools and the long-standing patterns of behavior within them shape use of the Internet. Yet understanding this issue is also vitally important. The ultimate value of Internet access in schools will clearly depend on the extent to which students and teachers use the Internet and on the purposes for which they use it. Thus, insight into the factors that shape schools' Internet use should suggest ways for educators to maximize the benefits and minimize the problems.

The overall goal of this book is to increase understanding of these issues by reporting the results of an intensive study of a major five-year effort, running from 1993 to 1998, to bring the Internet to the Waterford Public Schools (WPS), a large urban school district. We call this five-year effort the Networking for Education Testbed (NET). In discussing this study and the NET project, we have used pseudonyms throughout for all individuals; institutions, except for some U.S. government agencies; places; and programs in order to protect the confidentiality of those participating in this research. Similarly, we have changed individuals' titles and the names of particular departments in the district when necessary to protect confidentiality, although they still accurately reflect the general nature of each individual's or department's responsibilities.

NET was one of four large-scale Internet projects, or testbeds, that the National Science Foundation (NSF) funded in the United States.

These projects are part of a much larger number of relatively recent, large-scale efforts to use technology to improve and reform education, efforts such as the urban systemic initiatives and the Interagency Educational Research Improvement grants competition. All in all, NET procured a total of over \$6 million in funding from government, foundation, and business sources. The majority of these funds came from an initial two-year grant and a subsequent three-year grant from the NSF.

NET's primary goals were to stimulate teachers in the Waterford school district to use the Internet in their work and to institutionalize Internet use in the district so that it could continue once external funds were no longer available. Specifically, the creators of NET hoped to encourage teachers at all grade levels and in all subjects to develop varied uses of the Internet in their curricula. Although project members also valued educators' use of the Internet for professional development, the emphasis was on encouraging educators to find ways to incorporate Internet use into students' everyday activities, in order to explore and demonstrate the potential of such use to improve education. The hope was that NET would function as a model for Internet activities within the nation's schools by developing approaches that other schools could successfully replicate.

NET's creators also wished to promote specific kinds of change through Internet use. The original grant proposal spoke of the need to find ways to connect teachers and students to the world outside the school and to make the tasks that students do in school less artificial and removed from their everyday lives. In addition, it spoke positively of using the Internet to facilitate active, independent student work and to enhance equity for students from diverse backgrounds. Thus, as we discuss in more detail in Chapter Six, those initiating NET expressed goals roughly in line with the view of education known as the constructivist approach, which has gained many adherents in education research circles as well as in schools (Ravitz, Becker, & Wong, 2000) in the past two decades.

In presenting findings stemming from the study of NET, this book provides the reader with a vivid research-based look at the process of introducing the Internet to schools and at the issues that can arise during this process. It also explores the consequences of such a change for classrooms, teachers, and students. However, this book is neither a how-to manual for educators desiring to use the Internet in their work nor a detailed description of the kinds of Internet projects

that students can undertake in schools. Books serving each of these goals are plentiful (Cummings & Sayers, 1995; Ellsworth, 1994; Garner & Gillingham, 1996; Grey, 1999; Roberts, Blakeslee, Brown, & Lenk, 1990). Nor is this book intended as a source of ready-made recipes for successfully introducing the Internet into other school districts. The district we studied did not find a solution to all the problems that arose during NET. Moreover, there is no guarantee that the solutions that did work in the Waterford district would work elsewhere, although the fact that our findings are drawn from the study of a wide variety of schools and classrooms, a wide range of age groups, and a very diverse array of students and Internet activities should increase their value to others. Finally, consideration of the very real technical challenges inherent in the process of Internet implementation is beyond the scope of this book.

What readers will find is a close examination of the human and organizational issues and processes that shape Internet use and its consequences in the classroom. Our approach has been influenced by our prior training (one author is a social psychologist, the other an educational anthropologist) and by a theoretical perspective called the *Web model* that views computer-based systems as “social objects whose architecture and use are shaped by the social relations between influential participants, the infrastructure that supports them, and the history of commitments in the institution utilizing these systems” (Kling, 1992, p. 9). This conceptual orientation holds that “political interests, structural constraints, and participants’ definitions of their situations” have major implications for how people use technology and what the consequences of such use are (Kling, 1992, p. 372).

This approach highlights the possibility that Internet use will be shaped not only by the nature of the technology itself but also by long-standing patterns of behavior and social organization within schools, the nature of the support provided to teachers and students who attempt to use the technology, and the history of computing in a particular school district. Further, this orientation suggests that anyone attempting to understand the use and impact of technology should pay close attention to the ways that access to technology influences individuals’ interests and the ways they interpret its introduction in the first place. It also suggests that understanding how Internet use shapes the school environment and those in it requires attending to how such use changes aspects of the social system, such as power relations between individuals or chains of interdependence. In short,

adherents of this approach do not conceptualize computers as discrete entities but as part of a social web (Kling, 1991, 1992); a tug on or alteration of one strand of the web will alter other strands and their relationships, making consideration of social as well as technical factors essential for understanding the impact of a given kind of technology on organizational processes and outcomes.

Therefore, in addition to studying such obvious issues as how Internet use affects various student outcomes, we pay considerable attention to exploring questions such as why teachers in the Waterford district chose to use or not use the Internet, why educators in some schools made much greater use of the Internet than educators in other schools, and why the school district eventually decided to institutionalize Internet use in spite of severe financial pressures and lack of compelling scientific evidence that Internet access improves the kinds of student outcomes of most salience to policymakers. We also attend closely to such issues as how Internet use can change relations between teachers and their peers as well as between teachers and students.

Existing research supports the view that simply making a given technology available to schools is not enough for schools to achieve the kinds of changes in education that many hope will follow in the wake of making such technology available (Cuban, 1986; Schofield, 1994). In the remainder of this chapter, we summarize some important findings of earlier studies of computer use in the classroom to provide a context within which readers can situate the findings that this book presents. We also introduce two major contexts that shaped Internet use in NET: that of the school district and that created by NET itself, including the individual NET schools and the project's technical design. And we briefly highlight important features of our research methodology.

COMPUTER TECHNOLOGY AND EDUCATIONAL CHANGE

What Can Schools Expect from the Internet?

The Predictions

In the tradition of the enthusiasts who have hailed the potential of other kinds of computer technology for education (Papert, 1993; Perlman, 1992; Walker, 1984), many see the Internet as having extraordinary

potential for improving schools and the way they operate. For example, Carlitz (1991, p. 26) believes that the Internet “has the potential to become the foundation on which all educational programs and material are developed and distributed.” Further, consistent with the widespread view that technology can bring about education reform, many see the Internet as likely to help educators achieve a variety of goals that current critics of education in the United States call for. For example, Berenfeld (1996, p. 82) argues that Internet use can bring the “real world” into the classroom. It can make schoolwork less artificial and removed from students’ lives outside of school by connecting them to individuals as disparate but as potentially valuable to their education as working scientists, native speakers of languages the students are studying, and eyewitnesses to events in the students’ curriculum. It also has the potential to break down barriers raised by the practice of studying each discipline in isolation. For example, it can promote interdisciplinary work by putting students in contact with individuals working on complex real-world problems that require multifaceted solutions. In addition, some have suggested that Internet access, in an instructional setting supportive of such changes, can lead teachers toward encouraging active student exploration and adopting a more interactive mode of instruction (Feldman, Konold, & Coulter, 2000). Such changes are consistent with the kinds of educational reform that many have called for over the past decade or more (Means et al., 1993).

Others predict increased collaboration between teachers as well as between schools and outside institutions. In addition, Berenfeld (1996) points out that students can use the Internet to share the products of their work with a large, geographically diverse audience outside the school, a practice many believe will increase the effort students expend on their work. Students can also use the Internet to view an extraordinary array of current information resources. Such access to the information superhighway, as the Internet was commonly called in the early 1990s, is likely to be of value to students because school library resources are both limited and dated, and textbooks are commonly dated as well.

Finally, many believe the Internet can promote equity in the country’s schools through providing rich and poor schools alike with access to the same extraordinary variety of information resources and opportunities for communication (Clinton, 1996; Berenfeld, 1996). A common belief is that the Internet may foster more equitable social

interactions between individuals from different backgrounds because it masks the physical markers, such as race, gender, and age, that often trigger unwarranted assumptions about the interests and capabilities of members of various social categories (Sproull & Kiesler, 1991; Riel, 1992; Zuboff, 1988).

The Realities

Yet such predictions may not be realistic. A plethora of failed reforms indicates that efforts to change schools often proceed slowly, are difficult, and frequently fail to meet their goals (Cuban, 1986; Hodas, 1996; Sarason, 1990). Despite many calls for curricular and pedagogical reform, for example, the twentieth century has seen only modest changes in classroom organization, teacher-student relationships, and instructional methods (Cuban, 1986). Reflecting on this pattern, Massachusetts Institute of Technology Professor Jerold Zacharias concluded, "It is easier to put a man on the moon than to reform public schools" (Cuban, 1986, p. 1).

Even more pertinent, studies of schools' adoption of technology have been close to unanimous in emphasizing the slowness of the process and the uncertainty of the outcome. Cuban (1986) provides a fascinating and rather sobering overview of the relationship between novel technologies and U.S. schools in the twentieth century. He demonstrates that time after time, beginning with film and continuing with radio and television, communication technologies that many hailed as having the potential to revolutionize the classroom have failed to do so. In the 1920s, for example, Thomas Edison predicted that the motion picture would soon make books obsolete (Cuban, 1986). There was similar enthusiasm for radio and television, each viewed as an improved means to bring the voices of the world's greatest leaders and best teachers into every classroom. Yet schools' use of these technologies has been far less than those outside the schools anticipated. Even more important, generally speaking, the usage that has occurred has not brought about the predicted revolutionary changes and striking improvements. Indeed, it is ironic that the radio in schools today is a contraband item that students smuggle in and use to distract themselves from classroom realities.

Likewise, many of the pre-Internet predictions that positive educational consequences would follow upon the use of computer applications in the schools have not been fully realized. Numerous scholars

studying the impact of computers on what schools do and how well they do it have concluded that computers, like previous technologies, have had less impact than many had hoped (Cohen, 1987; Cuban, 1986; Hodas, 1996). For example, Cohen's analysis (1988) of computers in schools suggests that use tends to be concentrated not at the core of the educational system but at its periphery, which undercuts this technology's potential for bringing about fundamental change. Moreover, as we discuss in Chapter Five, the level of computer use that those enthusiastic about computers' potential to improve education hoped for is often much higher than the level eventually obtained (Cuban, 1986; Schofield, 1995). Although some research suggests substantial change as a result of computer use and also emphasizes that such change is likely to be evolutionary (Sandholtz & Ringstaff, 1996), the documented impact of computers in schools is still far from revolutionary.

Further, studies that have linked computer use with positive consequences have also suggested that these consequences do not necessarily stem directly from use of these machines. Rather, they often appear to stem from related factors. For example, evidence shows that the kind of structured, computer-assisted instruction (CAI) that was very popular in the 1980s, and which is still used in many districts, can have a positive effect on student achievement as commonly measured (Bangert-Drowns, Kulik, & Kulik, 1985; Hativa, 1994; Kulik, Bangert-Drowns, & Williams, 1983; Kulik & Kulik, 1991; Niemiec & Walberg, 1985; Samson, Niemiec, Weinstein, & Walberg, 1986). Applications such as intelligent tutors (Wertheimer, 1990; Mostow et al., 2000) and multimedia videodiscs can and sometimes do promote student achievement (Cognition and Technology Group at Vanderbilt, 1997; Means et al., 1993). However, changes in teachers' behaviors when using these computer applications may account for some of their apparent impact (Hativa, 1994; Schofield, 1995; Schofield, Eurich-Fulcer, & Britt, 1994).

Furthermore, intense instructional design efforts are often a crucial part of the development of software used in CAI programs, intelligent tutors, and multimedia videodiscs, and this seems to be at least partially responsible for their success (Kerr, 1996). This suggests that the particular software application educators choose can make a difference in outcomes, an observation that at one level appears obvious but that many people overlook when posing questions about the effect of computers or the effect of the Internet on education.

What Scholars Know About the Consequences of Internet Use

To date, there has been little systematic research about the academic consequences of Internet use for precollegiate students. Indeed, as we discuss in Chapter Seven, such research is a complex and daunting task because the Internet can be used in such a broad variety of ways for such a wide range of purposes. A few studies have suggested positive outcomes for certain kinds of uses. For example, some suggest that student use of e-mail applications to communicate with others can undercut the stereotypes students have about others and broaden their horizons (Garner & Gillingham, 1996; Cummings & Sayers, 1995; Davidson & Schofield, 2002). Further, the results of teacher surveys suggest that those who often use the World Wide Web in their teaching tend to exhibit more of the pedagogical changes that many hope will stem from Internet use than do teachers who make less use of this Internet application (Becker, 1999a). To the extent that such changes in educational practice are likely to lead to improved learning for students, these findings are encouraging.

But in general, Internet use is too new in classrooms to have been studied in any depth (Windschitl, 1998), although a large number of brief reports exist in which educators detail their experiences using the Internet in schools and write about its impact, usually in quite positive terms (for example, Cahall, 1994; Donath, 1995; Christy, 1998; Curtiss & Curtiss, 1995; McCarty, 1995; Potter, 1992; Wright, 1992). Furthermore, some studies suggest that positive results require more than simply making the Internet available to students. For example, Wallace, Kupperman, Krajcik, and Soloway (2000) found that sixth-grade students tended to use Web browsers readily but naively. The students were generally successful neither at finding useful information nor at using the information they did find in a thoughtful manner. Another study points out several potential advantages in the classroom learning environment when students used the Internet but concludes that the measured learning of students in those classes was very similar to that of peers in comparison classes (Songer, 1996). Yet another major project designed to promote collaborative learning about science among students in far-flung classrooms found that teachers tended not to use the curriculum's networking features much, and it concluded, "We now believe it is critical to identify the classroom itself as the primary community of learners in which the dialogue among students

takes place” (Feldman, 1999, p. 7; see also, Young, Haertel, Ringstaff, & Means, 1998). Another report based on this same work concludes, “Our thinking has evolved during [four] years of research. We are less convinced today that the Internet will provide an easy route to improved learning; we have come to believe that people-to-people connections and especially face-to-face communications play a central role in learning” (Feldman et al., 2000, p. 132).

Optimistic expectations about the Internet’s ability to provide equality of educational opportunity are also not based on solid data about how Internet use works out in practice. To begin with, consider data about computer use. A number of scholars have pointed out that, far from reducing inequity in education, technology acquisition and use can reinforce it. For example, a persistent although narrowing gap exists between rich and poor districts in the prevalence and quality of the computer technology available to students, with rich districts consistently having more computer equipment and more technical and teacher support for computer use relative to the number of students they serve (Anderson & Ronnkvist, 1999; Becker & Sterling, 1987). In addition, when they do have access to computers at school, children from different backgrounds are often encouraged to use them in quite different ways, with those from more privileged backgrounds using them for more creative, less rote kinds of work (Apple, 1998; Campbell, 1984; Becker & Sterling, 1987), although this difference also appears to be waning over time (Becker & Ravitz, 1997). Finally, research suggests that, when other factors are controlled, having a computer at home has relatively little impact on the school performance of poor and minority students, although it is associated with marked positive effects on the performance of students from homes of higher socioeconomic status (Attewell & Battle, 1999).

There is no particular reason to expect patterns of Internet access and use in schools to deviate from those found for other kinds of computer applications. Indeed, existing research suggests clear parallels. For example, in spite of strong government efforts to equalize Internet access through financial subsidies of up to 90 percent of the cost of access for schools in the poorest districts, patterns of inequality persist. A survey of one thousand public schools concluded that classrooms in well-off schools were nearly twice as likely to have Internet access (74 percent to 39 percent) as those in poor schools (Mendels, 2000), and educators in well-off schools report receiving

more technical and instructional support to help them use technology as well (Ronnkvist, Dexter, & Anderson, 2000). It also appears that teachers of high-achieving students are at least somewhat more likely than teachers of low-achieving students to use the Internet and to believe that it is essential to their teaching (Becker, 1999b). Moreover, students with previous experience with supportive learning partnerships energetically pursue relationships with mentors over the Internet, whereas those with fewer positive prior experiences tend not to (O'Neill & Gomez, 1998), suggesting yet another way in which Internet access may reinforce existing inequalities.

Understanding the Relation Between Internet Access and School Change

Even if some studies demonstrate that Internet access has positive consequences for some classrooms or students, there is no guarantee that it would have these results in most cases. First, Internet access does not guarantee Internet use, and it seems obvious that use must occur for there to be any realistic possibility of sustained positive outcomes. Second, because the Internet can be used in an extraordinary variety of ways, from an on-line work sheet to an unstructured tool for student communication and exploration to a mechanism for the implementation of well-planned collaborative efforts, one cannot assume that the activities for which students will use it will be part of an effective instructional plan. Third, there are no universally used, strong quality standards to help teachers differentiate well-designed Web sites from poorly designed or inaccurate ones, although resources to help educators select accurate, relevant, and usable Web sites are increasingly available. Finally, there is no reason to assume that the kinds of positive changes that often occur when teachers use CAI, artificially intelligent tutors, or well-designed multimedia videodiscs will necessarily follow from Internet use. Indeed, there is some reason to think just the contrary. For example, one of the changes that Schofield (1995) found flowing from the use of such artificially intelligent tutors was that teachers tended to increase the time they spent with weaker students because they felt confident that the tutor would be supplying the stronger students with useful instruction, allowing them to progress without necessarily needing the teacher's assistance. In the less structured and often rather chaotic world of the Internet, a teacher

has no such assurance. Thus, at least some of the factors that appear to account for the achievement gains noted with other instructional uses of computing may not exist when students use the Internet.

Another issue, which we discuss in more detail in Chapter Four, is that most schools in the United States do not adequately train and support teachers to make good use of the computer technology available to them. There is little reason to expect substantially better training and support for Internet use, although growing awareness of teachers' inadequate preparation for using computer technology has led to major government programs designed to mitigate this problem. Furthermore, study after study has suggested that teachers do not feel they have the time they need to learn how to use new computer technology (Becker, 1990; Evans-Andris, 1996; Heaviside, Farris, Malitz, & Carpenter, 1995), a situation unlikely to change without significant cost or a fundamental rethinking of how to allocate teachers' time. Schools tend to allow teachers little time free from the demands of students, and they provide relatively few opportunities for teachers to engage in dialogue with their colleagues or to reflect upon their practice (Flinders, 1989; Sizer, 1985). Such school practices contribute to teachers developing "conservation strategies" (Flinders, 1989) that impede experimentation with new and complex methods and resources, including technologies.

Finally, consistent with the conceptual orientation that we described in the previous section, research suggests that the consequences of introducing any technology into ongoing organizations depend not only on the technology itself but on the context into which it is introduced. For example, introducing information technology in some work situations appears to increase productivity, but in others it decreases productivity (Attewell, 1994). Similarly, information technology reinforces existing power and authority relationships in some work situations and significantly restructures them in others (Kling, 1991). Moreover, although those deciding to spend resources on computer technology usually focus on its potential direct impact on productivity or efficiency, which in the schools would include such results as changes in student learning, such technology often has profound but slowly unfolding and unanticipated effects on the social system of the workplace, which in turn can have broad unforeseen implications for organizational functioning (Sproull & Kiesler, 1991). And virtually all the studies we cite concerning the impact of Internet use in schools emphasize the crucial importance of teachers' and students'

characteristics and behavior or of the broader school context in shaping this impact. This is consistent with Walker's conclusion (1996, p. 99) that "details matter most" when trying to understand how technology influences education. It is also consistent with a long history of research on educational change that suggests that those working toward such change must be aware of the ways in which the structure and organization of educational systems influence the adoption and adaptation of innovations (Crandall & Associates, 1983; Fullan & Stiegelbauer, 1991; Gross, Giaquinta, & Bernstein, 1971; Huberman & Miles, 1984; Oettinger, 1969; Sarason, 1971; Schofield, 1982; Smith & Keith, 1971; Sussman, 1977; Van den Berg, Van Velzen, Miles, Ekholm, & Hameyer, 1986).

THE DISTRICT CONTEXT

The WPS System

Because the context in which technology is used is so important in shaping the change process and its consequences, we turn now to a description of the school district in which NET, the Internet project we studied, was conducted. Chapter Eight, which discusses the degree to which the district ultimately institutionalized Internet use, presents additional information about the district and its initial response to NET.

The WPS system is an urban district with approximately 2,900 teachers and forty thousand students. Roughly 55 percent of the district's students are African American, and a large majority of the remaining 45 percent are European American. Just under 40 percent of the students come from homes receiving public assistance, and over 60 percent are eligible for free or reduced-price lunches, which indicates a limited family income.

In spite of the fact that many of Waterford's students come from homes of relatively low socioeconomic status, which is often associated with relatively poor performance on standardized tests, the district's students, especially the younger ones, perform fairly well academically. Children in elementary school score at or very close to the national average on standardized tests of reading and mathematics skills. More than 40 percent of WPS middle school students perform above the national average on similar tests. Although fewer high school students perform as highly on these tests, almost 75 percent of

WPS high school graduates enroll in institutions of higher education. Thus, constituents of the district generally consider it to have a viable school system, and it enjoys a reasonable measure of public support.

Nonetheless, during NET's life, the WPS faced at least two significant problems that had been developing for a number of years before NET arrived on the scene. First, enrollment in the system had been declining for twenty-five years. Reflecting a concern that both European American and African American middle-class families were moving elsewhere or choosing to send their children to private schools as well as a concern about a thirty-year decline in the proportion of white students in the district's schools, school board members were immersed in a controversial redistricting proposal. This proposal, which generated heated controversy, was designed to move the district back toward neighborhood schools, the pattern that had existed before desegregation efforts started in the mid-1970s. As the district superintendent noted in a 1996 report to the community,

The Spring of 1996 will be remembered for the unprecedented number of educational forums, public meetings and public hearings held in response to a proposal for redistricting city schools. . . . No proposal ever to come before the Board has drawn the [*sic*] level of interest and response from the community.

Second, WPS had been under severe financial pressure for more than a decade. As a result of declining property values in the region, the district's tax base had failed to keep pace with inflation, and no relief from this problem appeared likely. Coupled with sharply rising costs connected to special education, this resulted in annual budget deficits as high as \$35 million during the NET years, in spite of a tax rate increase shortly before NET began. Indeed, at one point, the city council expressed a desire to audit the district's budget, implying that the district was spending money irresponsibly or that the system was corrupt. Contributing to the high cost of operating the district was a teaching force consisting predominantly of individuals with many years of experience who received higher salaries than younger individuals could command. To balance its budgets, the district had to cut staff, programs, and professional development activities and to plead for special funds from the state annually for many years. This contextual factor meant that competition for resources was fierce during NET's existence. As one district employee described it, "Every dollar

has been fought over tooth and nail by everybody who has a vision that might get hold of it.”

In such a situation, it is not surprising that funds for the purchase of technology were extremely limited. When NET started, the district had very little up-to-date computer equipment. In fact, a school district newsletter put out just a few months after the NET project began in 1993 said the district was at “ground zero” with regard to existing technology resources and had been in a “holding pattern” for many years due to a freeze on funds for technology purchases. It also pointed out that the computers in the district’s elementary and middle schools were neither IBM- nor Macintosh-compatible and were no longer available on the market. The computers available in the district’s high schools were newer, but even many of those machines were almost a decade old, which meant that they lacked the power to run many of the software applications produced in the 1990s. A consultant’s report, written a year after this district self-characterization had been published, confirmed this view, saying the district “lagged behind other districts” in computer technology. District officials were often candid about the situation. As one put it, “The district is in such bad shape when it comes to technology that . . . we’re talking a patient . . . near death here.”

Also indicative of the district’s awareness that its technology was antiquated was the fact that the district created three technology plans during NET’s five-year life. Change was necessary not only because of the scarce and outdated technology in the schools but also because the district had adopted a number of computer skill standards for its graduating students; these standards were to take effect at the end of the 1990s. Similarly, the state in which the district is located was in the midst of promulgating a series of education outcome standards that included technology use standards. The first two of the district’s technology plans created during NET’s life, which called for spending almost \$200 million and \$95 million respectively, were just too expensive to gain widespread support. Even though the proposed expenditures were spread out over five or more years, they appeared too large, given that the district’s entire annual budget was roughly \$350 million and that there was no reason to expect the ongoing deficit to resolve itself even without the burden of major additional technology expenditures. As we discuss in Chapter Eight, toward the end of the NET project, the district ultimately adopted a third, much more modest, three-year technology plan costing \$25 million and funded by a bond issue.

THE NET PROJECT

The project itself also constituted a context for the use of the Internet in the WPS district. In addition to introducing that context, we intend this section on NET to give readers an idea of the extent to which the situations of most interest to them are similar to the one studied here.

NET Structure and Staff

NET was structured as a collaboration between Fairfield University; the Waterford school district, in which Fairfield University is located; and a nearby, federally funded supercomputing center affiliated with yet another local university, which we will call Reynolds University. A high-level administrator from the school district was involved with the initial NET grant proposal as a coprincipal investigator, although a district teacher, Peter Marcus, was actually more involved in laying the groundwork for NET. In addition, the district provided some matching funds. Although the original proposal emphasized that institutionalization of Internet use within the school district was a long-term goal, most of the responsibility for implementing NET rested with people other than the district staff, a factor that eventually led to some significant conflict, as we will discuss in Chapter Eight. A university professor from Fairfield University, Don Quick, who was the primary initiator and organizer of the project, served as NET's director during the original two-year grant, and the supercomputing center was responsible for providing the required technical expertise. Responsibility for systematically studying NET was in the hands of Janet Schofield, a university professor who had recently published a book about the use of computer technology in high schools (Schofield, 1995).

The NET staff consisted of three main groups: the education staff, the technical staff, and the research staff. We discuss the first two of these groups in some detail here because they were responsible for implementing NET. Understanding their roles is important to understanding the content of this book and especially the implications of the research findings. We discuss the third group and its role in the Appendix because that group was responsible for studying NET but not for its implementation.

NET EDUCATION STAFF. The members of the NET education staff, numbering initially three and eventually four, were all experienced

teachers. Although all had some experience with educational technology, their initial level of familiarity with the Internet varied greatly. The group had a variety of responsibilities. First, as we describe in Chapter Two, they provided formal and informal technical training and support and other kinds of professional development for teachers, helping educators see how they could use the Internet in their work. The education staff also brought NET and what they had learned through implementing it to the attention of educators outside the district and assisted in fundraising efforts. Second, as we describe in Chapter Eight, this group took a leadership role in working to institutionalize aspects of NET within the WPS district. As part of this effort, they were the primary liaison between NET and the school district, working with district advisory committees for various aspects of NET, maintaining a NET Web site, and publishing a NET newsletter.

In addition to carrying out these tasks, the education staff was influential in the development of many NET policies and procedures. For example, they played a crucial role in activities as diverse as crafting a policy setting forth acceptable Internet use (students and their parents were required to sign a document agreeing to this policy before students could have Internet access), designing the process through which school-based teams of educators became part of NET, crafting NET's approach to professional development activities, and deciding to what extent NET as an entity would attempt to filter the material available on the Internet.

Note that the term *NET education staff*, or *education staff*, always refers to NET staff. The terms *NET team* or *NET educators* refer to the group of teachers, school librarians, and others directly involved in NET in each NET school.

NET TECHNICAL STAFF. The NET technical staff consisted of four individuals already employed by the supercomputing center who were assigned to work part-time on NET. The specific individuals involved changed over time. As a group, they had a broad and varied set of technical skills, and they all held computer science or related degrees. They initially devoted a substantial amount of time to selecting the operating systems for the computers supplied by NET, working with educators in the NET schools to plan the wiring needed for Internet access, deciding whether a central server (a computer that manages the connection of other computers to the Internet and may also host

a Web site) or school-based servers would best accomplish NET objectives, and experimenting with various kinds of connectivity at different schools. As NET progressed, they configured servers, set up and maintained computers and peripheral equipment such as printers, provided technical assistance to educators, and, as we describe in Chapter Eight, worked to build technical expertise in Internet use in the school district.

WORKING TOGETHER. Although the NET technical and education staffs had separate spheres of responsibility, they worked together very closely, and their responsibilities often overlapped. For example, NET assigned each of the schools participating in the project a pair of NET staff members, one from the education staff and one from the technical staff, who assumed special responsibility for helping teachers at that school implement proposed Internet activities. Particularly in the early stage of NET's life, there was considerable tension between members of the education and technical staffs, stemming from differences in their professional practices and routines. (For a detailed discussion of the issues that arose and how they were resolved, see Davidson, Schofield, & Stocks, 2001.) Nonetheless, over time these individuals found ways to handle such differences, and by the end of NET these problems had virtually disappeared.

School Context, Selection, and Plans

The schools that participated in NET differed in a number of ways. Moreover, each one had its own set of plans for using the Internet.

NET SCHOOLS. In all, teams of educators at twenty-nine schools—fifteen elementary schools, four middle schools, and ten high schools—formally participated in NET. These schools varied greatly in the socioeconomic status and sociocultural composition of their student bodies. So, for example, high schools participating in NET ranged from one in which 99 percent of the students were African American and 50 percent received a free or reduced-price lunch due to low family income to another in which 79 percent of the student body was European American and only 22 percent received a free or reduced-price lunch. The student bodies in the NET elementary and middle schools also varied markedly. As well, the schools varied greatly in size, the age of their physical facilities, and in their curricular emphasis.

SCHOOL SELECTION PROCESS AND COMPOSITION OF NET TEAMS. A fundamental fact shaping NET was that in spite of its substantial budget it did not have anywhere near the resources needed to bring the Internet to all the district's classrooms. Neither did it have the resources to bring all the participating schools on-line simultaneously. Thus, each year for five years, the NET staff and the project director decided how many new schools they had the resources to work with effectively. That number of new schools was then admitted to NET. In the first year, in order to get work under way promptly, NET staff chose the schools to be admitted. In all later years, a broadly constituted committee of people outside NET made the selection.

Moreover, although we refer to *NET schools*, NET did not undertake to wire entire schools or to supply all faculty at participating schools with Internet-connected computers in their classrooms. Rather, teams of educators, usually consisting of six to twelve people per school, submitted proposals for incorporating Internet use into their curricula. (We discuss this competitive procedure and the rationale for it further in Chapter Two.) It was these individuals, the *NET teams*, rather than the entire school, who received computers and who had priority with regard to receiving Internet connections and support from NET. In addition to varying in size, the NET teams also varied in composition, with some teams containing community members or the school's principal, whereas others did not. These teams also differed markedly in the extent of their members' initial familiarity with the Internet, the extent to which they included members with varying disciplinary specialties and, as we will discuss in Chapter Five, their internal dynamics. In order to provide access to as broad a cross section of individuals at each participating school as possible, NET did almost always require that a librarian be a member of each school's team. This allowed NET to place a small cluster of Internet-connected computers in the school library, where they were readily available to many more teachers and students than were typically able to use the machines placed in individual teachers' classrooms.

PLANNED INTERNET ACTIVITIES. The nature and content of the curricular projects that the selected teams proposed varied in almost every imaginable way. Some activities focused intensely on a particular discipline, whereas others were designed to support interdisciplinary curriculum units. Some proposals focused on connecting computer labs to the Internet for lab-based activities, whereas others,

clearly the majority, dispersed a smaller number of computers with Internet connections throughout the classrooms of participating educators. Although educators designed most activities to enhance students' access to individuals and resources outside of the school through the Internet, others were planned to encourage students to provide information by way of the Internet to others, either within or outside the school district. Readers will find more details on the amount and kind of Internet usage that actually occurred in NET throughout the remainder of this book, especially in Chapters Two, Five, and Six.

FACILITATING INTERNET USE OUTSIDE OF NET TEAMS. Finally, although the emphasis was on providing Internet access for the NET teams selected through the annual competitions, NET's education and technical staff members tried to accommodate other educators in the district as well, in line with NET's ultimate goals of stimulating and institutionalizing productive Internet use. Thus, even though teams in only roughly one-third of the district's schools were formally selected to participate, by the time NET ended it had provided 90 percent of the schools in the district with LAN (local area networking) or dial-up access to the Internet. In addition, it had provided at least some professional development opportunities or support for teachers in most of these schools. Further, to the extent possible, the NET staff assisted those in NET schools who were not part of the formal NET teams but who were interested in using the Internet in their work. There was considerably more demand for such assistance in some schools than in others. But when members of a school's NET team could not meet this demand, the central NET staff tried to help.

Technical Design

When NET began in 1993, Internet connections in classrooms were unusual. The technical aspects of NET changed dramatically during its five-year life span as a result of two factors. The first was a planned course of technical experimentation designed to allow NET to explore alternative approaches to providing schools with Internet access and to choose those that appeared to work best. The second was the major changes that occurred in the broader technical environment as the Internet itself expanded and the hardware and software options related to Internet use proliferated and evolved. In addition, undergirding

NET's approach was the belief that the project should be as responsive as possible to educators' wishes, which also led to variation in the technical design at different schools. Because of all this, NET's technical structure was evolving and complex. However, because a general understanding of NET's technical structure is useful in determining which results of this project are likely to be pertinent to other situations, we briefly lay out here some of the more important information about NET's technical setup.

NET evolved from an initial setup with one central server to a distributed architecture in which each of the NET schools had its own server. These servers used BSD Unix, running on Pentium hardware. Several considerations in addition to cost figured heavily in the shift to decentralized servers. First, these servers provided each NET school with more Internet connections; schools with their own servers no longer had to compete with each other for Internet access, trying simultaneously to use a single server with a finite number of connections. In addition, this architecture allowed NET to transfer to the individual schools many system administration and other tasks that the technical staff would otherwise have handled centrally. This relieved some of the burden on the central resources, which grew increasingly heavy as more and more schools and educators joined NET. Of course, it also increased the burden on the school-based NET teams. The distributed architecture also facilitated local decision making about such issues as the creation of student Internet accounts and the allocation of disk space. Finally, various district and NET staff felt that providing schools with their own servers increased security. Separating the server used centrally for administrative purposes from the ones used by students lowered the risk that a student hacker could access administrative computers and files.

The Internet connections that NET provided also evolved over time. Initially, virtually all connections were through dial-up lines. As time went on, the technical staff tried various approaches to providing faster connectivity—such as local area data, or LAD, lines, Integrated Services Digital Network (ISDN), and Ethernet over cable. Ultimately, NET settled on 56K ISDN as its standard and replaced other modes with ISDN in NET schools. Classrooms were able to use both Macintosh and PC platforms when connecting to the Internet.

NET provided connection to a LAN within NET schools both for computers that it placed there and, to the extent possible, for other Internet-ready computers in these schools, although Internet access

was usually provided to those participating in NET before the school's LAN was ready.

Once a school had Internet access, the project gave specific individuals within that school Internet accounts. These accounts were used for varied purposes including e-mail, accessing newsgroups and Internet Relay Chat (IRC), and storing personal files on disk space that NET provided.

In NET's early years, the education staff decided who should be given accounts. They routinely gave such accounts to NET team members. However, guided by a desire to encourage Internet use, NET staff also provided accounts to other educators in NET schools or to those who requested accounts in other district schools to which NET had provided Internet access; NET staff asked only that they make professional use of the Internet. Initially, most uses of the Internet required an account. However, over NET's life span, technical and other developments meant that a specific account was not necessary for more and more of the Internet activities that individuals engaged in at school. For example, once Internet browsers like Netscape had been developed, individuals were able to use the World Wide Web very easily without having to access their accounts, and this application became very popular with teachers and students over time. Similarly, the advent of free e-mail services provided by Internet service providers to anyone wishing such services also increased the range of activities that students and others without accounts could engage in using NET-provided Internet access. Students who wished to establish NET accounts needed a teacher's endorsement of their request, as well as parental permission. Although individual students sometimes made requests for Internet accounts, it was common for NET teachers to request individual accounts for entire classes of students. As NET schools received their own servers, the NET staff handed off the creation of accounts for individuals connected with that school to NET team members at those schools, consistent with NET's general philosophy of locating as much control and responsibility at the school level as possible.

Educators with home computers could obtain dial-up Internet access for those computers through NET as long as they had a NET account. Educators' home Internet access was a priority. During NET's first few years, the modem pools that allowed educators to connect to the Internet using their own modems and telephone lines were located at the two local universities connected with NET. Later, the WPS devel-

oped a modem pool of its own for this purpose, using phone lines already in place for administrative staff to use during the workday. In sharp contrast, students were not allowed to use their accounts to access the Internet outside of school for numerous reasons including concerns about the amount of traffic this would generate as well as about their making inappropriate use of the Internet. NET's policy was that "using someone else's network account is not acceptable." Indeed, this stricture was part of an acceptable use policy that students and their parents had to sign before students could have access. However, both teachers and students sometimes violated this policy.

METHODOLOGY

We describe in considerable detail in the Appendix the methods we used in our study. However, the way any study is conducted is of crucial importance in determining how readers should view its results. Thus, we briefly outline our approach here as well.

The two major methods of data gathering we used in this study were intensive qualitative observation and interviews. We selected a subset of five NET schools for intensive study, gathered a significant amount of data in an additional eight schools, and collected more limited information from the remaining NET schools. Furthermore, in order to understand the context in which NET functioned, we also gathered extensive data on the pertinent activities and perspectives of both the NET staff and those in the district charged with responsibilities related to NET.

All in all, over NET's five-year existence, we conducted more than one thousand hours of observation in milieus ranging from classrooms to school board meetings to teacher professional development sessions. Research staff made over 230 separate observations in over thirty-five classrooms in which the Internet was being used and observations of over one hundred meetings in which different groups of educators participating in NET drew up plans, discussed problems, and shared information about their accomplishments with their peers. We also observed over 180 meetings in which NET staff formulated plans, dealt with problems, and planned institutionalization of the NET project.

We carried out more than 400 semistructured, open-ended interviews, including over 170 interviews with teachers, over 140 with students, 47 with district administrators and policymakers, and over 50

with fourteen individuals who were part of NET (staff members, NET's director, and so on). We interviewed some individuals repeatedly, generally at one-year intervals, in order to obtain a fuller and more dynamic perspective than we could have from a single interview. Others we interviewed only once.

We supplemented observations and interviews with a wide range of other data-gathering activities. We collected a large amount of archival data, including all proposals submitted to NET's annual competitions, as well as a variety of planning documents, newsletters, and other written materials. We gathered a substantial amount of quantitative data, including NET server login data, responses to surveys of those who accessed the Internet through NET accounts, and responses to other questionnaires.

Analysis of such a large and varied data set, as described in the Appendix, was a complex and lengthy process. We analyzed each kind of data set in a manner appropriate to it, ranging from the qualitative coding of field notes to the production of descriptive and inferential statistics from the survey and questionnaire data.

An important goal of all this work was to develop an empirically based understanding both of the issues that arise when schools begin to use the Internet and of the ways educators respond to these issues. A second goal was to illuminate how Internet use is shaped by the behaviors and expectations of those in schools, ways in which Internet use can change schools, and the likely consequences of school Internet access and use. The chapters that follow offer a detailed picture of the issues, many of which are likely to arise in other districts as well, that NET staff, NET team members, students, and others had to grapple with as the Internet was introduced into their schools. The following chapters also explore the myriad ways that classroom and schoolwide contexts shape Internet usage, including the limitation of Internet use stemming from clashes between the cultures of the Internet and of the school and classroom, and the facilitation of Internet use by certain kinds of school context conditions. Other chapters illuminate many of the ways the Internet is used in classrooms as well as the impact of Internet use on outcomes as disparate as classroom roles and relationships, teachers' feelings about themselves and their work, and students' motivation. We begin our discussion of NET and its consequences with an issue that must be addressed early on in any effort at pedagogical change, building demand and support for the change among educators.