

Teachers' experiences with computers: A comparative study

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ABSTRACT

Findings from two ethnographic studies regarding teachers' uses of computers from 1991 and 2004 are compared to discover how teachers' experiences of computer have changed since the proliferation of computers in schools and how teachers' experiences of computers have remained the same. Despite the tremendous increase in availability of computers in schools and modest progress in teachers' computer use, a comparison of data demonstrates continuing token integration of computers by teachers. Such factors as lack of effective training, and need for collaboration and involvement in planning for computer use which inhibited teachers' computer use in 1991 continued to exist in 2004.

Keywords

Computer use, Comparative study, Case study, Technology integration

The most visible change that has occurred in public schools in the United States over the past two decades has been the addition of computers in labs and classrooms. According to the National Education Association (2002), one computer was available for every 4.2 public school students nationally in 2001 – as compared to one computer for every 125 students nationally in 1981. Similarly, Internet access was available in 77 percent of instructional rooms by 2000, an increase from roughly 3 percent access in 1994 (Cattagni & Westat, 2001).

One major driving force for this change has been the policy and financial support from the U.S. Government. *A Nation at Risk*, a widely read report produced by National Commission on Excellence in Education in 1983, was the catalyst for developing computer skills among school students, which named computer skills as among the “Five New Basics” (National Commission on Excellence in Education, 1983, p. 24). Eighteen years later, the *No Child Left Behind Act of 2001* repeated this emphasis by including a recommendation that all students should be technologically literate by the eighth grade. Accompanying these policies was a huge amount of funding from the government and private sources. The technology-related investment in K-12 education for infrastructure, professional development and technical support in the ten years from 1993 to 2004 exceeded \$40 billion dollars (Dickard, 2003).

However, multiple studies have found unsatisfactory results regarding computer integration in schools (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; Ertmer, 1999; Peck, 2001; Rogers, 2000). Instead of facilitating teaching and learning in a significant way, computers are found to be “oversold and underused” (Cuban, 2001). Such findings draw our attention from the expectations and potentialities of computer use to the realities of computer use, and prompt us to ask questions such as why are computers underused in schools? Why don't teachers choose to use computers?

Among various explanations and analyses provided by researchers, Fullan's have perhaps been the most systematic (Fullan, 1991). He posits that multiple factors influence the implementation of any changes in education, including the use of educational technology. Teachers are one factor effecting technology implementation in education. In contrast to most studies which treat teachers marginally and simplistically, Fullan suggests that researchers and policymakers examine the changes that are the result of technology integration from teachers' perspectives in order to understand their subjective experiences of the matter in their work context.

The purpose of this research report is to compare the findings from two studies, both of which explored teachers' experiences with computers through prolonged engagement in the teachers' native social settings, their schools and their classrooms (Bichelmeyer, 1991; Shi, 2004, 2005). These two studies were completed 13 years apart (in 1991

and 2004); the comparison of findings from the two studies tells us something about the progress of computer integration in U.S. schools over the past two decades.

Through examination of teachers' concrete experiences with computers and probing of teachers' perceptions regarding these experiences, the researchers shed a unique, interesting and valuable light on the question of computer use in schools. The historical view provided by this comparison, the striking contrast between ubiquitous presence and low use of computers in schools, and the general lack of studies on teachers' experiences with computers in the context of their daily professional activities make this report an important contribution to discourse in the field of instructional technology.

Brief Literature Review

"We're Wired, Webbed, and Windowed, Now What?" is the title of an article by Trilling & Hood (1999) which captures a fundamental question regarding technology integration in schools. Now that billions of dollars have been spent on computers and Internet connectivity, it is appropriate and necessary to ask such questions: How are these computers used? Have teachers and students become experienced users? Have teachers used them to teach in new ways? Have students been able to achieve at higher levels because of the use of computers in teaching?

It may well be argued that the most successful large-scale technology integration project to date has been the Apple Computer of Tomorrow (ACOT), a ten-year long project sponsored by the Apple Computer Corporation. Researchers found that technology impacted teaching and learning and that effective technology integration facilitated student improvement in a variety of skills identified as essential to prepare today's students for tomorrow's world (Sandholtz, Ringstaff, & Dwyer, 1997).

Unfortunately, the success of the ACOT project has been quite the exception in school technology integration. In fact, many research studies report that no significant increase in academic achievement has been found on the part of students as the result of technology integration, though students are reported to show higher interest and motivation in learning (Bryson & Castell, 1998; Schofield, 1997; Schofield & Davidson, 2002).

Reported use of computers by teachers does not offer much promise for impacting teaching and learning, either. According to the National Center for Education Statistics (2000), among teachers who use computers or the Internet at school, 39% of teachers use the computer to create instructional materials, 34% for administrative record keeping, 23% to gather information for planning lessons, and less than 10% of teachers use computers for such activities as multimedia classroom presentations, accessing research about best practices in teaching, communicating with parents and students, or accessing model lesson plans.

Cuban (2001) reports low use of computers by teachers in terms of the frequency of computer use: "[L]ess than 10 percent of teachers who used computers in their classrooms were serious users (defined as using computers in class at least once a week); between 20 and 30 percent were occasional to rare users (once a month); well over half of the teachers were nonusers" (p.133). Employing a critical perspective, Cuban stresses the fact that for those teachers who use computers, they use computers mainly for communication, administrative tasks and creating teaching materials such as student handouts and Internet searches, and "[l]ess than 5 percent of teachers integrated computer technology into their regular curricular and instructional routines" (p.133). From these observations Cuban draws the conclusion that computers in schools are "oversold and underused".

Due to low use of computers by teachers and consistent reports of no significant increase in academic achievement as the result of computer integration, many people have begun to ask how to justify the expenditures made for computers in schools. In an article titled "Our biggest challenge: Proving the power of technologies in educational settings," Peck (2001) observes that a backlash against technologies has begun, admitting that "[t]here are many advocates, but few offer evidence" (p.25). This is echoed by Molenda and Sullivan (2002) when they write that one of the major issues with regard to educational technology in 2001 was that the new media movement with computers (as with previous media such as film, radio, and television) has hit the plateau and that schools are cutting back on high-tech investments as they deal with budget struggles (Molenda & Sullivan, 2002).

In 1985, Bramble and Mason predicted that there would be four phases of integration for educational computing in schools in the United States (Bramble & Mason, 1985, pp. 295-297). The four phases they identified were:

1. Experimentation, 1960-1976, when "methods and terminology are developed..."

2. Popularization, 1977-1985, when “public education enthusiastically adopts computers...”
3. Transition, 1985-2000, when computers “change teaching techniques and redefine the curriculum”
4. Infusion, 2001-?, when computers become “an integral part of the curriculum...”

Obviously, we have experienced the popularization period (at least in terms of the number of computers that are now available in schools). However, the transition period seems to be much more prolonged than Bramble and Mason had predicted, and the future of educational computing is unclear.

This research report will add to the knowledge base by casting light on factors that have influenced technology integration during the transition phase identified by Bramble and Mason. Additionally, this report will provide evidence for and an explanation as to why this transition has been more difficult and longer than these theorists and others who are interested in the integration of technology in schools expected it to be.

Method

This study is a cross-case comparison of findings from two ethnographic case studies regarding teachers’ experiences with computers. The two case studies were completed 13 years apart, in 1991 and 2004.

The 1991 study followed the method of naturalistic inquiry (Lincoln & Guba, 1985), while the 2004 study followed the method of critical inquiry (Carspecken, 1996). In both case studies, ethnographic methods were selected as the most appropriate approach for inquiry because they allowed the researchers to become immersed in teachers’ worlds through prolonged observation, document analysis, and interview in order to identify teachers’ experiences and views regarding important issues around the integration of technology in classrooms. The open research agenda of ethnographic inquiry gave educators opportunity to voice their needs, whereas historically, issues around integration have been defined by administrators and technologists, with little direct input from teachers.

The rich data set that is the result of ethnographic inquiry and prolonged engagement made it possible for the two researchers to compare data about several key factors impacting teachers’ experiences with computers, even though neither researcher conducted their original study with the intention of completing this cross-case comparison.

Research Questions

The broad focus for the 1991 study was on educators’ subjective experiences with computers and on their perspectives of how to best use computers for communication, professional development, teaching and learning.

The focusing questions for the 2004 case study were: How do teachers use computers in the context of their daily experiences? What do teachers perceive as the important functions of computers in their daily experiences? What impact do computers have on teachers’ professional lives?

The focus question for the cross-case comparison was, How have teachers’ experiences with computers changed from 1991 to 2004?

Contexts of the Case Studies

Fictitious names have been assigned to all schools, communities, projects, and persons that are named in case study reports throughout this paper.

The 1991 case study. The focus of the 1991 case study was the educational community engaged in the implementation of the IN-CITE computer network. IN-CITE (Information Networks – Computer Integration Throughout Education) was the first computer network to facilitate communication and sharing of resources among educators in its State, which is located in the Plains region of the United States. Four constituent groups were served by the IN-CITE network, including teachers, student teachers, school administrators and librarians. The network linked 17 computers in 16 schools in 6 school districts to a hub station in the Educational Resource Lab (ERL) at the Central University (CU) School of Education.

The hub station at the ERL was a multimedia local-area network equipped to facilitate the development, compilation, organization and dissemination of educational information to all schools linked through IN-CITE.

The IN-CITE stations at each of the 16 participating schools were located in the library or in a teacher work area; each station consisted of a state-of-the-art Macintosh SE with a 20 megabyte hard drive and an Imagewriter II printer. The stations were connected to the hub by a dedicated phone line and modem.

Schools and districts were selected to participate in the IN-CITE project based on representation from across grade levels and cultural settings, minority representation and the number of CU student teachers placed in the district each semester.

The purpose of the IN-CITE project was to facilitate communication among teachers via the network, to familiarize constituents with emerging technology, and to encourage constituents to integrate computers into educational environments.

The 2004 case study. The focus of the 2004 case study was Addison County High School which served about 750 students in Addison County in the Midwestern United States. The largest employer in the county was the district school corporation, which had four elementary schools, one junior high school and one high school. Addison County High School employed about 60 teachers and staff.

The technology department of the school corporation had a staff of five, including the director, a network administrator, one website administrator, one school technician, and one lab supervisor for the high school computer lab.

There were over 200 computers in the high school. Each classroom had a computer station for teachers' administrative use. In addition, the school had four computer labs including an industrial technology lab (about 20 computers), a computer sciences lab (about 15 computers), a business lab (about 10 computers), and a lab for general use (about 30 computers). There were a few additional computer clusters in some of the other classrooms, such as the arts room and the publications room. The computers varied in their configurations, and not all were networked.

Participants

The 1991 case study. Purposive sampling of constituent group members was completed using a serial nomination process in order to achieve maximum variation in sampling. Sixteen teachers, four student teachers, eight librarians, two school administrators and one IN-CITE staff member representing every school that participated in the project were interviewed over a period of nine months. Although the study was primarily concerned with how teachers use computers, interviews with members of the other constituent groups were included in order to gain additional perspectives about issues surrounding the educational and computing environments at each school, about what motivated teachers to use computers, and varying observations and perceptions about how teachers used computers in their daily context.

The 2004 case study. Observation and interviews with nineteen teachers, administrators and technology support personnel at Addison County High School were conducted over a period of eight months. As with the 1991 study, interviews with members of the administrators and support staff were included in order to gain additional perspectives about issues surrounding the educational environment at each school, about what motivated teachers to use technology, and varying observations and perceptions about how teachers used computers in their school environment.

Data Collection Methods

The 1991 case study. This study employed the naturalistic inquiry methodology developed by Lincoln and Guba (1985) which involved four phases of inquiry. First, an orientation was conducted through participant observation and interview in order to discover the salient issues and to determine what additional information was needed. Second, focused exploration was completed using structured protocols in interviews to obtain more in-depth information about the areas identified as most salient to the study. Member checking was completed in the third

phase of the study and the case report was revised as a result of the member check. Fourth, an external audit was completed by a researcher with expertise in naturalistic inquiry in order to evaluate the trustworthiness (dependability, confirmability and credibility) of the study.

The 2004 case study. This study employed a critical ethnographic methodology following a five-stage procedure outlined by Carspecken (1996). The first stage involved the compilation of the primary record for the study through the collection of documents and observational data. Stage two involved preliminary analysis to reconstruct the cultural themes and system factors that are often unconscious to the actors by identifying both the routine and unusual events in teachers' daily activities. Stage three involved dialogical data generation through interviews with teachers and other stakeholders of technology integration in the school. The focus of stage four was to develop a conceptual framework in order to discover specific relationships between teachers' use of computers and system factors, and to triangulate this data through member checking and peer debriefing. Finally, the focus of stage five was to apply the identified system relationships as explanations of findings (p. 43).

Instrumentation for both studies. In both studies, tools for recording data included observation logs, interview notes, calendars of daily activities, methodological journals, reflective journals, and document/record files.

Data Analysis Methods

Original case studies. Data analysis was completed separately and independently for each case study. However, both case studies were developed using similar data analysis techniques. For both case studies, data from observation and interview logs, documents and record files were unitized, coded, categorized and sorted. Data units were compared using the constant comparative method (Glaser & Strauss, 1967) and analyzed to discover emergent themes. Both case studies were written using data category structures that evolved through constant comparative analysis into the emergent themes of the study.

Comparison of case studies. The two researchers reviewed the independent analysis categories that developed from each case study, and identified common themes between case studies. Similarities and variations of findings between case studies for each theme were noted. These similar themes, and the similarities and variations of findings within each theme became the structure for the findings and conclusions of the comparison report.

Limitations of the Study

Because the comparison data are from two case studies that were completed by independent researchers with different purposes and in different contexts, this comparison should not be viewed as a longitudinal study, nor should the two data sets be viewed as being related in any way. Because the findings outlined in this research report are not drawn from direct correlations between the two data sets, the findings and conclusions presented should be viewed as interpretive in nature.

Findings

Through the comparative data analysis process, six themes were found to have been identified by participants in both studies as having effects on teachers' experiences with computers in the school environment. These six common themes included 1) accessibility of computers, 2) availability of technical support, 3) perceptions regarding usefulness of computers, 4) appropriate programs for teachers' use, 5) factors facilitating teachers' use of computers, and 6) factors inhibiting teachers' use of computers.

Accessibility of Computers

1991 study. In 1991 the only teachers who had personal computers in their classrooms were the "innovative" teachers; those teachers who were using computers due to their own interest and initiative. None of the teachers' computers were networked to the Internet. The computers that these teachers were using were typically made available through grants, negotiations with school administrators, or through personal purchases. Additionally, the

majority of the 16 schools that were the focus of the 1991 study had only one computer lab in the school, usually with about 15-20 computers in the lab. In high schools, these labs were used primarily for computer programming, but in all schools these labs could be scheduled by any teacher who was interested in using them with students for instructional activities. None of the student computer labs were networked to the Internet. The labs were not often used by teachers other than the computer programming teacher for instructional purposes; but when they were, they were generally used by English teachers to allow students to do word processing or by other teachers to administer instructional software programs or for word processing.

2004 study. In the 2004 study, all teachers had personal computers in their classrooms, regardless of how little or much the computer was used to support administrative and instructional activities. Some teachers had several student computers in their classrooms, as well. These student stations were generally found in the classrooms of teachers who were more active computer users, such as the science teacher who created a class website that includes syllabus, schedule and other resources for students. Addison County High School had four computer labs, three for specific courses ranging from 10-20 computers, and one lab for general student use with about 30 computers. Each lab had at least some portion of the computers networked to the Internet. The general computer lab is reported to be busy, with many teachers scheduling classes there when they want to use the LCD projector to present information from the computer to students.

Availability of Technical Support

1991 study. All teachers reported that the technical support provided by school administrator for their computer use was inadequate. In the majority of schools, there was no funded support at the building level, so whatever support was available was generally provided by innovative teachers or the computer programming teacher, who would volunteer time or perhaps receive one course release for their efforts. Funded technical support was generally provided at the school district level. In a few rare cases technical support was provided by outside consultants, or provided through awards from grants or other funding agencies.

2004 study. The majority of teachers reported that the technical support available to them for their computer use was adequate. This perceived adequacy may have been due in part to the fact that there was a number of teachers who were advanced computer users provided support to other teachers (something akin to a larger group of innovative teachers at the building level as described in the 1991 study), as well as to the fact that funded support was available at the school level from the lab supervisor in addition to the district-level support through the technology department of the school corporation.

An interesting difference between the teacher participants in the 2004 study and the 1991 study was that teachers in the 2004 study identified students as one source of technical support. Most teachers in the 1991 study would not have considered the idea of asking for support from students, alternatively, many expressed concern that students would perceive them as technologically incompetent if the computer had a problem that they couldn't fix while working with students. Apparently, teachers in the 2004 study had no such concerns, which would indicate that it has become more acceptable in the past 13 years for teachers to ask for help from students, at least in the area of computer support.

Perceptions Regarding Usefulness of Computers

1991 study. Obviously, personal computers were still very new in 1991, and teachers' perceptions about computers in the 1991 case study reflected the uncertainties that accompany newness. Most of the teachers in that study expressed uncertainty about the value of computers in education while they identified many specific concerns, such as: whether software interfaces could be made more intuitive, whether the speed of Internet connections could be increased, whether software programs from various vendors could be made compatible with each other so that they wouldn't crash so often and so unexpectedly, whether high quality programs could be developed to meet teachers' needs for administration and instruction, and whether enough computer stations could be purchased with tight school budgets so as to make it possible for a majority of students and teachers to use them.

At the same time, a few teachers could imagine the potential benefits of computer use if the uncertainties listed above could be overcome (generally, these were the same teachers who were identified as “innovators”). The perception of potential was based on the possibility of more effective administrative tools for recording data, tracking students and grading; more effective warehousing of instructional resources that could be easily re-used from one semester to the next; and the potential of email and networked applications to break through the barrier of the four walls of the classroom that isolate teachers and students from others in their building as well as the rest of the world.

2004 study. By 2004, the computer had overcome at least a number of the uncertainties that were identified by teachers in 1991. However, while all teachers used the computer in some ways for their daily work, not all of them perceived it as an important tool of education. In fact, only a few teachers were enthusiastic about the changes that computers had brought to their ways of teaching, and most were not that excited. Some felt the ways of teaching were quite the same, and some expressed the view that, while the computer does allow for easy access to information, the quality of that information is often questionable and therefore the computer is still an “immature research tool”.

A lingering uneasiness about computer use in education was expressed by a veteran English teacher who represented a very small but vocal minority when he said that the most valuable thing in teaching is the human touch, and that it is important for students to learn to respect others. This teacher said he believes that staring at a computer screen and typing away on the keyboard take away that human aspect of teaching and learning and that it is pitiful that students have no way to develop this respect because “you wouldn’t show respect to a screen.” However, despite his doubts about computers, he takes students to the lab because he feels they are more motivated when working at computers.

Teachers’ Typical Computer Use

1991 study. In 1991, the few teachers who were using computers were using them primarily for administrative purposes such as word processing to create documents for class including assignments and tests and grade book programs or simple databases to record and track grades. As described earlier, if computers were used at all by teachers for instruction, they were used primarily for word processing in English classes. Some of the innovative teachers may have developed a HyperCard stack or some little program to teach a math concept or a scientific principle, but that was the very rare exception. Internet research was very difficult in 1991, when “surfing the net” was still a function of text-based or command line programs because the World Wide Web had not yet been introduced for general use. Neither was the computer used for presentations because LCD panels were not yet available on the general market and computer screens were too small for a teacher to display information to a class of 20-30 students.

2004 study. Given the advances in hardware, software and internet speed, one might expect to see a large difference between teachers in 1991 and 2004 in terms of their typical uses of computers. One with such an expectation would be disappointed. Teachers who participated in the 2004 study were still using computers for primarily administrative purposes (though proportionally many more teachers were using computers for these purposes in 2004 than in 1991). One interesting twist regarding teachers’ computer use in this regard, however, is that a mandate from the administration at the school corporation level and the school level resulted in teachers’ use of email for internal communication, a student management package for recording grades and taking attendance, and a database to match final examinations with state standards. The primary use of computers for instructional purposes by teachers continues to be for word processing, though the amount of Internet research in class activities is increasing. And there are a few teachers who could be described as engaging in the intensive integration of computers into their classrooms, including creating course websites, posting schedules, assignments and resources on the Web, and having students use computers to complete in-class activities.

Factors Facilitating Teachers’ Use of Computers

1991 study. In 1991, the factors that teachers said would facilitate their use of computers were in actuality a wish list, because none of the five factors that were identified were available to teachers at that time. In addition to accessibility, hardware/software stability and technical support, teachers identified the potential for more efficient

completion of administrative tasks and potential access to better instructional materials as factors that would facilitate their integration of computers into their daily professional routines.

2004 study. At Addison County High School in 2004, all teachers had personal computers in their classroom, some had student computer clusters in their classrooms, there were four computer labs and more than 200 computers throughout the school – in other words, accessibility was no longer an issue and teachers did not even consider it as a factor that facilitates their use of computers in daily activities.

In the 2004 study, teachers did identify four of the same factors that teachers in the 1991 study named as facilitators of technology integration; however, for teachers in 2004, these factors were not a wish list but rather a dream come true. Teachers reiterated the importance of hardware/software stability and technical support, and they also noted the increased efficiency of administrative tasks and the ability to develop better instructional materials as factors that supported their use of computers. Additionally, in the 2004 study, a majority of teachers cited increases in students' motivation when working with computers as an important reason they use computers.

Factors Inhibiting Teachers' Use of Computers

1991 study. One reason teachers cited in 1991 for why they did not use computers was that they were simply not in the habit of doing so. Another factor related to habit that was identified by teachers as inhibiting their use of computers was intimidation – these machines were unfamiliar, they were not user-friendly, and there was little support available to teachers who were willing to try. Teachers reported that their over-full schedules left them little time to become familiar with computers, which might have helped to decrease their intimidation.

Teachers also noted that the time they did have to dedicate to innovation would be during in-service workshops for professional development activities, but that there was little or no effective training for computer integration offered at these times. A discussion of the elements that lead to effective professional development for teachers' computer use is beyond the scope of this report; suffice it to say that teachers wanted professional development opportunities in which appropriate uses of computers for administration, teaching and learning were demonstrated; that included hands-on activities; that extended beyond a single two-hour session, and that were delivered by individuals who had K-12 teaching experience.

Finally, the participants of the 1991 study noted that teachers spend most of their professional working life isolated from their peers and from administration, and therefore they lack the opportunities to work with others and to be involved in planning for the innovations that they are required to implement in their own classrooms. The lack of collaboration and ownership were identified by teachers as critical factors that inhibited their computer use.

2004 study. Participants in the 2004 study did not name habit, intimidation or lack of time as factors that inhibited their computer use. They did, however, echo the voices of the 1991 teacher participants when they emphasized that the lack of effective training, lack of collegiality and lack of involvement in planning for technology integration were factors that kept them from using computers.

An additional factor cited by teachers in the 2004 study as inhibiting their use of computers was the lack of material support, meaning that, as one might expect in an always financially burdened public school setting, teachers reported having to periodically spend their own money for peripheral devices and supplies (such as computer cables), and that their frustration with this situation was a discouragement from using computers.

In addition, a few teachers identified the standards movement as an inhibitor to their computer use. These teachers felt that the mandate to teach to standards diverts their energy away from truly improving teaching, with or without technology integration.

Summary of Comparative Findings

For two studies that were completed 13 years apart, by different researchers, in different contexts and with different participants, the congruity between themes identified by the teachers who participated in the two studies is striking.

This congruity may be considered as evidence that the same issues that were important to teachers 13 years ago continue to be important to teachers today.

The similarities and variations identified within each theme appear to be the natural result of the now nearly ubiquitous presence of computers in the daily experiences of teachers. Comparative data analysis indicated that computers are more accessible today than they were 13 years ago, both in individual classrooms and labs throughout the school. There is now more formal, funded technical support at the building level for teachers than there was 13 years ago, but there is also more informal support for teachers in the form of their peers, and teachers are now comfortable taking advantage of help from students who are sophisticated computer users, in contrast to teachers 13 years ago who were reticent about looking inept in front of students. Thirteen years ago, most teachers were uncertain as to whether computers would one day be useful tools for education; today more teachers perceive computers as an important tool of the educational process. Most teachers believe that the use of computers increases students' motivation to learn.

That's the good news. There is less positive news, as well. Comparative data analysis also indicated that teachers continue to use computers primarily for administrative tasks and that intensive technology integration for innovative and meaningful teaching and learning is a rarity. It appears that there has been little improvement over the past thirteen years of in-service training or professional development experiences for teachers who want to learn how to fully integrate computers into their daily activities. Teachers still report that they experience a lack of collegiality and lack of involvement in planning for the innovations that they are required to implement in their own classrooms.

Finally, the impact of the standards movement on teachers' use of computers is unknown at this time; however, it appears that it's a mixed bag at best, with some teachers viewing it as a positive influence for computer integration and others viewing it as yet another distraction diverting their energies away from being able to create meaningful teaching and learning experiences.

Conclusions

In 1991 few teachers achieved technology integration in their classrooms due to such fundamental issues as lack of accessibility and technical support. In comparison, the majority of teachers in 2004 appear to have achieved basic levels of computer integration into their daily professional activities. So, the difference between teachers' experiences with computers from 1991 and 2004 is that the majority of teachers have moved from no integration to basic integration of computers into their everyday activities.

However, such basic level of technology integration has been far from changing most teachers' teaching practice and curriculum. At a fundamental philosophical level, the most important elements of teachers' experiences with computers in 2004 appear to be the same as they were in 1991 – and this may well have been expected. In 1986, Cuban (1986) wrote in "Teachers and Machines" that, unlike instructional technologists who are interested in the integration of technology into classrooms for technology's sake, teachers are interested in taking care of their students and will judge the worth of any technology by the ability of that technology to help meet teachers' needs as they attempt to facilitate learning. Like the teachers described by Cuban, the majority of teachers who participated in the 1991 case study reported that they did not consider their non-use of computers as a problem in and of itself. What mattered most to those teachers was that they were engaged in effective teaching to support student learning. Thirteen years later, the majority of teacher participants in the 2004 case study also expressed their ambivalence to the use of computers for their own sake. These teachers, along with their principal, expressed the belief that, while it is important for the administration to provide computers for teachers and students, it is up to teachers to decide whether it is appropriate to use them or not – and that computers are simply tools which do not, in and of themselves, make a teacher good. During one interview, the principal said, "I can take you to a classroom right now with a teacher who uses very little technology [and who is] an incredible teacher. Then I could take you to another classroom to a teacher who uses technology all the time and who is also very good."

So it appears that teachers' ambivalence toward computers and their commitment to meeting the needs of their students reported by Cuban in 1986 and replicated in the 1991 case study continues to be the same in 2004. The wise instructional designer would do well to note this sameness, even as they note the progress that has been made in computer integration. It is very possible that the message represented by this sameness is the key to achieving the

highest levels of technology integration as labeled on the hierarchy of teachers' technology needs. If, instead of marketing technology to teachers as an end in itself, instructional technologists were to collaborate with teachers to identify their real problems and authentic needs, then together teachers and instructional technologists may be able to integrate computers into schools and classrooms in ways that will allow teachers to foster learning and achievement for every student.

References

- Bichelmeyer, B. A. (1991). *The pilot implementation of an educational computer resource network: A naturalistic study*. Unpublished doctoral dissertation, The University of Kansas, Lawrence, KS.
- Bramble, W. J., & Mason, E. J. (1985). *Computers in schools*, New York: McGraw-Hill Inc.
- Bryson, M., & Castell, S. D. (1998). New technologies and the cultural ecology of primary schooling: Imagining teachers as Luddites in/deed. *Educational Policy*, 12 (5), 542-567.
- Carspecken, P. F. (1996). *Critical ethnography in educational research*, New York and London: Routledge.
- Cattagni, A., & Westat, F. E. (2001). *Internet access in U.S. public schools and classrooms: 1994-2000*. Retrieved May 5, 2007, from <http://nces.ed.gov/pubs2001/2001071.pdf>.
- Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*, New York: Teachers College Press.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*, Cambridge, MA: Harvard University Press.
- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38 (4), 813-834.
- Dickard, N. (Ed.). (2003). *The sustainability challenge: Taking ed-tech to the next level*, Washington, DC: The Benton Foundation Communications Program and EDC Center for Children and Technology.
- Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, 47 (4), 47-61.
- Fullan, M. G. (1991). *The new meaning of educational change* (2nd Ed.), New York: Teachers College Press.
- Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*, New York: Aldine.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*, Newbury Park, CA: Sage Publications.
- Molenda, M., & Sullivan, M. (2002). Issues and trends in instructional technology: Hitting the plateau. In R. M. Branch & M. A. Fitzgerald (Eds.), *Educational media and technology yearbook 2002* (3-18). Englewood, CO: Libraries Unlimited.
- National Center for Education Statistics (2000). *Teacher use of computers and the Internet in public schools*, Department of Education.
- National Commission on Excellence in Education (1983). *A nation at risk: The imperative for educational reform*, Washington, DC: Government Printing Office.
- National Education Association (2002). *Good news about public schools in Indiana*, Retrieved May 8, 2007, from http://www.gcsc.k12.in.us/~Maxwell/good_news.htm.

Peck, K. L. (2001). Our biggest challenge: Proving the power of technologies in educational settings. In R. M. Branch & M. A. Fitzgerald (Eds.), *Educational media and technology yearbook 2001* (24-30). Englewood, CO: Libraries Unlimited.

Rogers, P. L. (2000). Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research*, 22 (4), 455-472.

Sandholtz, J. H., Ringstaff, C., & Dwyer, D. C. (1997). *Teaching with technology: Creating student centered classrooms*, New York: Teachers College Press.

Schofield, J. W. (1997). Computers and classroom social processes: A review of the literature. *Social Science Computer Review*, 15 (1), 27-39.

Schofield, J. W., & Davidson, A. L. (2002). *Bringing Internet to school: Lessons from an urban district*, San Francisco, CA: Jossey-Bass.

Shi, M. (2004). *The dinosaur and the computer lab hog: An ethnography of teachers' work in the computer age*, Unpublished doctoral dissertation, Indiana University, Bloomington, IN.

Shi, M. (2005, March-April). The dinosaur and the computer lab hog: Eight teachers' experiences with computers. *Educational Technology*, 56-63.

Trilling, B., & Hood, P. (1999, May-June). Learning, technology, and education reform in the Knowledge Age or "we're wired, webbed, and Windowed, now what?" *Educational Technology*, 5-18.