

Factors Affecting the Adoption and Use of Computer Technology in Schools

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ABSTRACT

There are many factors facing teachers in their quest to implement computer technology in instruction. The purpose of this paper is to identify and examine frequently occurring factors affecting implementation of the technology. Part One, is a literature review which identifies eight frequently occurring factors affecting implementation. Part Two contains selected portions from interviews with four urban elementary school teachers in a district. The factors affecting implementation and methods of implementation are examined in the context of the teachers' personal experiences in a school. Part Three outlines current issues and trends for change surrounding the implementation of computer technology in district schools. These issues and trends are the expressed views of the district technology expert. A synopsis of the current trends in computer use and points for consideration in affecting true integration of computer technology in instructional process is presented in the conclusion.

INTRODUCTION

"Microcomputers offer exciting approaches to teaching that were not even dreamed of twenty years ago, but the extent to which the educational potential of microcomputer technology will be realized remains to be seen. Some teachers will use microcomputers to revolutionize their classrooms. Perhaps you will be one of them."

(Geisert and Futrell, 1995, p. xvii)

Geisert and Furtrell express the view of educators and parents about the promise computer technology has to effect major educational reform. Bennet (1997) echoes Geisert and Futrell and offers an even more aspiringly detailed vision of the computer's potential in education:

Today's technology, if used differently, could bring advances that would improve education dramatically. Ordinary students would make massive gains, and restraints on bright students would dissolve. Wherever illiteracy is a problem, it would be eliminated,

and handicapped students would have vast new vistas opened to them (p. 1).

But what about computer technology's promise? Many studies about how computers are utilized in schools reveals that although there have been many successes involving effective implementation of computer technology, a more sobering reality exists. Surveys indicate that computers aren't fulfilling their potential to effect significant changes in education, are under-utilized, and are not being implemented in very effective or creative ways (Ginsberg & McCormack, 1998 ; Bennet, 1997 ; Miller & Olson, 1995). Though teachers agree on the potential that lies in computer technology to effect significant changes in education, more often than the full potential of the computer is not being exploited. The reality is that computers are most often employed to supplement traditional classroom pedagogy and have not been fully integrated into classroom learning activities (Ginsberg & McCormick, 1998). What are some of the factors that prevent teachers from implementing computers and realizing the full potential of the technology?

The purpose of this paper is to investigate some of the issues that prevent regular classroom teachers from realizing the potential of computer technology in their teaching. Part One is the literature review, revealing some of the recurring factors that act as barriers to effect the implementation of computers by teachers. Part One will provide a background and context for Part Two and Part Three of this paper.

Part Two presents selected parts of a series of four interviews with elementary teachers. In this section, the factors affecting implementation are examined on a personal level in the context of one urban elementary school. Four teachers share their experiences and views regarding the factors that affected their decisions to implement or not implement computer technology into instructional practice.

Part Three presents selected sections of an interview with a media specialist of an urban school district. The media specialist offers his views in terms of some of the issues surrounding the implementation of computer technology in the district and what changes he foresees would make the implementation more effective.

The conclusion is a synopsis of current trends in the use of computers in education and presents future considerations for effecting implementation.

Definitions

For the purpose of this paper, the following terms are defined:

Barrier	Any conditional factor that affects the implementation of computer technology; a disabler.
Implementation	Any use of IT in the teaching of students; the use of computer technology for instructional purposes.
Disablers	Factors that act as disincentives for teachers and which have a negative effect on the implementation of computers in schools.
Enablers	Factors which act as incentives for teachers and which have a positive effect in the implementation of computer technology in schools.
Frequent Computer Users	Teachers who have a personal knowledge of computers for personal, administrative or IT applications; teachers who frequently plan for and schedule IT into instruction.
Information Technology	...the term information technology (IT) was defined as the hardware and software used to implement the following applications in the target school district: drill/practice, tutorials, simulations/games, word processing, painting/drawing, music composition, spreadsheets/graphics/statistics, electronic bulletin boards, automated card catalogues, electronic encyclopedias, student information, communications packages, electronic mail, group conference and budget inquiry (Roszell, 1995, p. 9)
Infrequent Computer Users	Teachers who lack experience and knowledge about using the computer; teachers who infrequently implement IT or use the computer for administrative or personal purposes.
Regular Classroom	A traditional classroom structure and environment. The grouping of students is homogenous; students in a regular classroom have similar academic ability.
Teacher Training	Any professional development process for teachers, including in-services and workshops.

Delimitations

3. Interviews were conducted between March 16th to March 20th 1998.

Limitations

1. The interviews were conducted within one urban elementary school district that is representative of district elementary schools in terms of level of computer technology and IT use. Generalizations about the factors affecting implementation and the level and nature of implementation within all elementary schools may be difficult to articulate. Consistent levels of teacher in-service, priority funding for computer technology, student population, teacher expertise and support, the nature of computer technology within a school are some of the variables requiring further investigation.
2. The study was intended to be an investigative venture that would provide a direction and insight for a more extensive study.

Review of the Literature

This literature review identifies some of the frequently recurring factors that affect implementation of computer technology into instructional processes. The factors are not presented in a ranked order in the literature review. What effects factors have on implementation in school divisions, specific schools or with individual teachers is relative to the educational context in which it is encountered.

Background and Framework for the Review

Roszell's (1995) findings regarding the factors that affect the implementation of computer technology provide a genesis for the literature review and interviews in Part Two and Part Three of this paper. It is not the intention here to review Roszell's study in detail. However, his findings into the recurring factors affecting implementation of computer hardware are relevant and purposeful and will provide a framework for the literature review.

Roszell's (1995) study was focused on one urban school district in Saskatchewan. The purpose of the study was to determine the degree teachers and administrators used Information Technology [IT] to support the goals of education and to identify the factors affecting the level of IT usage. Roszell surveyed urban district teachers and school-based administrators to estimate their level of IT use, the effectiveness of the IT they employed, and the degree to which various organizational and personal characteristics affected the amount of IT they used. Roszell found that teachers who used IT in the district perceived IT applications to be effective, but that there were a "relatively low number of teachers using IT" (p. 171).

More significant to the purpose of this literature review is that Roszell's research yielded a list of frequently recurring factors that influence the use of IT:

To summarize, the most important factors, identified in this literature, shown to have an effect on the implementation and use of IT in schools are: access to computers; availability of software; self-motivation; confidence and skill; the amount of time available for software review and teacher preparation; priority of computer use in the school; availability of hardware; attitudes of administrators; and teacher education and training (p. 54).

From the list of ten factors which he saw as having the greatest impact on IT use, Roszell, identified five factors:

...the availability of time for teachers to prepare to use computers in instruction; the availability of high quality software; the availability of hardware; personal knowledge about computers; and administrative support (p. 58).

Though Roszell did not include it in his list of recurring factors, he identified "pedagogical factors" (p. 171) as those requiring further investigation and research. Roszell stated that the research would benefit software developers and persons responsible for implementing technology into school curricula. The integration of computer technology has tremendous potential to effect changes in traditional education in terms of pedagogy. For this reason, the pedagogical factor will be included as part of the framework for the literature review.

The Time Factor

The time factor surrounding the implementation process is viewed by teachers as being a major barrier in their using computers. Stallard (1998) states that teachers are reluctant to embrace technology because of its potential to shorten learning time for students. Stallard contends that teachers face a number of potential interruptions during the typical hour-long class and that, consequently, the actual time spent teaching and learning is shortened significantly. Hence, if the implementation of computer technology involves a "potential interruption" to teaching and learning time, teachers may avoid using the technology:

Since time is short to begin with, many teachers are reluctant to "fiddle" with any type of instructional technology if it is going to reduce learning time (p.2).

The Congressional Office of Technology (cited in Bennett 1996) includes a list of other conditional factors that make demands on teachers' time and affect individual teachers' decisions regarding implementing computers in the classroom:

...teachers who have taught with computers agree that - at least initially - most uses of computers make teaching more challenging. Individualized lessons, matching software to curriculum, scheduling student computer time, monitoring use, providing assistance, and troubleshooting - all adds burdens to the teacher's time...The net effect is increased demand on teacher's time and creativity...very few teachers have adequate time for planning and preparing to use technology (p.1).

Roszell (1995) cites a study by Pelgrum and Plomp (1991) whose world wide study of computers in education "identified 29 conditions that affected the implementation and

use of IT [Instructional Technology] in education." (p. 54) . This study found that one of the most frequently occurring and significant conditions affecting teachers' willingness to embrace computer technology in instruction was the lack of available preparation time for teachers to develop lessons that used computers.

Availability of Hardware

Ginsberg and McCormack (1998) conducted a survey of 1163 teachers to discern what barriers teachers encounter in using computers. The responses to their survey indicated that issues surrounding computer hardware were the most serious barriers affecting implementation:

Regarding hardware, teachers in both highly and less effective schools reported "serious" to "very serious" concern with "too few computers" and "too few printers." Teachers in less effective schools also reported concerns about "computers being too limited" (p. 2).

Middleton, Flores and Knaupp (1997) view the hardware factor as an accessibility barrier. They contend that computer labs are an effective strategy for reducing the student-to-computer ratio in schools. However, the competition between teachers for blocks of time in the computer lab may result in some teachers giving up on scheduling time in the computer lab and thereby ceasing to implement computers in instruction. They also contend that the accessibility to computer hardware may also be dictated by the subject being taught. In some instances, the physical location of computers and the students needing access to them will act as a barrier to teachers implementing the technology:

A second problem is that real scientific activities and hands-on mathematics are difficult to carry out in a computer laboratory. Most such activities require more room and equipment than staff members can haul into and out of a room not dedicated to such activities (p. 2).

The third and most important issue, according to Middleton et al, involves limitations of computer labs and issues of scheduling computer time. Middleton et al argue that computers need to be situated in classrooms where they can be easily accessed by students and used in a meaningful and pragmatic way. The barrier of poor or limited accessibility prevents true integration of the computer in the instructional process:

[W]hen large numbers of computers are in a room separate from classrooms, many students get hands-on experience occasionally, but no one gets to use the computer in a truly authentic way--that is, the way a scientist or mathematician might use it to solve a difficult, time consuming problem. In order to be true tools for learning, computers need to be on hand when the need arises, not next week when the lab is open (p. 2).

Software Issues

Newhouse's (1997, p.2) evaluation of computer-saturated learning environments in part considers issues concerning teachers' implementation strategies for computers in the

classroom. One factor that is identified by teacher respondents in Newhouse's study is the lack of availability and access to software that is subject content appropriate. This factor is perceived by teachers as being a serious barrier that has a negative effect on their using computers in their classrooms.

Lockhart et al (cited in Mann, 1997) names the application of appropriate software and hardware to curricular specific computing, the process of "articulation"(p.30). Primary to the implementation of the software is its assessment in terms of its use and appropriateness in the context of specific learning outcomes. Part of this articulation process is having curricular software and manuals catalogued and accessible for easy use by teachers (Mann, p.3).

Ginsberg & McCormack (1998) list a number of teacher issues and potential barriers to implementation that are software resource related:

- matching courseware to curriculum
- evaluation, quality control
- acquisition, setting priorities
- security, placement
- appropriate use (p.253)

Similar software issues that act as barriers to successful implementation can be found in Ginsberg & McCormack (1997) and Morton (1994).

Attitudes of Administrators

Individual teacher initiative accounts for much of the implementation of computer technology in schools. Lack of support by administrators is identified as a significant barrier toward implementation of computers in classrooms (Morton 1997; Brand 1998). Arzt, (1991) and Lockard et al (cited in Mann, 1997) argue that successful implementation of computers can only occur if administrators offer teachers support and leadership. Persky (cited in Brand, 1998) states that in addition to administrators developing a philosophy to guide the implementation of computer technology, they can support the technological professional development of teachers by:

- establishing flexible schedules so teachers can practice what they have learned (or to continue their learning);
- encouraging and facilitating team teaching and peer coaching
- allowing teachers to visit each other's classrooms to observe computer technology integration; and
- scheduling regular meetings among teachers using technology to plan and evaluate instruction (p.13).

Pedagogical Factors

Galligan (1997) emphasizes the role of individual teachers in implementation of computers and how teachers can affect the educational appropriateness of the

technology:

It is their [teachers'] choices of how, when, where, why and by whom computers are used that determine whether or not the "technological pull is educationally beneficial" (p. 1).

The versatility in the ways computers can be employed for instructional purposes is varied, sometimes within the context of the software itself. "Effective teachers" (p. 2) states Galligan are teachers who make effective choices "about why they are facilitating any particular computer- based learning experience" (p. 3).

Becker (cited in Galligan, 1997) provides a number of variables that complicate the pedagogy of implementing the computer in instruction:

...although computer availability is important, the most important factors determining whether teachers use computers effectively are planning time and teacher attitudes, style and background (p. 3).

Drury (1995) states that changes surrounding pedagogy are necessary if teachers are to be successful in implementing technology to support learning. He states that the "lack of sound pedagogical basis for integration of technology within the school has led to a narrow and unimaginative usage" (p. 3). He argues that teachers and schools focus the use of computers on classes such as "computer studies" (p. 3) rather than in other subject areas and thus "most study is of the technology rather than with the technology" (p. 3). He contends that this practice has the "effect of marginalising" (p. 1) computers in education. Drury predicts a change in pedagogy and teacher role:

The emphasis in our classrooms will shift increasingly from the product of learning to the process of learning and good teachers will be regarded as those who instil in students the skills required to navigate successfully through an information rich world (p. 1).

Galligan expresses a similar view about teacher roles and the pedagogy of computer technology:

The outcomes of computer use at the classroom level are shaped by the theoretical framework and beliefs of individual teachers; the range of their pedagogical repertoire; and their sensitivity and responsiveness to the structure, potential and limitations of particular software programs (p. 4).

Teacher Attitudes

Teacher attitudes toward computer technology may be a significant factor in the implementation of computers in education. Griswold (1984), Stevens (1984) and Stephenson and deLandsheere (1985) cited in Madden (1989) express a concern that computer literate individuals will "reap greater benefits than their counterparts who lack that knowledge" (p. 16). Their concern is that the development of computer literate individuals is dependent on computer literate teachers who have "in general demonstrated a resistance to learning about computers" (p. 16).

Lidtko (cited in Madden, 1989) attribute the reluctance of teachers to embrace computer technology to a number of factors that include: anxiety from dealing with equipment, a

sense of loss of control over the teaching situation, hardware and software availability, lack of technical support, time and effort for training, remaining current in the field, and appropriately implementing the technology in the classroom. An earlier study by Lidtke (1979) is cited and summarized by Madden (1989):

Results indicated that while teachers did not feel that their own jobs were threatened by computers, they still saw them as dehumanizing, isolating, prone to error and possibly as a violation of the right to privacy. Similar results were reported by Tetenbaum and Mulkeen (1984) (p. 13).

A more recent study by Newhouse (1995) found that some teachers do not believe that computers have "a useful educational objective" (p. 5) and that they are "nonessential and supplemental to their teaching and classrooms" (p. 4).

Dupagne and Krendal (cited in Morton, 1996) completed a review of literature on teacher attitudes towards computers. They are able to identify "twenty aspects related to teachers perceptions of computers, the impact of computer use and the impact of personal and learning environment characteristics affecting a teacher's intention to use computers as teaching learning strategies" (p. 5).

Drury (1995), in his reference to a study of the Canadian Ministry of Education and its attempt to implement IT in schools in Ontario, finds that:

Canadian ministry officials estimate that only 20 percent of the teaching cohort are at least "moderately committed computer users" and even this 20 per cent may not be in favor of a dilution of the traditional curriculum model - "software integrates the curriculum. It can work against a subject approach." However research indicated that the main factor leading to a high level of IT-usage was a school- wide consensus on the importance of IT use for students and the amount of teacher-teacher collaboration (p. 2).

Kazlauskas and Koop (1995), in their examination of the barriers to the implementation of computers, observe:

A critical factor that all staff needed to recognize and understand that integrating computers into classroom practice is a complex innovation which requires change to the whole school's practices and culture, to the curriculum, and in teacher's attitudes and classroom practice. Such change is achieved incrementally over a long period of time (p. 2).

Personal Familiarity With Computers

A study by Morton (1996) draws some important conclusions surrounding teachers' personal familiarity with computers and how lack of personal familiarity and experience may act as a barrier:

- the acquisition of computer expertise and skills is generally left to teacher initiative

- high levels of anxiety in using computers is experienced by teachers wanting to use computers and have few role models to follow
- teachers view the use of computers as promoting learning in students
- teachers are aware that increasing the frequency of computer use will lead to changes in pedagogy
- teachers are critical of lack of computer resources to implement change
- administrators have created a major barrier to implementation because they are focused on learning about the computer instead of using the computer for learning (p.1).

Van Lengen (cited in Morton, 1996) finds that for the most part all teachers are willing to implement the computer but "the problem was that many [teachers] were either infrequent users or they didn't know how to use them"(p. 8). Compounding this problem is the need for infrequent teacher users to have structured opportunities to develop and practice computer skills. In addition is the startling revelation that "those that do not know how to use them [computers] have successfully avoided the many basic staff development activities that have run over the years" (p. 8).

Appropriate role models are required for infrequent users to implement and manage computers. Morton (1996) presents a complicating factor to the role model situation:

...the situation is that those role models exist, are generally based on computing studies teachers using computers in laboratory situations...and the more subtle obstacle of computing being the domain of mathematics / computer studies [teachers] inhibits the spread of computers across the curriculum (p. 5).

Newhouse (1995) identifies teachers' lack of computer literacy as being an obstacle to their using computers in classrooms. Newhouse draws a conclusion about the number of years of experience with computers teachers have and the impact it makes on the implementation process:

...most teachers need two or three additional years of experience using computers to become significant users of computers in classrooms...teachers need up to five years solid experience in using computers to become proficient at integrating them [computers] in the curriculum (p. 5).

Newhouse's findings are shared by Roszell (1995):

The most commonly identified factor, in the literature affecting IT use by teachers, was their level of knowledge and skill in using computers. This factor was identified by Zammit (1991), Ely (1990), Pelgrum and Plomp (1991) and Brummelhuis (1991) (p. 151).

Teacher Training

Seidman (1996) has conducted a study into issues surrounding teacher training and its relationship with the successful implementation of computers. Along with the statistical analysis, Seidman finds that the handwritten comments by teacher respondents

"overwhelmingly expressed a need for teacher training on basic computer skills" (p. 145). Seidmen also states that teacher training should not be limited to teachers who teach computing. Seidmen refers to an international trend on the part of educators to train all teachers on the use of computers:

This need for teacher training is explained by the fact that most of the presently hired teachers received little or no training in their formal education. It could also be a reflection of the need to update teachers' knowledge in the world of fast moving technology of communication. Training all teachers on the educational use of computers gains special importance when considering integrating the computer into regular curriculum. Teachers need to know how to use computers first before they can integrate [them] (p. 145).

Seidman states that subject matter teachers are reluctant to consider the implementation of computers in teaching:

The relatively cautious position of the SM [subject matter] teachers is perhaps due first to their limited experience with software and hardware, and second to the uneasiness about changing their habits and techniques as some of them expressed in their written comments (p. 147).

Mintz (1997) echoes Seidmen's view that teachers are unprepared to use computers in their classrooms and they "lack support and educational guidance" (p. 3). Mintz points to professional development and training as a solution to successful implementation:

...the next crucial step [in successful computer implementation] is the professional development for teacher that will provide them with materials, strategies and new understanding to meet the learning goals (p. 4).

The Office of Technology Assessment Report (cited in Geisert and Futrell, 1995) was written for the U. S. Congress to provide federal policy-makers an information base for making long-term decisions about computers in education. The OTA Report states that technologies have the potential to enrich the teaching and learning process but only under certain related conditions:

- adequate teacher training in the skills needed to operate the technology
- a clear vision and understanding among educators of state-of-the-art development and applications
- support for experimentation and innovation
- time for learning and practice (p. 256).

The OTA report lists adequate teacher training as one of the recommendations in the report:

Provide adequate teacher training. Teachers will need continuing in-service programs as technology changes, as more effective uses of technology are developed, and as research provides a better understanding of how children learn. (p. 257).

The teacher is central to the implementation of computers in the classroom. Adequate teacher training is necessary it that is occur. Essential to teacher training is drawing a link between pedagogy and technology (Solomon, 1995; Bennett, 1996; Holzberg, 1997;

McKenzie, 1994).

Summary of the Literature

In summary, the framework for the review is based on frequently recurring factors affecting the implementation of computers identified by Roszell (1995). Eight frequently occurring factors that act as potential barriers against the implementation of computers by teachers have been reviewed in the literature:

- time factors
- availability of hardware
- software issues
- attitudes of administrators,
- pedagogical issue
- teacher attitudes
- personal familiarity with computers
- teacher training

INTERVIEWS WITH FOUR URBAN ELEMENTARY TEACHERS

Introduction

An interview with four elementary school teachers in an urban school district in Saskatchewan was conducted in March, 1998. The interviews were conducted with teachers who teach in one elementary school in the district. The school is a fair representation of the status quo in terms of computer technology that is available and level of implementation.

The goals of the interviews were:

1. to investigate how regular classroom teachers in an elementary school implement computer technology
2. to examine in the context of an elementary school and from the personal perspective of regular classroom teachers, the factors affecting implementation of computers
3. to have teachers discuss their personal views, issues and experiences involving computer technology

Interviews were arranged through the principal of the school. Four teachers volunteered to participate in the interview. Two of the teacher volunteers, Mrs. Y and Miss C, are infrequent users of computers. Both of these teachers see benefits in their students

using computers in their learning activities but face barriers in implementing computers on a more involved and frequent basis in their teaching. Two other teachers, Mr. C and Mrs. T, are categorized as frequent computer users. These teachers view computers as an important part of the students' learning experience and are motivated to incorporate computer technology in various aspects of their teaching practices and did so with regular frequency in their daily teaching.

Interviews were audio-taped with the permission of the participants. Interview questions were generated for both user groups (see Appendix A). The interviews were semi-structured in format and on average were 15 minutes in length. All of the teachers were honest and open and had much to say about computer technology in their school and personal lives. Each interview has been transcribed. Portions of the interviews were selected and organized for the purpose of this paper.

Mrs. Y and Miss C's interviews reveal some of the factors that disable them in the implementation of computers. These factors are organized under the sub-heading "Disablers."

Mr. C and Mrs. T's interviews present the factors that serve to enable these two teachers to implement computers into instructional process. These factors are presented under the sub-heading "Enablers."

Infrequent Users and the Factors That Disable Implementation of Computers

Interview 1

Mrs. Y

"And it's me that's not particularly comfortable or happy with computers...I'm more into arts, humanities kinds of things."

Background

Mrs. Y is an experienced classroom teacher. She teaches language arts, mathematics, social studies and art to Grade Eight students. She also teaches social studies in Grade Seven and art in Grades Five, Six and Seven. In addition to her teaching duties, she is the assistant principal in the school.

Mrs. Y considers herself a "non-user" of computer technology and states that she does not implement computers in her teaching. She also states that she has no future interest in planning the use of computers in her classroom. The extent of her use of the computer in the instructional arena is described thusly by her:

Well, I do word processing with my kids. I mean I have the kids do word processing. So I

mean at that level I use computers, but I don't use computers in terms of instruction.. I would say I'm not highly involved in using computers. I mean kids have access to it. Part of [not using computers] is because of the people I work with. The fellow that's in the five/six [split grade] room and Mr. C are quite knowledgeable about computers so, it's like let someone who knows what they're doing do it.

Disablers

Limited Accessibility to CD-ROM

Mrs. Y identifies some factors that act as barriers toward any inclination on her part to incorporate computers in her instruction. The first barrier has to do with the fact there is only one new stand-alone computer that is CD-ROM capable in the school. Gaining access to and planning use of this computer is difficult because not all the students have adequate access to it. Compounding the accessibility issue in terms of number of students, time and equity, is the problem of having to physically move the computer from another location in the school to her second floor classroom:

... we don't have the capacity [to handle many students]. You see, we have one computer with a CD-ROM and my kids use it if we do research. But when you have thirty kids in a class and you have one computer, its [usefulness is] minimal...this is a multi-level [two storey] school and I'm up on the top floor. And so there's no way you move a CD-ROM [computer] up and down a flight of stairs.

Limited Internet Access

Mrs. Y pointed out another example of computer technology that has a dissuasive effect on her inclination towards using the computer. The second factor involves the text-only version of the Internet available in the library. Mrs. Y elaborated by saying that students are not very motivated to use the text only version of the Internet. She points out that many students have access to the computer and Internet connections at home and that for many of her students the slow text-based access to the Internet dissuades her students from using it for research purposes:

Now we also have access to the Internet, but that's the same thing [as the lone CD-ROM computer]. We have one computer in the library where they [the students] can access the Internet and they can only do that when a teacher is present...and they discovered that the computer in the library is text based and reading a text-based account really isn't very exciting.

Supervision and Classroom Management

There are two factors that act as barriers in Mrs. Y's example of the library Internet connection. The rule governing student access to the Internet computer eliminates any possibility of independent student work because supervision must be arranged by the classroom teacher. Mrs. Y points out that it would be impossible for her to supervise the students working the computer and conduct a class with the rest of her students in her second floor classroom which is a significant distance from the library. Alternate arrangements for supervision that involve other teachers, or the possibility of having to move her entire class down to the library, is not always a viable solution to this problem.

Teacher Roles and Support

Mrs. Y makes an interesting comment about the role that technical support and the computer knowledge of other teachers plays in her not pursuing the use of computers in the instructional arena. Mrs. Y feels fortunate to have been in schools where there has always been a knowledgeable computer expert. Rather than using these experts as mentors or motivators to develop and incorporate computers in her own teaching situation, she has used expert's support to acquiesce:

[S]upport [would be another factor in not using computers]...and I think part of that has been because either I've had the good fortune to work with people whose forte is computers...then it [lack of support or computer knowledge] hasn't forced me to become particularly knowledgeable of computers. It's always been someone else's area. And I quite happily turned it over to them and let them do it...And I've always been in schools where someone has been a computer expert in terms of having done their run through in using their computer. I've been in some schools that had better computers in terms of software [and] where you could actually take a group of kids in and use software. But normally, I was teaching art and someone else was doing that with my kids.

Lack of Motivation

In a discussion involving the factor of lack of personal familiarity and experience with computers affecting implementation, Mrs. Y reveals that she had participated in some in-service sessions downtown at the Board Office's computer lab and at her school. She also describes her use of the computer as being limited to reading e-mail and that she has a computer at home, but she does not bother to use it. Mrs. Y is quite frank in admitting that even though she has opportunities to increase her level of knowledge and familiarity with the technology, she has little interest and motivation to do so:

I don't use the computer at home. My husband uses it all the time. I mean we have an Internet account at home and...basically I don't use the computer.

Final Comments

Mrs. Y feels the important issue for her is that the students in her class have access to computers and that she provides them with that opportunity. In her opinion it is not important for her to plan to implement computers into her instructional process. She illustrated her comment by stating she has accompanied her students to a workshop at the Board Office to learn how to access the Internet. She also points out that the computer lab is across the hall from her classroom and students are allowed to access the lab to use the computers for word processing. She feels satisfied that even though she is not integrating computer technology into her instructional process, her students are learning what they need to know about computers:

So maybe it's not that important that it's me that's doing it, but that the kids have access to computers, and my class certainly do. And that's because I team teach with two other people that are very knowledgeable and share this group of students...They are

getting the skills and they're certainly learning about the computer and the things they can do with the computers, they're just not learning it from me.

Interview 2

Miss C

"I think now the children are coming out of highschool with computer skills far beyond anything I will ever personally accomplish. They are so far ahead, whereas I hadn't even touched a computer before I went to university. It's sort of out of my realm."

Background

Miss C is a relatively new teacher. She is in her third year of teaching. Her present teaching assignment is a Kindergarten class of twenty students. She has two Apple GS computers in her classroom. The children have access to the computer during "choosing time" when the computers become an activity center in the classroom:

It's there and they just go to it on their own. We have different centers where they choose to go. That's one of the centers...one of the places they will go. They often pair up and go to the computer. So I'll have maybe four children working there.

Disablers

Limited Software

Miss C states that one factor that prevents her from using the computer more frequently as an instructional tool is the absence of appropriate software:

They [the computers] are quite old. Still using the large floppy disks. I don't find I have a whole lot of access to disks for it... I don't have a lot of things for them to choose. I think there are three games in the school that are sort of Kindergarten level.

Miss C identifies her lack of awareness regarding available software as another factor for not using the computer as an instructional tool:

I would like to use the computer a bit more... Maybe I'm at fault here for not finding more programs. I just don't know what [computer software is] available [elsewhere], just what's in our school.

Lack of Support and Assistance

Her first year of teaching was at another school in the division. Miss C relates that she has on occasion taken her class for computer activities in the school's computer lab. She is quick to point out that although the children enjoy their time working at the

computer stations, it would not be possible for her to do this without the help of older students that aid the younger Kindergarten-aged children:

But when I do use the lab I do need a bit of extra help. We had care partners come in with us for the first while and then the children were able to use the lab on their own.

Lack of Technical Support

Miss C points out two aspects surrounding the lack-of-support barrier for not using the computer lab in her current school. One issue is that the young age of her students dictates that there be extra help present to work at the computers with the students. Miss C points out that managing twenty Kindergarten-aged children in a computer lab would be impossible for her to do on her own. A second issue is that at least one person in a support would need to have the necessary computer knowledge to troubleshoot problems since she, and in some cases parent volunteers, is afraid of computer technology:

Until lately there was a staff member that was wonderful with computers and he was really great about helping. [If] I had a [computer] problem I'd ask him about it and it was really nice to have somebody like that on staff. [He was] quite knowledgeable. I think if I had the extra support staff that I'd use them [computers] more. But it's not just [having support] when something happens, it's having bodies in the room, working with me, with the children working with the computer. Not just myself running computer to computer with twenty children trying to get all the disks in and making sure they're all going in the right way. I found that when I did use it before if I had a care partner in with me or a group of care partners and another teacher..or just myself and another teacher it [using the computer lab] worked fine, or a parent that [knew] something about computers. There again some parents don't want to help if they are afraid of the technology themselves. There are a few...still a few of us out there that don't know much about them [computers].

Final Comments

Miss C admits that her lack of familiarity with computers also acts as a barrier to the implementation of computers. She has not attended any workshops or in-service sessions and she states that using the computer is "a little scary." Miss C states that she is overcoming this fear of computer technology since she has started using the computer as an administrative tool:

...we do have a wonderful computer here. I've gotten quite a lot better at using it. Doing up unit plans. I'll have them all on computer. Writing letters home...correspondence. I have done the report cards...the written part on the template. That I did this year for the first time.

Frequent Users and Factors That Enable Implementation of Computers

Interview 3: Mr. C

"I would like to see a continuum in terms of what we do from grade to grade, because right now I think it's inconsistent. It all depends on the teacher, not necessarily what the curriculum says. A teacher has a computer background. They tend to do what they can. If someone has no computer training or experience nothing gets done. So you could have a brilliant year one year...go on to the next grade and have nothing. And that's sad."

Background

Mr. C has been teaching for nineteen years. His present teaching assignment includes teaching a Grade Six-Seven split grade with thirty-one students and science to thirty Grade Eight students.

Methods of Implementation

Mr. C has integrated computer technology into his instruction. His students are given the opportunity to use computers in the labs, individual classrooms and library on a frequent basis:

I have it scheduled into my timetable so we definitely have computer literacy time two times a week for a 45 minute periods. But when I give writing assignments, I work that time in so I might give them the assignment and have some of them write it out in hand but others I have them go in and word process. And if it is learning center activity, then the computer is a part of that, so during that time as well they can go and use the computer as well to do book reports, or if it's a learning center activity card that says, "Construct an epitaph".. there will be students that will run off to the computer and use Print Shop or even Hyper Studio and do something on that. So I try and schedule it in as much as possible.

One expectation he has of his students is to develop keyboarding skills and use the word processing program to complete writing assignments:

At the beginning of the year we used MECC programs. We used a word processing program too to teach them keyboarding skills and just general word processing so that they could become familiar with Claris Works. And we've been using Claris Works up in the lab for all the language arts assignments. I expect all my Grade Sevens [with] any assignment that involves any type of writing, be word processed.

Mr. C also explained that he uses the computer as a research and multi-media tool with his students:

In our library we have an LC575 [model computer]... with a CD-ROM. So we're using the Grolier CD all the time to do research. We also have an Internet connection in the

library, so I encourage the students to use the Internet as much as possible to bring down any information that they can. Besides using that for research, [and] for word processing, we also have a program here called Hyper Studio... a multimedia program that allows [users] to incorporate text and graphics as well as pictures, [and] digital pictures that you take with a Quick Take camera. So we've also used that for projects like book reports. We went out to our camp and took the Quick Take camera and a laptop.. we used the Quick Take to take pictures of all the activities we were doing and the kids came back and prepared a program based on our camp experience. So each frame had a different aspect [of the trip] they were trying to highlight..[the students] also learned how to edit the pictures and modify them so they could incorporate them into whatever art they were doing... I've [also] had people do book reports using the Hyper Studio program.

Mr. C does not see accessibility as a barrier to his integrating the computer in his instruction and has used some creative approaches to circumvent accessibility problems:

Our problem is that we only have one computer that has a large enough memory to do anything meaningful with Hyper Studio. So each project that I do in my classroom I limit to one group. I usually have four people on the computer doing one project. And then with the book reports, not everybody opts for that because it's a bit more challenging. So usually there isn't a demand for it [the computer].

Enablers

Opportunities for Individualized Learning

One key factor that Mr. C identifies as being important in his integration of the computer into his instruction is the potential that computers offer teachers to modify and otherwise individualize learning and skill development in students:

...there's so many computer programs that you can use and send them off to work individually to strengthen skills - in math, in language comprehension, and that sort of thing. And I do that as well. We have a computer lab set up so it's easy to send them with a disk and say, "I want you to work on this resource."

...when [a teacher has] kids who are academically talented and you really want to challenge them in terms of critical and creative thinking, using computer software is brilliant, because they can take it as far as they want...it's not even limited by me. I give them a general idea and say, "Now...go do this". And they do.

Computers as Motivation

Mr. C identifies the computer's ability to motivate students to learn as the most important factor that enables him to integrate computer technology in his instruction:

I'm big on trying to motivate students at all levels...with all of their interests. So I know kids are really big on the use of computers, so I figure if I can incorporate computer technology into my classroom, the kids are going to be more motivated to complete programs, do projects, even do writing assignments... for example, one boy last year...

was one of these kids who had suffered right up until Grade Seven with all his rough written work. As soon as he started word processing and people could see exactly what it was he was trying to say in his writing...he was getting higher marks. His self-esteem rose; it was wonderful...he's in Grade Eight this year and he's still word processing his assignments. So for him it's a self-esteem thing. For other kids, it's just high interest. So anything that catches [student's] interest I am keen on learning. And when I learn something like Hyper Studio, I can see that it's going to grab some kids. I go for it. I think it's great...I think that [the computer] motivates students to get higher marks.

Administrative Support

Another factor that Mr. C identifies as enabling him to successfully integrate computers in his instruction is administrative support. Mr. C believes that the implementation of computers in the school is one of the top priorities that is supported by the principal of the school. This is reflected in the fact that the principal has promoted computer use in the school on the part of both the students and teachers. In addition, Mr. C states that the principal has supported the new network lab by ensuring that money is made available for hardware and software:

...our principal has a high priority in terms of making sure we have replacement parts,[and] that we have all the material hardware and software that we need to keep it [the lab] running.

Technical Support

Technical support is another important enabling factor identified by Mr. C. He states that computer hardware and software problems occur frequently and that solving these problems is time consuming. Solving many of the problems is beyond his current level of computer knowledge. Two forms of technical support are available to the school:

...we do have a computer tech downtown that whenever we have a problem we can call him so he'll come in and fix things up. As well, we have a really close relationship with the computer whiz at WM [a nearby highschool] and so he comes on his days off or his free time or whatever. And he helps us.

Teacher In-Service

In-service and training is another important enabler in Mr. C's integration of computer technology. He has attended many in-service sessions during the ten years he has incorporated computer technology in his teaching. In-service sessions are held after school from four p.m. until 6 p.m. at the district Board Office and conducted by the Board's Computer Consultant. Mr. C has attended recent sessions on using Hyper Studio, the Internet, and navigating the Internet using Netscape Navigator. His future plans for in-service include attending a session on Web page development, something he is anxious to try doing with his students. Mr. C enjoys the in-service sessions because

they are practical. He feels he learns things that he can take and immediately use in the context of the classroom. He had one suggested change regarding current in-service structure:

It would be great to have them as part of our professional development. So if we're going to have half-day planning and professional development in the afternoon, it would be great to have these computer programs offered [as in-service sessions], so that I could go and do Internet, or I could go and learn how to do the web page.

Mentorship

The last factor that Mr. C identifies as being an important factor that enables him to integrate computers in his instruction are other teachers who provide direction and motivation in his interest to use the computer:

As soon as we had any [computers] in the school...I was on them. And then just trying to see how I could use them in my classroom ...every school that I've been at I've had people who are really keen on computers and I got my excitement from them. So I'd see what they were doing and of course I'd want to do it and see if I could take it even further. So...it's just kind of an evolution. I've been fortunate there have been people with good ideas and keen interest.

Final Comments

Even though Mr. C does not identify pedagogy as an enabling factor in his using computers with his students, it should be noted that during the course of this interview his Constructivist approach to teaching was a factor that allowed him to avoid many of the barriers experienced by other teachers who have not been successful in using computers in instruction. He allows for individualization and small group work. His students are allowed to work in other locations in the school such as the computer lab or the library:

This is my nineteenth year teaching and I probably started out teaching structured. You know everyone in rows. We'll do this for forty-five minutes...we'll do this..this ... this and very structured. And probably after my fifth year, I started this progression, moving towards more independent learning and challenging students at their own levels. And then trying to set up structure but still allowing kids to go off in their own directions. So for me, this is not a problem.

Mr. C is a self-motivated teacher who is interested in further developing the extent to which he implements computer technology in his instruction.

Interview 4

Mrs. T

"I'm always open to new ideas and I hope as time goes on we'll be able to make more use of the technology in responsible ways in our classrooms...in positive ways to help them become better learners...our motivation is to help them to become critical and creative thinkers. I think there are lots of positive ways computers can help our children."

Background

Mrs. T teaches Grades Two and Three. She is very motivated and interested in ways that computer technology can be better "incorporate[d] in the school program". She is frustrated with the fact that her students are limited to the old Mac computers in the school and that grade and content appropriate software has not been purchased for the newer computers in the lab. She is lobbying to have grade and program appropriate software purchased for the computers in the new lab and make the lab available to all primary students in the school:

...I keep making a few little inferences like, "What can we do for the primary teachers?"... I think the younger children have a lot of knowledge...a lot of computer knowledge. And I know they can work mouses and that kind of thing as well. So I know a lot of them could do that. To me it's just frustrating that we don't have that [access to the newer computers] right now.

Methods of Integration

Despite her frustration with not having access to the new computer lab in the school, Mrs.T has made use of available software for the older computers and integrated computers in her instructional process:

...we have a computer in the classroom which the children use when they finish their work or as a reward type of thing...if a parent comes in they may go to the computer individually with a child. I have a parent that comes once a week, so occasionally, she will go and type out a story for them or just go through a program. And then we also go to the computer lab once a week and each child gets a chance to use the computers there. I choose a program for them or sometimes I give them their own choice.

...different language arts ones...the kids use the Oregon Trail...they like that one...and then there's... Initial Phonics and Initial Consonants...Word Gobbler and Number Gobbler... those kinds of things...then they really like the math ones as well. There's Space Subtraction and Rocket Factory...whole bunch [of available software] for the primary level.

Enablers

Personal Knowledge and Familiarity

Mrs. T is motivated to integrate computers in her instructional process. She feels it is important for her, on a personal level, to become familiar with computer technology if she is to be able to use the computer in a meaningful way with her students. She makes purchasing a computer a priority in increasing her familiarity and knowledge of computer applications:

... we bought a computer at home...so I'm familiar with Windows... I wanted to have [a computer] at home to make sure that I did get familiar with it...with the program[s]...I know what a CD-ROM is and that kind of thing...I'm not afraid of those things anymore..I think that it does help you [being familiar with using a computer].

I've got kids of my own so...we buy CDs..I know sort of what's available out there in terms of commercial types of things [software]. I'd like more in terms of curriculum and educational kinds of things [software].

Opportunities For Individualization

Mrs. T has surveyed the parents in her grade to determine which households have computers. She encourages parents in these households to "help their child" become "computer literate". She gave examples of students who have used the Internet to do research and word processing at home and shared their work with the rest of the class.

She illustrates her belief in the potential benefits of using the computer to help meet the needs of individual learners:

I have a student that's a Special Needs student and he has a low self-esteem. [He] has great difficulty putting things down in writing. But he does have the ideas in his head. We were [helping] writ[e] a story for him...he was afraid...he'd say "Well don't put this down I'll just say it...and don't write it down."...[the associate teacher] said, "Well if we do put it down we'll type it up on the computer." Well then he was just thrilled and he started to tell her this story. She wrote it down and then they went down to the computer and they typed it up...he was just thrilled. And he could help out with the typing of it as well. So for him the computer is a really good thing...He doesn't have to worry about that frustration [the difficulty of handwriting]. So for some kids I've really seen [the computer being] a benefit.

Teacher and Classroom Resource

Mrs. T is able to find a number of ways to use the computer as a resource to help her in her teaching. She has used reporting system programs, accessed picture files, word processed songs for the choir, generated newsletters, and has begun to use the Internet as a research tool to help her develop classroom materials:

I've accessed a few things for children's literature and that kind of thing. We're doing an Aboriginal Unit [and] I found the recipe for making bannock and that kind of thing. And it's good because [I tell] the kids I found this on the Internet... the kids are interested.

...I looked it up [Rememberance Day] poems written by Grade Two students..I brought them to my class and I read them. And the kids were really excited...we talked about [the] child['s] home...then we brain stormed some ideas..well their [my students'] poems turned out [to be] really interesting...I know that it [reading the Internet poetry] really helped them because they could see what some other children had written.

Teacher In-service

Mrs. T has attended teacher in-services at after-school sessions during the school year and sessions offered during Institute and Convention days. She believes that the "hands on" nature of the in-service sessions has resulted in her willingness to try integrating the computer in her teaching:

[I] went through step-by-step... I was really terrified initially with [the] computer... [I'd] sit there and [ask] what do I do next? And now I'm not as afraid to...try different things. It doesn't bother me anymore...I enjoyed them. There were some [sessions] right at the school board we [attended] that were really helpful.

Final Comments

Mrs. T believes her primary students are being "left behind" as far as having equitable access to newer computers and appropriate software in her school. She strongly believes that her students have the knowledge and skill level to operate computers on their own and should be given that opportunity as equally as the older students in the school. She admits to being frustrated with the current access inequity to the newer computers in the school. She has been quite vocal on staff in expressing her feelings and hopes to bring about changes in the situation in the near future. She believes that the computer offers students many educational opportunities and benefits and, like books or any other resource, computers play an essential role in the learning of her students.

Summary of the Interviews

The Infrequent Users

Mrs. Y and Mrs. C's interview comments reveals information consistent with the findings in the literature review. The major factors that have a disabling effect on implementation for the infrequent users are:

Limited accessibility to hardware and content appropriate software. Included in this factor is Mrs. Y's issue regarding the "text only" version of the Internet. Mrs. C cites the old and limited content appropriate software as being a disabler.

Lack of support. Both teachers indicate that additional help with supervision,

particularly in the lab setting, was an important issue. Mrs. Y feels she has technical support from other teachers in the school and leaves the implementation up to them. Miss C feels that technical support during the time that she uses the computers would be a key factor in her decision to implement them.

Lack of familiarity and experience. Both factors influence the teachers. Miss C is slowly overcoming her hesitancy to use computer technology. She is accomplishing this by using the staff computer for word processing and report cards. Mrs. Y is comfortable with her knowledge level of computers and is not concerned with having to learn more than she already knows about computer technology.

Teacher attitude. Both teachers see computers as being beneficial to students, however it is not a priority for either teacher to aggressively implement the technology. Mrs. Y does not see implementation of computers as part of her teaching role. She believes that role belongs to other teachers in the school. Miss C is hesitant to proceed with implementation. This may be due to her finding technology "a little scary" and because of the young age of her students. Her personal issues include not having sufficient supervisory and technical support in a computer lab environment.

The Frequent Users

The interviews with the frequent users yielded some interesting insights into factors that have a positive effect on the implementation process. The major factors that had an enabling influence on the frequent users were:

Teacher attitude. Both Mr. C and Mrs. T are enthusiastic and passionate about the implementation of computers. Both teachers view computer technology as an important and essential part of the instructional process. Both these teachers are strong advocates for computer use in the school. Mr. C is considered to be the computer expert in the school and Mrs. T is lobbying for better access to computers on behalf of the primary teachers in the school.

Personal Knowledge. Both frequent users have a high level of personal experience and knowledge compared to the two non-users. Mr. C and Mrs. T have personal computers and are familiar with the different platforms. Both teachers express a strong desire to learn more about computers and apply the new knowledge in the classroom

Pedagogical potential. Mr. C and Mrs. T give examples in their interviews of how they are implementing computers in the instructional process. Both teachers recognize the potential of incorporating the computer into the process of teaching and learning. Mr. C in particular comments on how his role of teacher is changing along with his methodologies as a result of the implementation of computers. Mrs. T describes how the computer has extended her ability to find resources for her primary-aged students. Both teachers believe that students find the prospect of using the computer for learning motivational. Both teachers cite personal examples of how they were able to use the computer to help them individualize learning opportunities for students.

Inservice. Both frequent users are keen to attend in-service sessions. Both teachers state that the pragmatic nature of the in-services is an important reason for attending.

Support. Mr. C cites administrative support in the school as being a major factor in the implementation of computers for students and teachers. Computer implementation is seen as a priority according to Mr. C. Mrs. T comments that computers are made available to staff to use for evaluation and word processing. A new Mac lab was established in the school this past year and a second lab was created when the old computers were centralized in the library. Mr. C and Mrs. T comment that technical support is readily available within the school and from consultants. Both teachers also mention past or present staff members that played a significant role in terms of motivating them to implement computers in their instruction.

A MEDIA SPECIALIST'S VIEWS OF ISSUES AND TRENDS FOR CHANGE

Introduction

Mr. D, a media specialist in an urban school district, was invited to discuss some of the issues surrounding the integration of computer technology by elementary teachers in his district. Mr. D offers insight into the system's new paradigm for change and how the changes may affect the frequency and success of implementation in district schools.

Portions of the discussion have been selected and provide a summary of the key issues and trends for change facing the urban school district:

Issue 1

Outmoded Hardware

"Our problem is we still have a huge install base of Ile's and GS's. We are moving slowly towards new Macs and Windows."

Mr. D identifies the limitations regarding the potential use of outdated hardware that many elementary teachers are facing in the system. He states that the limitations of old hardware is a barrier toward any meaningful discussions about how best to integrate computers in instruction. Mr. D states that the district is moving toward the purchase of new Mac and Windows computers through the process of "rotational funding." Based on a four year rotation, schools within the system are provided funding for computers. Each school's funding allotment is adequate for the purchase of five new computers. Though Mr. D admits rotational funding isn't the answer in addressing the enormous deficit schools face in terms of replacing old hardware, it will impact on how teacher's use technology in schools:

If all they've got is a GS in the back of the room you're looking at Mac software and that's about it. The folks want to begin to use them as research tools. They want to use

them for production, either through Claris Works or things like Hyper Studio. We are slowly moving that way...

Mr. D outlines another significant step in solving what he describes as "the inevitable crisis" the school system faces as it tries to supply and fund sufficient numbers of new computers for its schools. The system is entering into discussions for a long term contract with IBM that will give the system a strategy to replace outmoded hardware which will impact computer implementation in district schools:

The school division is meeting with IBM. IBM wants to bring a total package in...they want to sell us [the division] the computers, the educational software, all the wiring, all the technical support. Once a year [the division will pay] x amount of millions of dollars [for] for the equipment ... At the end of four years they take the equipment away and bring new [computers]. I think that for us to get to a [point] where we can walk into each and every place [school] in [the district] and find a sufficient amount of equipment...we won't get this "broken front" in terms of how things [computers] are used out there [in the schools].

Issue 2

Teacher Competency and In-Service

"I think we really need to spend more time with teachers and make sure that teachers are more competent with the use of computers."

Much of Mr. D's time is spent planning and offering teachers what he refers to as "solution-based" in-service. The term solution-based refers to Mr. D's belief in delivering in-services that offer teachers a pragmatic approach to integrating computers in teaching. Examples of recent in-service opportunities for teachers includes using the computer for writing newsletters, electronic mark storage, obtaining an e-mail address, Claris Works and Hyper Studio.

Mr. D points out a limitation in current in-service strategies. Current in-service strategy emphasizes a single concept or single theme approach. It does not address the need for sustained and longer term in-service opportunities for teachers. Consequently, Mr. D feels that on a system level there is little consistency between schools and teachers in terms of their computer competencies and knowledge level. He believes that it is important to standardize the knowledge and skill levels of teachers through alternate in-service strategies:

How do you telegraph to people that it's important to get some training? I think

we have to look at some other ways of doing PD [professional development]. I think bringing people together continually may not be the future. We may need to be producing PD down here [at the Board Office] that comes out on a CDROM..[a teacher] can go through some of the steps to learn how to use a computer or some steps on how to create a newsletter. I think we need to find some other ways of doing things so it's not continually taking people out of a classroom or out of a school for a day.

Issue 3

Developing New Capacities For the Computer

"We've gone from the model where the computer is a 'solution in search of a problem'"

Mr. D is critical past implementation practices employed by the school district. The practice was to purchase computers and place them in schools with the hope that teachers would employ them in educationally appropriate ways. The past model of the computer as "a solution in search of a problem" has been replaced by a new model that realizes the potential of computer technology:

And there are a number of reasons for the change [in the role of the computer]. I think we have a different view of how computers fit into schools and into society. I think computers have a different capacity these days. Almost every computer that goes into schools these days is put into a wide area network. That gives us [the teachers] the ability not only to get the Internet itself, but also use the Internet to find distributed databases that we purchased. So we are developing computers these days as research tools.

Related to realizing the potential of computers is the school system's move toward standardizing the purchase of software. This strategy reflects a concern for better planning and implementation:

The other thing we're doing as a system is we are buying standard software for each school. Up to very recently schools were getting three or four hundred dollars [for software purchase]...there were some great things [programs] bought, sometimes there weren't. Even with the great things it was only in one school...if they [teachers] moved [from the school] they had to buy something new. So what we've tried to do is purchase software that supports the instructional imperatives that are out there. Grade Four keyboarding and upper middle years keyboarding, Middle Years computer literacy...then whatever else we want to occur as well. We're buying Claris Works. Claris Works runs almost identically on the Mac and Windows platform...so platforms really aren't an issue. We bought Hyper Studio...a multimedia production tool. All the Right Type which is a keyboarding program [it is available in] all schools. It meets our curriculum needs. We've bought World Book Encyclopedia...it is a research tool even for those [schools] that don't have access to the Internet...what we've tried to do over the past two years is put in place some software that meets the instructional needs...[the software] is standard across the system and is standard across the platforms. All the software packages that I named run identically on Windows and Mac so that if [a teacher] moves from a Mac school to a Windows school it's [not an issue].

Issue 4

Developing a Technology Plan

"We are trying to put in place some guiding principles behind educational use of

computers... "

Mr. D explains that the school system has instigated a process for the establishment of a five year technology plan. Mr. D highlights a number of components to be included in the plan:

- a. Central to the plan is the system's goal to provide "easily accessible technology for teachers and students". The computer technology will be "burden free" so that significant amounts of time is not spent learning the technology or maintaining it.
- b. A "computer-pupil ratio" level will be established along with plans of how the ration will be "supported and maintained."
- c. The plan will include "discussions with [system staff], not just [administrators] here at Central Office." Discussions will address issues surrounding technology requirements and support staff.
- d. The plan will provide answers to the question, "What is appropriate use of [computer] technology in our schools?"
- e. here will be a "continued commitment to training teachers" in the area of computer technology.

Summary of the Issues and Trends for Change

Mr. D's presentation of the issues and the upcoming trends for change suggest that many of the factors that affect the implementation of computer technology will be addressed:

Accessibility to hardware, software and technical support. The current practice of "rotational funding" for schools and the potential for a long term contract with IBM will begin to address the implementation factors surrounding hardware, software and technical support. Mr. D views the alleviation of the factors as eliminating the "broken front" as it relates to level and frequency of computer implementation in the district schools. He envisions a more equitable access to newer and well-supported technology. He sees this as changing the way teachers will use the technology in the classroom.

Professional development. Mr. D views in-service as a vital component in the process of effective implementation of computers in schools. He believes that current in-service strategies must move away from a limited single concept approach to professional development. He sees a trend towards alternate and longer term professional development opportunities for teachers.

Pedagogical issues. Mr. D sees a change in the awareness level of teachers regarding the educational potential of computers. Mr. D's view of the computer as having "a different capacity" in the educational arena suggests that teachers will develop their pedagogical capacity to implement the computer in a variety of educationally effective ways. Mr. D's outline of the district's technology plan is also related to the pedagogical issues surrounding the implementation of computers. Components of the plan, as outlined by Mr. D, include such issues as educationally appropriate uses of computer technology, technology requirements, teacher training, and support. All these components have the potential to change traditional pedagogy and teacher roles.

Conclusion

Teachers realize the tremendous potential computer technology can bring to teaching and learning. Teachers will continue to use computers in their classrooms despite the many factors affecting implementation. The challenges facing teachers in their initiative are vast and complicated and affect them on a personal and professional level. Teachers are expected to develop their technological skills and knowledge and use computers their classrooms. Pedagogical issues challenge teachers' approaches to teaching and learning and impacts traditional classroom practices.

The potential of computer technology can only be realized if educators at all levels understand the issues facing them, define the role of computer technology in education, and plan for its appropriate use by classroom teachers.

A brief look at the current trends in computer use and what can be done to begin to fulfill the potential of the technology may provide a direction for further study in this area.

What's happening now? Moersch (1995) observed a number of trends in the current use of computer technology:

- Staff development for use of computers tends to be insufficient and misdirected.
- Computer implementation is used for isolated activities and oftentimes unrelated to key instructional concepts.
- The use of the computer is often "one step removed from the classroom teacher."
- Computer technology has not effected change in schools and is used instead to sustain current curricula.

The majority of school district technology plans do not establish strong links between the technology and specific learning goals and objectives such as "emphasizing higher order thinking skills" or the restructuring of subject-specific curricula. Existing technology plans tend to "emphasize a need to meet a vaguely defined computer/student ratio or establish districtwide local area networks." (p. 1)

What can be done to change the current trends observed by Moersch? Collis (cited in Knezek, n.d., p.7) offers two important points for educators to consider when developing answers to this question.

The first point made by Collis relates to the role of the teacher and the "traditional paradigm underlying that role". Both the teacher role and the traditional paradigm must change if the full potential of the technology is to be realized and act as a catalyst for "fundamental curriculum change." The practical implications of this suggests that planning and teacher support are the first steps to be taken by school districts. The creation of a technology plan that establishes goals, learning outcomes, and strategies and that addresses all variables and issues regarding computer technology is essential (Solomon 1995, p.67). Technology should be implemented to meet the goals of education and these goals must be measurable. Evaluation of the goals would indicate the level of achievement and provide a direction for appropriate changes in implementation

strategies (Mintz 1997, p.4).

The second point made by Collis is the teacher, not the technology, is of central importance to the implementation of computers in schools. Staff development must have a curricular focus and help teachers integrate technology into the curriculum. This implies changes to current professional development strategies. In-servicing that focuses on specific computer applications outside of the curriculum does little more than teach computer skills. If authentic integration of computer technology is to occur, professional development strategies must focus on giving teachers an understanding how educational objectives can be supported by technology and how computer technology will impact their pedagogy (Sheldon & Jones, 1996; Browne & Richie, 1991 cited in Brand 1998, p.12).

Microcomputers offer exciting possibilities to advance and change teaching. It is essential that educators define the computer's role and application if the true potential of this technology is to be realized.

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Appendix A

Teacher Interview Questions

A. Background Information:

1. What is your present teaching assignment?

2. Are you currently using or have you previously used computer technology as part of your instructional process?

B. Teacher Users - Enablers and Disablers

1. Describe how you use the computer in your instructional process. (grade level, subjects, frequency of use)
2. What are some factors which enable you to integrate computer technology as part of your instructional process? What would be the major factor? Explain.

Possible ideas to be explored:

- access to computers
- availability of software
- priority in the school
- self-motivation
- support
- training and in-service
- attitudes of administrators
- personal familiarity

3. Do you use the computer to administrate or manage aspects of your teaching? Explain.

If yes... Explain. Has using the computer as an administrative tool been a factor in your using the computer in the instructional arena?

If no...what are the reasons you don't use the computer to help you administer of manage aspects of your teaching?

4. Describe any in-service, training or workshop sessions involving computer technology that you've attended through the SBE. Were you satisfied with what these sessions offered you? Is in-service an important reason you use computers in your instruction? What changes for improvement would you make to professional development in the area of the use of computer technology in the classroom setting?

5. Do you own a computer? Has this been a factor in your integrating computers in your instructional process?

C. Teacher Non-Users

1. What are some of the factors that dissuaded you from using computer technology in your instructional process?

Possible discussion points:

access problems

not enough computers

not enough time to review software

quality of software

lack of personal knowledge and skill

not a priority

lack of students' keyboarding skills

prep time

lack of support or training

not sure how to integrate

lack of administrative support

2. Do you use the computer to administrate or manage aspects of your teaching? Explain.

(Use follow up questions from #3 section B)

3. Do you have a computer at home? Has your experience with it been a factor in your choosing not to use available computer technology in the school? Explain.

4. Have you attended any teacher in-services, workshops or training sessions involving computer technology? Describe the nature of the session. If answers no...what type of in-service session might you attend that involved computer technology and might this persuade you to begin to use computers as part of your instructional process? Explain.