A CASE STUDY OF THE IMPACT OF THE USE OF INFORMATION TECHNOLOGY ON TEACHERS WORK AT THE HIGH SCHOOL LEVEL

SCOTT REID

A Case Study of the Impact of the Use of
Information Technology on
Teachers Work at the High School Level

By

Scott Reid. B.A.. B.Ed. B.VocEd.

A thesis
submitted to the School of Graduate Studies
in partial fulfilment of the requirements for the Degree of
Master of Education

Faculty of Education
Memorial University of Newfoundland and Labrador
March 1999

Abstract

This study provides new images of teachers who are pioneers in the use of information technology in the classes they teach. This study looks at teachers at a high school which is a leader in using information technology in the classroom. The findings indicate that most of the teachers participating in this study were enthusiastic about the possibilities that information technology holds for classroom use. Examples are given of how information technology is impacting on teachers' work and attitudes, professional development, professionalization, intensification, discipline, and students views of the world. Teachers insights on the future of teaching and acceptable use of technology were also examined. Ten issues were identified which could determine the success or failure of the use of information technology in High Schools. These include: maintenance, inequalities, security of school information, cost and need for training, information overload, pace of change and stress, plagiarism, control by big business, finding good software, and do the benefits outweigh the disadvantages.

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CHAPTER 1

INTRODUCTION

Background to the Study

The Internet is the world-wide interconnection of computer networks at universities, colleges, institutions, commercial enterprises, governments, and increasingly, K-12 schools. It is a global federation of 12,000 networks linking some 15 million people in 100 countries. It is estimated to be growing at one million users per month.[1]

The challenge for policy makers and educators is to recognize the changes which are taking place, adapt to the new realities, and achieve maximum benefit from the use of this new technology. Information technology has many exciting potential benefits for education, but the presence of this technology in society and its use in education holds some potential problems as well. Many (Grooler, 1986; Laver, 1989; Perelman, 1992; and Tapscott, 1998) believe that network technology will bring about systemic reform in education. The tools and services available will enable educators, students, and the public to link, share and access information as never before.

Information technology expands classroom resources dramatically by making many resources, including original source materials, from all over the world available to students, teachers, and school administrators. It brings information, data, images, and even computer software

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[1] Because of the rapid growth of the Internet it is difficult to obtain current information on the number of users. The information presented here is from Carroll, Jim and Rick Broadhead (1994) Canadian Internet handbook, Prentice Hall Canada Inc., Scarborough. The explosive growth of the Internet is documented in many of the other sources listed in the References.

into the classroom from places otherwise impossible to reach. and it does this almost instantly. Access to these resources can facilitate individual and group projects. collaboration. idea sharing. and can make available curriculum material not found in schools without Internet access.

As a hands-on classroom tool. the use of networks can be a motivator for students. Its use encourages the kind of independence and autonomy which many educators agree is important for students to achieve in their learning process (Tapscott.1998).

The Provincial Government has released a report. Technology In Learning Environments. (Newfoundland and Labrador Government. 1995). which is a project undertaken to develop a strategic plan for the integration of information technology into the teaching learning environment. the curriculum development process. and the learning resource management process of the K-12 education system of Newfoundland and Labrador. In the 1998 Federal budget (Martin.1998) the Government allocated funds towards increasing classroom use of information technology. Given these policy initiatives by both the Federal and Provincial levels of Government. further research in this area will be useful.

Significance of the Study

The purpose of this study is to get a better understanding of how the use of information technology is impacting on the work of teachers. An investigation into a school at the forefront of this area provides images and insights. related to this one location. which might be useful to others undertaking work in this area. Also. the findings would be useful to the people at the school itself. as the results of the research might provide information on how the school staff and administration can improve things they are doing or alert them to potential problems.

Many people (Grooler, 1986; Laver, 1989; Perelman, 1992; and Tapscott, 1998) are predicting that the introduction of information technology has the potential to "transform" the learning environment. At this point, the new technology is still being introduced into schools around the world. Research on what is happening in one school that is a leader in this area would provide useful information regarding the overall use of this technology for classroom teachers.

Research Questions

My main research problem or question is: How does the use of information technology across the curriculum affect teachers' work at the high school level? To answer this primary question, the following questions were investigated:

1. How has the use of information technology changed teachers work and attitudes?

2. How has the introduction of information technology impacted on professional development?

3. Do teachers believe teaching will change in the future because of information technology?

4. With regards to professionalization and teachers' time, what impact has information technology had?

5. Has the introduction of information technology had an impact on school discipline and students' views of the world?

6. Have there been any problems with acceptable use?

7. Are there other problems which could result from the use of information technology in schools?

CHAPTER TWO

REVIEW OF THE LITERATURE

Teachers' Work and Attitudes

Many writers (Neisbitt & Aburdene,1990; Tapscott & Caston,1993; and Toffler,1990) put forward the case that as a society we are currently entering a period of technological and social change which will bring about major alterations in the way we work and live. One of the main agents for change is information technology and the Internet. A statement by Tapscott & Caston (1993) is typical of the explanation many give of what is happening in the world:

> While many complex and significant technical issues must be overcome, the research showed that the main difficulties were not in the area of technology. Rather the organizational structures for managing computing, along with the knowledge skills, resource base, approaches to systems planning, and even organizational culture, were being challenged by the era. Moreover, the basic nature of business operations which have been essentially unchanged for decades needed to be questioned. (p. 26)

Toffler (1990) uses the term "Power Shift" to describe the shifts happening in society as a result of the new significance of knowledge and technology has in relation to power. While writing about the future and social change, he has placed these present happenings into a historical context from agricultural, industrial, to knowledge based societies. Many references have been made in the news media and business journals[2] about how technological changes are now changing the way many

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[2]Many television programs, such as CBC News World, Future World focus on this issue. Popular magazines and newspapers such as Time, News Week, Fortune, Business Week, National Geographic, the Globe and Mail, the Financial Post and many others have had special issues or cover stories on information technology.

people live and work.

> In the information era, the currency of choice will be computers and the networks that link them. ... In the new economy, there will be no hierarchy, everyone will have equal access to the source of power: information. ...Just as the highway system and the electrical power grid formed the infrastructure for the old economy, information networks will be the arteries of the new economy. (1994, July 2)

Rawlins (1992) relates the changes brought about by the Internet and information technology to what happened as a result of the invention of the printing press. He sees the data highways, connecting schools, colleges, universities, researchers and industry, as helping start a society wide revolution similar to that which resulted from the invention of the printing press.

> The last time something this radical happened was in the 15th century when the printing press used the newly available cheap paper to take over the manuscript market, throw scribes out of work, and explosively increase the number of available books. Print led to pagination, indices, and bibliographies since they were now possible and they made searching easier. And that forced people to learn the alphabet so that they could use the new indices. Print increased literacy, democratized knowledge, increased accuracy, made fiction possible, made propaganda possible, created public libraries, and created the idea of authorship. (p.5)

One major difference in the evolution of the Internet and that of printing is the speed at which the change is happening. These society wide changes which are being predicted can be expected to have a tremendous impact on teachers' work and attitudes. Tapscott (1998) outlines eight shifts which he believes educators and students need to make if they want a more powerful and more effective learning paradigm. These shifts are: from linear to hypermedia learning, from instruction to construction and discovery, from teacher-centered to learner-centered education, from absorbing material to learning how to navigate and how to learn, from school to lifelong learning, from one-size-fits-all to customized learning, from learning as torture to learning as fun, and from teacher as transmitter to teacher as facilitator.

The Future of Teaching

There are diverging views on how these changes, in technology and in society, will affect the future work of teachers. Some see technology as a blessing, others see it as a curse. Perelman (1992) is one who sees these new technologies totally changing the way schools are organized. The following statement shows the nature of the changes he foresees:

> For a technological revolution is sweeping through the U.S. and world economies that is totally transforming the social role of learning and teaching. This learning revolution already has made the "classroom teacher" as obsolete as the blacksmith shop. (p. 20)

He sees the new information technology ushering in a new era of "hyperlearning" and the end of education as it is known. According to him this is a very positive development which holds virtually unlimited potential. Salisbury (1996) also sees classrooms as being obsolete and not suited to meeting the educational needs of students in the future.

> We sometimes hear the phrase "using technology in the classroom." In fact, this idea is counterproductive simply because the classroom is a technology - a technique designed for a learning age when the teacher was the dispenser and source of all knowledge. To facilitate this role, we designed the self-contained classroom, put the teacher's desk and a chalkboard in front, sat students in rows, and organized them into groups that met for the same amount of time each day and moved on to the next class at the sound of a bell. This technique (or technology) served us very well for a period of time. But today's computer and telecommunications revolution is spawning an educational crisis. The classroom method of educating students has become obsolete. It is simply not able to provide the individualize, high speed, customized education that is now possible and essential. (p.188)

He presents the possibility that classroom learning may be suitable for some kinds of learning. The change process happening in education he thinks is quite natural, similar to what has happened to other things like the steam engine, the kerosene lamp, and the horse-drawn carriage. He gives a description of future schools that are very different from those of today.

> In the future, schools may consist of learning labs designed more along the lines of a modern automated office environment rather than classrooms designed for teacher delivery of

instruction. There may be labs designed for traditional, discipline-oriented learning (such as biology) or for cross-disciplinary, problem-oriented activities such as space exploration, natural resources, and creating inventions. The teachers would be responsible for helping students put together an individualized program of study that represents the core curriculum requirements and also considers each student's interests and goals. The teacher and the student monitor the student's progress and use acceptable norms, benchmarks, and standardized tests as reference points. Resources would be allocated to the labs based on usage. (p. 196)

Another item he raises is the possibility of on-line home schooling. He notes that there is already a significant trend towards home learning. Also, private sector companies are preparing to service the home schooling market, providing curriculum by subscription and developing educational software.

> Tapscott (1998) also thinks education as we know it will change; he says,

> Given the growing evidence that interactive media can dramatically improve the learning process, clearly teachers will need to change their role. Rather than fact repeaters they can become motivators and facilitators. (p.154)

He gives an example of a teacher who is using information technology in the classroom and explains how it changes the work of teachers. The project involves students working in teams to find answers and resources related to their project. "The students learn to cooperate, work in teams, solve problems, and take responsibility for their own learning -- by doing" (p. 155).

> Heterick and Gehl (1995) say the real question for educators in the future will not be about hardware and software, because these problems will have been solved, but will be about the ancient issues: semantic, rhetorical, philosophical, and scientific.

> By the year 2020 higher education will be well past the point of seeing information technology as an accretion to the historical way of doing business and will be using the technology to radically change the way society learns. Just as other sectors of our economy have seized the opportunity to expand their service areas from local to national to international, so will higher education. (p. 25)

> Postman (1995) has a very different view. He sees many dangers in placing too much faith

in the "god of technology"(p. 47). arguing that new technology may be useful for teaching facts, but it works against the learning of social values. He points out that many of the problems facing the schools of today and the future can not be solved using new technology. Stoll (1995) questions the high cost of technology and wonders whether the money would be better spent on hiring more teachers or buying more books (p. 117). He also reflects upon the limitations technology could place on teachers:

> Think of how teachers must feel, surrounded by kids behind computers. They don't see the smile on a child's face when she suddenly understands a point. They can't tailor their classes to reach those bored students in the back. They miss the recognition from parents of having done a great job. Instead, the credit goes to an inanimate silicon chip. Still. I'll bet I know exactly where the blame falls when things go wrong. (p. 142)

Teachers would no longer be required to use their professional skills and they would not be given the rewards that come from helping a student learn. Information technology would make teachers work less satisfying.

Professional Development

Tapscott (1998) concludes that because children have grown up using the Internet -- "the net generation"-- there will be a shift from broadcast learning to interactive learning. He says historically the field of education has been focused on instruction, a one-way, centralized, broadcast with an emphasis on predefined structures. The new technology will make possible interactive learning which will give the learner more control over the learning experience, thereby changing the role of teachers. He sees this as a challenge for the education system:

> Needless to say, a whole generation of teachers need to learn new tools, new approaches, and new skills. This will be a challenge -- not just because of resistance to change by some teachers, but also because of the current atmosphere of cutbacks, low teacher morale, lack

of time due to the pressures of increased workloads, and reduced retraining budgets. (p.149)

Some of the research done related to the Apple Classrooms of Tomorrow (ACOT) Project

point to the importance of professional development if the use of technology is going to be

successful in schools. This project, which began in 1985, involved the computer company providing

computers to various schools as an experiment. In a report on the professional development aspects

of this project, David (1996) makes some observations:

> One overarching lesson from the original ACOT classroom is this: to help teachers
> incorporate technology in ways that support powerful instruction requires an array of
> professional development experiences quite different from traditional workshops and how-to
> training sessions. Rather than focusing on technology per se, these requisite experiences must
> focus on changing pedagogical beliefs and practices, with technology as a tool when
> appropriate. (p. 238)

After 10 years of the ACOT project, policy analysts were saying that for the use of technology to be

successful, 30-40 percent of the total effort would have to be on training and staff development.

Yocam (1996) also provides an examination of professional development among ACOT

teachers. He observed the difficulty teachers had integrating computers into the work they do.

> It's one thing to help a teacher learn how to use a computer and software. It's quite another
> to help teachers broaden their repertoires of teaching strategies to include constructivist
> approaches that incorporate the use of technology. (p. 268)

In the early years of the project during follow-up visits to classrooms of teachers who had

participated in workshops, he noticed that teaching strategies had not changed much. Over time

gradual changes became noticeable. He concluded that to challenge their professional beliefs about

practice, teachers need sustained support:

> What we knew was that when we introduced technology to ACOT teachers, the old ways of
> doing staff development didn't work well. When we thought about what did work, it always
> seemed to involve the teachers in conversations about change and reflection on their practice.
> (p. 272)

Wallinger (1997) explains that there are many pressures on teachers to adopt the use of technology but generally very little attention is given to the need for professional development. She also makes note of some of the difficulties in designing professional development programs to service this field:

> A growing problem is the disparity of ability and experience among the participants in training sessions. Another difficulty for teachers is the sheer speed with which technology is developing. New products evolve so rapidly that one can scarcely learn a given software application before an upgrade is released. (p. 19)

Professionalization and Intensification

Some researchers see potential problems developing if the use of technology in schools becomes seen as a substitute for good teaching. Apple and Jungck (1992) talk about how, in many cases, the de-skilling of teachers results from the use of technology:

> The skills that teachers have built up over decades of hard work -- setting relevant curricular goals, establishing content, designing lessons and instructional strategies, community building in the classroom, individualizing instruction based on the intimate knowledge of students' desires and needs and so on -- are lost. (p. 23)

They use the example of "Curriculum on a Cart" -- package programs which diminish the role of the teacher -- to illustrate many of the problems that can result from the use of technology in the classroom. They see this as a major problem for they argue that it requires teachers to become less of a professional and more of a technician. Noble (1998) puts forward a similar idea in relation to what is happening in the field of post-secondary education. He thinks the trend towards the use of technology robs faculty of their knowledge and skills, eventually leading to a loss of control of their working lives. He believes that the conversion of courses to courseware will result in "digital diploma mills".

Once faculty put their course material online, moreover, the knowledge and course design skill embodied in that material is taken out of their possession, transferred to the machinery and placed in the hands of the administration. The administration is now in a position to hire less skilled, and hence cheaper, workers to deliver the technologically prepackaged course. (p. 25)

Hargreaves (1994) examines many of the pressures on the teaching profession during these changing times. He explores aspects of teachers work such as: time, intensification, emotions, and collegiality in the context of change. He asserts that driven by concerns for productivity, accountability and control, the administrative tendency is to exert tighter control over teachers' work and teachers' time. He describes intensification as leading to reduced time for relaxation, lack of time to retool, chronic and persistent overload, and reduction in quality of service because of corner cutting to save time. He gives specific examples of the many demands on teachers' time based on examination of cases presented by experienced teachers and education professionals.

If there is a single thing that teachers always need more of, it is time. There just never seems to be enough of it. Getting through the content, hearing all your students read, writing reports, keeping up to date with marking papers, learning new computer skills, trying out a new teaching strategy, cooking a proper supper once you get home - there do not seem to be enough hours in the day to get through all these things. (Hargreaves, 1997, p. 79)

He goes on to describe teaching as a "caring profession", an "endless job that is never finished", where teachers are "always haunted by feelings of guilt and inadequacy".

Bruno (1997) also recognizes the importance of teachers' time as a factor in any changes happening in schools.

Because time is needed by classroom teachers to earn a living, develop relationships, and develop themselves, questions regarding teacher participation in reform and change over the career of the classroom teacher are fundamentally a matter of time. In short, school reform and change is fundamentally about time, and the cost for school reform is not about dollars but about extra time taken from the lifetimes of teachers. (p. 39)

He also notes that some teachers are reluctant to spend time on technological change because of the

constant pace of change and the unfulfilled promise of classroom benefits by earlier technology.

> Because new instructional strategies, updated curriculums, and technological innovations are highly information based, some school reform efforts require a conscious effort on the part of individual classroom teachers to invest time out of their lifetime (usually at home) to seek this information. The added investment of time that school organizations require from teachers outside of the school setting, or "keeping up" time, is another time burden that many teachers resist. (p. 83)

Discipline and Students' View of the World

Some critics of the use of information technology in schools point to problems with regards

to discipline and improper use of such technology. Stoll (1995) found that computers can be a barrier

to close teaching relationships. He claims it is easier for students to "goof off" when technology is

used in the classroom; that many students use information technology to escape from the real world:

> No surprise that children don't develop good response mechanisms for threatening behaviour in the real world. We can't pull the plug on the bully down the street or the jerk that we have to work alongside. Computers teach us to withdraw, to retreat into the warm comfort of their false reality. Why are both drug addicts and computer aficionados both called users? (p. 136)

He also gives examples of astronomy students who study star charts on computer disc or students

who study about the environment by chatting to someone online rather than going outside and

experiencing the real thing. Stoll (1995) concludes that students are learning that the world is "a

passive preprogrammed place"(p.147).

Postman (1995) expresses a similar view. Writing about the use of information technology

as a motivator, he says:

> We are presented with a student who is "bored with the real world". What does it mean to say someone is bored with the real world, especially one so young? Can a journey into virtual reality cure such a problem? And if it can, will our troubled youngster want to return to the real world? (p. 41)

These criticisms of the use of information technology in education, if valid, would be influential factors in determining how teachers use information technology or if they use it at all. Weinstein (1997) also recognizes the limitations of computers to interact with students on an emotional level.

> To design computer technologies with the emotional needs of students centrally in mind is a tall order. The dominant psychology undergirding the emergent field of Human-Computer Interface design is still a cognitive psychology which rarely takes into account how emotions cloud or illuminate thinking. As long as the primary input device to student computers is a keyboard - not an instrument sensitive to emotional currents - there will be no easy way for a computer to respond to the emotional needs of its user. (p. 54)

He does not, however, think that this is impossible and he refers to the shift from the computer as a calculating machine to a simulation machine. He says, the fact that students play with technology shows the possibility that it holds as a teaching tool. Teachers should be asking themselves how the Socratic form of education can be "technologically recasted".

Acceptable Use Policy

There has been some discussion in the mass media of the problem of children accessing inappropriate material through the Internet. This is an issue which has been raised as Internet access for students at school becomes more and more common. Stoll (1995) says teachers and school board officials still do not spend as much time reviewing material that children have access to through the Internet as they do reviewing textbooks and library material. He says there is little to prevent students from accessing sexually explicit material or instructions on how to construct a bomb. He also notes that there are no regulations with regards to online content for advertising. He asks, "How long before kids download animations of dancing cigarettes" (p.135)?

Tapscott (1998) points out that despite sensationalist news coverage of cases of child predators using the Internet, statistically most of the abusers are members of the victims' own family. He recognizes the potential problem of acceptable use but does not advocate government regulation:

> The possibility of children accessing material inappropriate to their age is certainly one of the most controversial aspects of the Internet, and understandably so. We don't want young minds corrupted. But the strategy each family adopts for dealing with this issue should be of its own making, not some solution imposed from on high. (p. 243)

He notes that many children are coming home after school to empty houses because of changing family patterns and recognizes that this is a problem. He suggests that the solution for some might be using the presence of inappropriate material as an opportunity to be a good parent, to share values and create open relationships.

Conclusion

Very little research has been done on the use of information technology across the curriculum in Newfoundland high schools and how its' use is changing the work of teachers. The review of the literature reveals it is necessary to further explore the questions raised. Research directly related to the implications for teachers' work and attitudes is very sparse. However many writers claim information technology is bringing about wide ranging social change. Further research into the effects of information technology is impacting on the work and attitude of teachers is necessary. Divergent views exist on how the use of information technology would impact on the future of teaching. Some see information technology bringing about an era of unlimited potential in education while others see the use of technology being misguided and problematic. The teachers interviewed in this study are in a position to offer insight that will aid in the development of a clearer

understanding of this issue.

The use of information technology also raises many issues in relation to professional development. Research done indicated that professional development for teachers was a critical factor in the success of the introduction of information technology into learning environments. Because of the findings of these other researchers which place great importance on professional development further research into this area is warranted.

Some critics argue that information technology will reduce the level of professionalism of teachers. similarly, critics argue that rather than enhance the personal or professional lives of teachers, information technology will demand inordinate amounts of time from teachers. Research is needed to substantiate or refute such claims. Based on the concerns of some critics of the use of information technology in the school, plus the discussion in the mass media of discipline problems and problems with acceptable use, questions were asked to gain information on these matters as it relates to this school. This study provides new images of teachers who are pioneers in the use of information technology in the classes they teach.

CHAPTER THREE

DESIGN OF THE STUDY

Methodology

The purpose of this study is to provide insight into how the introduction of information technology changes the work of teachers at the high school level. A qualitative case study research method has been chosen because it best suits the requirements of such an investigation. By examining in depth what is happening at one of the leading schools in this area, I was able to gain insight into the impact this technology is having on an individual school and the teachers who work there.

Qualitative research deals with multiple, socially constructed realities or "qualities" that are complex and difficult to divide into discrete variables (Glesne and Peshkin, 1992). In this case, the research task is to understand and interpret how the various participants in a school see the introduction of information technology impacting on their work. An interpretation will be drawn from the perspectives of the participants. As Miles and Huberman (1994) say:

> Qualitative data, with their emphasis on people's lived experiences; are fundamentally well suited for locating the meaning people place on the events, processes, and structures of their lives: their "perceptions, assumptions, prejudgements, presuppositions" and for connecting these meanings to the social world around them. (p.10)

The philosophical groundings of the qualitative approach to research is usually based on two factors (Bryman, 1988). First, some questions in relation to the social sciences are fundamentally different from the natural sciences and to understand people and their social realities requires a different method. Secondly, often attempts to understand people and social situations are based on

a study of people's experience of that social reality. There are many characteristics of qualitative research which make it suitable for investigating the use of information technology in schools. Teachers will be able to express their point of view or perspective on what is happening at the school. The context in which events are taking place will be presented and taken into account. Also, the various items and how they are interconnected and changing will be taken into account. Qualitative research tends to favour a strategy which is relatively open and unstructured rather than a rigid, predetermined frame of reference. This flexible research structure provides opportunities for the researcher to discover unexpected issues which may be of importance to the study.

The openness of qualitative methods allowed for an in-depth examination of the situation being experienced by teachers at this high school. As Glesne and Peshkin (1992) say of the qualitative method:

> Qualitative researchers avoid simplifying social phenomena and instead explore the range of behaviour and expand their understanding of the resulting interactions. Through the research process, they assume that social interaction is complex and that they will uncover some of that complexity. (p. 7)

Data Collection

Requests were made to interview the principal, vice-principal, and all teachers at a school selected because of its national reputation as a leader in the application of information technology in teaching across the curriculum. The school and the staff at the school have won many awards for leadership and excellence in education. Conversations with officials in the Provincial Department of Education and members of the Education Faculty at Memorial University of Newfoundland also confirmed that this school was a leader in the area of information technology. The school has 38

teachers and offers grade 10 to 12 to 650 students. With the permission of the School Board and Principal, written requests to conduct interviews were made directly to all teachers at the school. Thirteen teachers, from various subject areas, responded to the request and interviews were conducted in person at the school at a time suitable to the participants. Interviews lasted from 45 minutes to 1 hour. Each interview was recorded and transcribed verbatim by the researcher for analysis.

The questions used in the interview protocol were developed based on a review of the literature on this topic. A pilot test of the interview guide was conducted with one teacher in order to establish the clarity of the questions as well as the time frame for the interview. Follow up questions and prompts were used to encourage participants to share their information and experiences.

Analysis of Data

All interviews were transcribed, then coded by categories used in the interview protocols and other categories which were added as a result of information raised during the interviews. The data files were then sorted to produce new data outputs arranged by coded categories. This sorted data facilitated a more complete analysis of the collected interview data.

To improve the credibility of the study, a summary report which included a copy of quotations used was compiled. All teachers were able to verify the findings and all those who were directly quoted were given an opportunity to read the section in which they were quoted to verify accuracy. To insure authenticity, all direct quotations have been cited as transcribed from the oral interviews. No attempt has been made to edit any of the dialogue.

Ethical Considerations

Signed consent forms were obtained from all involved in the interviews. The signed copy was kept and a copy was given to the participant for future reference. Participants were informed of measures taken to ensure anonymity, such as the use of codes rather than names in interview transcripts. The participants were informed of their freedom to withdraw from the study at any time and or refrain from answering any questions they preferred to omit. It was made clear to teachers that the interview was not an evaluation of their performance as teachers. Rather, the purpose was to obtain information and insight into how the introduction of technology has changed their work. To protect confidentiality, the name of the school has not been used.

Schedule

Initial contacts was made with the school in March 1998 and first interviews arranged with teachers as early as possible after permission was received. After that, transcription, analysis and writing occurred through the summer of 1998. Participants were provided with a report of findings and copies of quotations used to verify findings in October of 1998.

CHAPTER FOUR

FINDINGS

Teachers' Work and Attitudes

Effects on Teaching

Teachers were able to give many different and specific examples of how technology had changed their work. One teacher explained that the use of information technology has made a dramatic change in his teaching:

> I use several different things; the Internet is one. I make my own web sites for people to use, so I have been using that to take my curriculum and present it in a way that is most useful for me. So I design my own stuff because I find there is nothing out there made just for me. So you can make your own and it is fairly easy and I've used it fairly successfully to do a couple of things and I am continually expanding upon that.

This is a trend which he hopes to continue next year by offering one course almost entirely as a web based course. The teacher says there are a lot of things which can be done through a web site, from giving students notes which he says is a "low end thing", to getting students to create their own web pages. Another use he has found is using a web site to enhance an actual field trip.

> I have a field trip that I do on-line. It takes them through a field trip to the inter tidal zone before they actually go there. So they see all the animals, all the stuff we are going to do before there, and it makes the trip run more successfully or more smoothly. We go to the inter tidal zone and do exactly what I have been training to do with the web site.

The web site introduces students to the animals and tells them what they are going to be doing while on the field trip. It shows them techniques they can use to analyze the ecosystem and record the data. The teacher explained that this type of preparation is important because the field trip is scheduled for a one hour period and that would not be enough time to teach students what they

need to know to make it productive. To get the most out of the trip, "they have to go out there and know it and go out there and just do it." The prior preparation through the web site assists students to benefit from the actual field trip.

Teachers report that many of the projects and assignments that are assigned involve the use of technology.

> If they are not doing a science fair project they have to do a project for me where they have to research a topic on the Internet, evaluate web sites and then give a Power Point presentation on them, on the topic that they have chosen. That is, if they don't do a science fair project - those that do a science fair project also have to search the web for information and ideas. We guide them along with the science fair page that we made up. We made this science fair page that gives a structured go through of the project, exactly how we want it for the science department. And the other term project, actually, there is another structured page, tells them exactly what they have to have done for every part of the project.

A teacher reported that having web sites outlining projects and assignments improves students accountability. Besides presenting the material in class, it is also on the net and the expectation is given that if they don't access the material, it is their own fault.

Some teachers use information technology in preparing for class. For example, one teacher used a video camera and taped material for students to use for various projects. Also, because the material which is available on CD-ROM and other packages are of low quality or do not meet the classroom needs of teachers, some teachers repackage existing material, customizing it for their class.

> Stuff you can make yourself is always better, I think, and if the students make it and they make it from dissections and stuff like that ... from the field trips that they do, you know, as far as I am concerned that is the way to go.

In the future this teacher is aiming to increase the use of the Internet as a teaching tool by doing some video conferences and undertaking projects with other biology teachers and students

from around the world. One idea he has is to create a Biome web page where students from other countries contribute pictures of their neighbourhood and their surroundings. Students from this school would be able to post pictures of icebergs, the inner tidal zone and the Tiga to show the uniqueness of this part of the world while students from other countries could e-mail attached files of their environment.

Another teacher makes extensive use of software programs to help teach physics. The students use Verner software and conduct 90% of their labs using computers. The students go into the laboratory and collect their data using the computer. Then they use word processing programs along with Excel to do graphs and presentations. The software allows the students to collect different kinds of data using various attachments that are plugged into the computer. The teacher explained that the technology could be used to help students better understand abstract concepts, such as motion.

> I find it very useful because they actually ... get their hands on it and motion is a very abstract topic but they can actually get their hands on it and have a look at it on the machine. So they love doing their labs with these computers and we use them all the time.

This same teacher explained that before the use of computers with photo gate attachments, which allow the computer to automatically record distance verses time and provides the information on the screen in the form of a graph, students would have to record data using a piece of ticker tape and do a graph after counting the dots. Using computer technology, students have more time to explore beyond the mechanics of counting dots and setting up the experiment. It actually lets them look at it and understand the concepts better.

> The students get into, you know, dropping objects down through the photo gate and "what kind of graph does that produce?" as opposed to, "If we slide it along the surface of the bench, using surfaces that have more or less friction". [This] gives them the freedom to do

a lot more because if I had asked them, using ticker tape, to do different surfaces, you know, "drop it, speed it up, slow it down", it would take them about four class periods to do it.

The use of computers is seen as allowing students to get into more meaningful work and it takes away the tedious work, freeing up time to concentrate on what the content means.

What happens if we make the cart go faster? How does that change the look of our DT graph? What if we push the cart in the other direction, what if we drop the cart? All these, so they go from lower curves to steeper curves back to steeper lines to curves to straight line sections for when it is not moving. All these kinds of things that they can interpret. It, in my opinion, it is much better.

This teacher was making plans to use technology even more in the future. In upcoming years she plans to have students search the Internet for information related to social policy issues that have a science component. For instance, students might be asked to gather information on a topic like the use of air bags in cars.

Another teacher made the point that resource-based teaching or resource-based learning is almost becoming "seamless, almost natural" in everything that teachers do because information is becoming easily accessible. Teachers and students can do research themselves and they can set up web sites where they can build a collection of items, making it easier for teachers to direct students in the research part of the subject area. This teacher thought there was still much potential yet to be developed in relation to the use of web sites in teaching. He explained that he already puts tests and homework online and archives them so students can go back a month or two later and look at things. The teacher pointed out that there are many advantages to putting information online: the storage is there for as long as it is needed, access is easy, and material can be updated quicker than with most other mediums.

Several teachers mentioned that they used Power Point and other computer programs to

improve their presentation of material to class. One teacher explained that by having specific

technology, the teacher can deliver more materials to students. For example, in mathematics, the use

of graphing technology, and graphing calculators as well as the delivery of other material have been

enhanced through the use of new technology. A math teacher said,

> There are topics I can broach with kids with those [new technologies] and explore that
> [which] would be very difficult using symbolism. So there are some things I can now do
> efficiently, that I could not efficiently do with the old choices.

Another teacher noted that the delivery of material in class eliminated a number of basic

problems faced by teachers who rely on the use of chalkboards, such as: poor hand writing, poor

artistic skill, contrast, lighting, and visibility. The issue of being able to see and understand the notes

is also taken care of and as well, classroom time is saved because information is prepared before

class. One teacher noted that the technology does not let teachers skip or omit any of the concepts,

it just helps them introduce new things, and time is not wasted drawing graphs or diagrams. Noting

the importance of keeping students interested, this teacher said he had always tried to come up with

a good presentation product and technology is just part of that.

> So if things are well laid out, if things are eye catching, if things are colourful, it makes a
> huge difference, and the classic example, is I know you remember watching a professor
> draw, draw like a galaxy. How meaningless is that, to draw a galaxy with a stick of chalk.
> I mean, that just doesn't cut it. Then, to see the best picture we can come up with of a
> galaxy, today's picture, like what M100 looked like today from the shuttle -- from the space
> telescope rather -- you can't get a better picture than that.

Many of the teachers mentioned that a French class at the school had recently done some

video conferences with a class in France and indications were given that this was something which

many other teachers would like to pursue. A member of the administration noted that the school was

going to be partnering with two other schools in the province to explore interactive video related to

art, theatre, drama, public speaking, and other areas.

A learning resource teacher explained that the traditional way of using the library with just print sources has become a thing of the past. Students automatically use the Internet and various software packages to get information for their projects. As well, teachers are more inclined to look for information they need using technology than they are in searching printed text. This has meant that the computer lab is a very busy place. Sometime the learning resource teacher has to set priorities and decide who gets to use the computer. "if you are working on a school project I will bump somebody off who is just sending an e-mail or just surfing the net a little bit or whatever."

An enterprise education teacher pointed out that there were a lot of resources available on the Internet for teachers and students. Students use web pages from various career centres to help with preparation of resumes, development of personal skills awareness and skill sets, preparing personal inventories and writing cover letters. Also, in preparing classes, it was noted that the Internet reduces the time and effort required to gather resources from various banks and government agencies. Because of the ease of access, the variety of information available to students is much richer. However, this teacher cautioned that students have to be given the proper instructions on how to use the Internet, or it can result in a lot of wasted time.

Students in the enterprise education class use information technology in very practical projects such as doing a business plan.

> So they do research and they go to the different business development banks. They have to do finance, so we have a number of different programs on-line, like the Toronto Dominion Business Planner, or the Scotia Business Planner; a number of CD ROMS that they can access to help them do their finances; and different sorts of spreadsheets and stuff for that. And when they do their research, there are all kinds of federal government and provincial government assistance online for young entrepreneurs and business developers.

An industrial arts teacher now uses the computer to search the net for information on building projects, building codes, electrical projects and things related to home maintenance or buildings. In the future he would like to have students using computer programs to design a project and then make it.

The music teacher said that technology was beginning to change her work but because there was need for additional equipment adapted for music teaching, it had probably been a little bit slower than in other subject areas. She thought one of the positive things about the use of technology was that it would give her more flexibility in addressing individual needs and allow her to address the different levels and needs in the classroom. Another thing she has noticed is the easy access to resources on the Internet for students to use. The students can find and download material to help them pursue their interest. She explained that there is some interesting software which allows students to experiment with different instruments and styles. She gives the example of one program which allows students to arrange music and conduct an orchestra.

A teacher who focuses on special education and literacy noted the motivational aspect for students when they see their finished product come off a laser printer. She also noted that using information technology helps her keep up to date with current research in her field because of the ease of access to information. The technology also helps her to do individualized programs for students. The use of technology can help students with different learning styles. Using CD-ROMs and other software, a teacher is able to stimulate all five of the students' senses. However she noted that there is still a lack of good software for some subject areas. She also explained that it takes a lot of work to bring technology into the classroom and use it to develop a valid learning environment: "You have to have a lot of ideas and you have to be very creative". For instance, before students go

online to look for information she requires them to have their purpose outlined and narrowed down well enough so they are actually looking for specific information.

Only one teacher did not use information technology in class and considered it too time consuming for use during class time. This teacher says there is only so much time available and using computers would just be adding something else that was not particularly user friendly. The main problem for this teacher is that the material is not available in a way that would make it easily usable in class. In the final analysis this teachers says, "I've got only so much time and so much interest", and the use of information technology in class is, "not something that I would pursue at this point". For this teacher the use of books, pencils and paper are just as effective in building general knowledge as the use of information technology.

The Teaching Relationship

Teachers reported that the relationship between teacher and learner is sometimes reversed with regards to information technology. Many teachers mentioned that they had students show them how to use technology.

> People who became learners, who hadn't been learners in a long time, they were finding kids in their class that knew more than they did. I remember learning how to download a file from the Net only a few years ago and a student showed me how to do it. I said, "What are you talking about, downloading files, show me". So he showed me. Cool. I didn't know you could do that and it just steamrolls from there. And now there is, in this school, if you really seek people out, stop, and ask them you will find, you will find people who could easily walk into industry and scare people with what they can do.

Another teacher made a similar comment noting that teachers had little choice but to accept that students often knew more about some technology than teachers.

So we can either stick to our traditional way of doing things and the kids are running past us because they are into it anyway, regardless if we are showing it to them or not. So we can do that or try to keep up with it. And I find it is a learning experience for me as well as for the student and a lot of times if I am spending a bit of time trying to update my homepage and add some links and so on and there are certain things I am not sure how to do. But I could easily open the door and ask a student and say, "I'm not quite sure how to do this" and he will come in and show me. He knows, or she knows, how to do it, and they can show me.

One teacher commented that when students were able to help teachers it gave the students a big confidence boost. Some teachers went as far as to use terms like co-learners to describe the new relationship between teacher and student.

There is a recognition that we're all going out one way, we all came one way, and we should all make the best of what we have got while we are here. If you know more than I do and if I need to know this, I will probably ask, and you should ask me and it becomes much more reciprocal. IT is the great equalizer here.

Technology is seen as " a great equalizer" by this teacher, forcing everyone to rethink their role as learners. This, he expects, will be the biggest single social change over the next ten years.

A point raised by many teachers was a feeling of rejuvenation created by the presence of information technology. A teacher expressed the view that because of the introduction of technology the 90's has been a tremendously challenging and exciting period for teachers.

I see it as it has given new meaning to the word "lifelong learning" and I doubt if you will find a teacher today who would not say they've been impacted, they have been affected and I doubt if you would find a teacher today who would say that lifelong learning has not gained a new significance for them personally and, along with learning new things and along with gaining new skills, I think there is a rejuvenation. To me, it is exciting. I mean, as a teacher, don't you love learning new things? Don't you love gaining new knowledge?

Another teacher thought that society in general was going through a period of awareness raising and because of that they questioned and recognized more the value of life. He describes his own feelings.

I'm more reinvigorated now. I enjoy my son more. I enjoy everything I do more because I am a more active learner. A lot of people here are like that. I think that will begin to happen. It probably already is beginning to happen. It is certainly already happening among kids that come through this place. and it will affect society over time.

One teacher connected the rejuvenation of teachers and the benefits this was having on students.

> You know, I see technology as having a very positive impact on education. I think it has been the stimulus for change and for learning within the school and as a result of seeing so many teachers learn. I think there is an attitude, a new attitude, and that new attitude has been shared with students.

As a result of this change, the teacher said he saw a lot of dynamic environments starting to develop where there is much sharing between teachers and between departments that didn't necessarily occur before. As a result of this, the organization as a whole, he thought, was learning more and learning faster and had a higher capacity to handle change than five or six years ago.

Some teachers thought that a new attitude about learning and the ownership of knowledge was developing. One teacher noted that people are more accepting of the fact that you are not going to know everything and that there are things you can learn from anyone. Another teacher noted that if a teacher was afraid to ask a student to share knowledge with them by showing them how to do something, then the teacher must have a self-confidence problem: "Sharing knowledge is just that, sharing knowledge," and "we have to change how we pursue knowledge ownership." Most teachers liked the new role they were playing as teachers. One teacher said students didn't see the teacher as "the guy who makes you sit up straight in your desk. with the rows neatly lined up and all those old fashion ideas about school."

Administration and Preparation

The use of information technology has changed school administration in several ways. One teacher explained that when she started teaching six years ago, it was not expected that teachers know how to type their own test. Now teachers are expected to know how to use word processors and have their test done in a proper format. Several teachers noted that there is a move toward totally electronic grade keeping. Next year, in this school, school attendance will be kept electronically. Several teachers mentioned that this format was much more convenient for them because they did not waste time physically carrying records down to the main school office. Other teachers expressed concerns that for teachers with no or limited technology skills, it is going to be a steep learning curve to keep up with these changes. Other teachers see this as a transfer of work that would usually be done by administrative assistants to teachers and the consequence is to make teachers busier. Another consequence of teachers being asked to do this additional work is that teachers are more demanding with regards to having the adequate equipment needed to do the work.

Another change noted by most teachers was the change in internal communications avenues. Teachers are expected to check their e-mail, and a lot of things that used to be done at a staff meeting are now done via e-mail. Some teachers thought that there might be problems because of the different comfort levels with dealing in technology.

> And so you know there is connectivity issues there because sometimes there are teachers that aren't in that loop and are not getting communicated to because others are making assumptions. So there are all kinds of subtle impacts of technology on teaching.

A member of the school administration estimates that 90% of the teachers are frequent users of e-mail and it is a popular form of internal communication although he noted that the school is still small enough to be able to use face-to-face contact as well as e-mail to keep in touch. Some teachers

commented that the length of staff meetings have been shortened because of the use of e-mail, and

another teacher commented that the meeting could be cut in half again if all teachers read their e-

mail. E-mail is also becoming an important communications tool between parents and teachers.

Parents e-mail and set up appointment to talk about their child's examination report, for example.

For administrative things such as scheduling, tracking students, evaluation, and finances, the

school uses a program called Winschool. They use spreadsheets called monthly returns to look after

the attendance records. Individual teachers also use information technology for record keeping

related to calls home, grades, and individual progress reports.

Teachers involved in courses like enterprise education or cooperative education noted that

information technology was very useful in doing the administrative duties associated with these

teaching positions. For example, they used it to produce letters, mailing lists, design invitations,

design agendas, pamphlets, and other promotional materials.

Also, several teachers noted that web pages on the Internet are a way of providing people

with information on what is happening in the school and allows for a level of accountability on the

part of the school.

> It is there, what is happening in the school is there. Outside information regarding the teaching profession is usually posted. As for curriculum - course descriptions and everything are on line. Anybody can access that and it is a two-way street. So, if somebody wants to question what I do, they can e-mail me and I can e-mail them back. There are a lot of positive things about it.

The Future of Teaching

Several teachers thought that in the future teaching would be more dynamic because

technology would enhance teachers' ability to be creative and make things themselves. One teacher

recognized that there have always been creative teachers, those who do something new and make something happen regardless of technology, but technology opens up many more possibilities for teachers. Also they see technology as making tedious record keeping such as attendance and marking less of a chore. Some teachers made the point that they thought the main role of the teacher in helping students learn was not going to change but how that objective is accomplished is going to change. Many teachers talked about the possibility of doing courses online rather than going to a classroom.

With regards to changes in the physical set-up of schools, teachers could see the chalkboard being removed or left unused as teachers use technology to present notes they prepared before class. They thought that class time would be used for experimentation, analysis, activities, discussions, or other things that are not possible if information is presented with chalk and talk. The belief is that, as the use of technology increases, classroom time will be used to develop more meaningful understanding of the topic.

There were some different views among teachers as to whether, in the future, school buildings themselves would become obsolete. Some teachers thought they would see more courses on-line and more innovative ways of teaching. Others thought that schools provided an essential role, other than providing information and content. Many saw the social interaction which goes on at school as being just as important as the content. This was seen as a reason why schools would remain an important institution well into the future. Others thought that the physical nature of schools would change slowly because rapid change in this regard would not be acceptable from a political perspective. People would not understand or be comfortable with such change and political pressure would slow the process.

One teacher expressed his opinion on the limitations of technology:

The one-on-one interaction with students, the compassion, the empathy, those things I don't think you are going to get from that machine that is on my desk there. And without those things, I don't think you are going to be a good teacher, regardless of how much you are into the technology.

Several teachers expressed the view that the increasing use of technology might have many negative impacts that schools would be expected to help manage. One teacher thought that the amount of time some students spend on the Internet or with computers at school and at home could be detrimental and some of the things learned through the technology could be very negative.

You know I really worry about kids spending 8-10-12 hours a day perhaps in front of the T.V. and in front of the computer playing some of these very violent games. So how does that impact upon teaching? Well, one way I think it impacts upon teaching it makes our role as educators all that much more important. I think there is a real need for more character development. I think there is a real need now for the teaching of things like values and ethics. My prediction is there is going to be a real emphasis in the future, and I see it starting now, a real emphasis on character development in the schools.

One teacher explained that where once these values were taught at home by parents, that is not happening now because generally parents are much busier, and spending a lot more time on their careers. The result, he feels, is that there is generally less interaction between child and parent. He believes that schools seem to be the only place where children learn how to behave the proper way, where they learn about manners, values and ethics.

Another teacher saw technology bringing about vast social change that would also mean dramatic changes for the educational system. He thought that information technology would bring about a social raising of consciousness in the general population and parents and students would demand changes to the education system. He said the "Pavlovian" system now in place, "running from 9 to 3 with 56 minute 'blurbs', with 30 people," is not going to satisfy people in the future. He

pointed out that within the school's own efforts at professional development, that formal settings did not meet the teachers' needs. When teachers became demanding learners and knew where they wanted to go, they sought out another option. He predicts that as social consciousness is raised and people know what can happen, they are going to demand that it does happen:

> I think schools are going to have to start to seek out other options, but I think it will be despite themselves and despite government which moves actually far more slowly than schools ever did. I think it will come from a social awareness, as some of these kids become parents and start putting pressures back on their own social institutions.

Thinking about schools in the future, he thought there would be no bells and there would be vastly different alternatives for students to choose from in relation to how they want to pursue their education. He thinks these changes will come about when people that are now younger than 35, with their knowledge of what individualized instruction and the power of technology has to offer them, begin to advance. When these people start getting into decision making positions, powerful positions, civil service, government, business, he thinks then there will be tremendous changes in social institutions.

Another teacher talked about innovative ways of educating that the new technology might make possible. One possibility raised was a virtual school where students would not come to a bricks and mortar facility but rather log on to a virtual school. He noted that this form of school already exists in Canada and other parts of the world.

Another form of educational option identified was that of private teachers offering their services over the Internet. For example, an expert in a certain subject area, someone who is known as one of the best in the world, could sell his or her services over the web to a certain number of students. They might even hire regional assistants so they could increase the number of students they

could enrol. Parents would then have that choice open to them.

The same teacher also thought that technology will allow teachers to offer more customized programs and more individualized learning programs. This would allow people to learn at the rate that they want to learn and not the rate that the textbook or the teacher dictates or even that the school dictates.

> As you know, right now you go to school in grade one you can only learn a certain amount in grade one unless you are doing enrichment, whereas if you and I have different academic capabilities, you may be able to learn twice as much in that year as me but generally speaking you are held back a little bit. I am probably accelerated a little bit. So I think you will see more of an individualized approach to education as a result of the technology.

In the traditional brick and mortar school, he thinks there will be a continued emphasis on the technology to enhance the traditional type program that is currently in place. He says the Internet has had a profound effect and will continue to have a much bigger effect on what happens in the classroom. He sees Power Point and other such programs becoming more prominent in school classrooms, and refers to it as "doing old things in new ways". In the near future, he sees students doing home study courses, getting notes off web pages, taking courses over the summer, doing extension type courses. Another teacher expressed a similar view and thought it was very realistic to have students working independently and consulting with teachers in person or by e-mail when necessary.

One teacher felt that the increasing use of technology meant that teachers were going to have to give up control in the traditional sense because it would be apparent that one person in the classroom is not enough any more, and that computers open up a whole new learning environment for students. This teacher recognized that this involves allowing students to take on more responsibility for their own learning and the teacher becoming more of a facilitator. This new role

for the teacher will also mean changes in the way classrooms and schools are organized and equipped. He predicts the classrooms will no longer be just the desk with the teacher in front of the class with the lectern and writing on the chalk board. As students move toward more resource-based learning, they are going to need a classroom that is more like the school library is now. He explains that there is evidence of this kind of change occurring now as the schools' learning resource centre is often overcrowded.

Another teacher noted that, while the tools may change, the basic form of a teacher with a group of students will remain the same; that teachers will still be needed to add the human aspects to the information technology. Teachers will use whatever technology is available to them but the true essence of teaching is not going to change. Another teacher expressed a similar point of view. She thought that basic skills such as reading or being more discerning readers, and having better analysis and value judgement skills, will receive a renewed focus, but the essential teacher-student relationship will remain basically the same.

> It's not going to change teaching relationships. In the essential teacher-student relationship you know, you had an authoritarian teacher before well you are still going to have those, you're going to have teachers who are more warm and cuddly relational teachers, you are still going to have those. So that is the focus of teaching; it is the relationship.

This teacher saw how some students who do not work well in a traditional school environment might want to take advantages of new delivery methods.

> One of the more exciting possibilities is that stuff like home schooling and workplace schooling become much more possible in terms of what you can offer the students, your core student. Seventy percent of your students, are still going to come to the building, still going to come and sit down and have a schedule and they might bring less books and they might plug in more to use what is on-line as opposed to carrying around books in a book bag.

She also suggested that schools might expand their mandate to offering courses to adults either

through night school or online.

One teacher raised concerns about the possible impacts this new technology might have on the numbers of staff needed. Although on-line courses have to be serviced, they can be offered from anywhere. The jobs could be anywhere in the world so there may be a decline in the local school, he cautioned. Another aspect of the use of information technology in education which was raised by one teacher is that it is a positive tool which can link the curriculum together; teachers can cross from one subject area over to another, with a freer exchange of information.

Another teacher thought that the whole school as it exists is going to be very different in 10 years time.

> I think the whole concept of schooling is going to change dramatically. I really believe that it is going to be very different and herding students every hour from one room to another room to another room in large groups is going to change and I think hopefully we will embrace a really positive thing about it, which is some students do not need to sit. Some students can do courses on their own.

She thought it would give teachers the option of doing a lot of things differently and maybe better. One example which she had heard people talk about that illustrated the concept of doing things differently was teaching somebody to play the piano online and the implications this new approach would have on the personal interaction between the teacher and the student.

One teacher cautioned that having access to information does not guarantee a better learning environment. Some of the changes that are happening, she says, may not be because of information technology but because teachers are learning more about the nature of human learning. In fact, she is concerned that computers might become too much of a focus and teachers may begin to organize schools around them, rather than keeping the focus on students. She believed that computers are only one aspect of a student's learning development. She felt as well that classes must be smaller so

teachers can know the student better and have better relationships with them. She foresees many changes in schooling in the future but only some of these would be facilitated by information technology:

> So I do see teaching not as conforming. I see structures loosening up. I see kids maybe not having to come to school everyday. I think we are going to have more freedom that way, more exchange of knowledge between students, maybe students actually going different places. So I do see a lot of excitement there.

One teacher raised concerns about the future because of the emphasis being placed on technology in education. She did not see it as being more effective than books and paper in presenting students with information that they needed to build their general knowledge. In fact she thought students were in danger of losing skills that they would need in the future:

> I don't see it as being effective. I see it as a tool, in certain areas, to be used, for students to know how to present in the work world basically. But they have an awful lot to learn at their level as the children they are and the students they are. That is, building their general knowledge which can be done no better than with work in books and pencils and paper. I think that there is a risk of losing the skills of writing and spelling. And you have to have that in order to read properly. So you can't say that technology or computers or the information highway is the panacea. It is not.

Professional Development

The Use of Information Technology for Professional Development

Most teachers did not provide examples of how they used information technology to access professional development opportunities. One teacher thought that information technology offered an undeveloped potential in relation to professional development. He thought school boards, the Department of Education and the Newfoundland and Labrador Teachers Association (NLTA) had an obligation to take advantage of the opportunities which information technology presented for the cost effective delivery of professional development. The teacher pointed to the possibilities that are

now available for the sharing of information through school web sites. If one teacher is doing something that is really innovative with technology, then, he believes there should be some forum where that can be shared with other people in the profession.

> People in formal co-ordinating positions or professional positions with the board ought to make it their business to identify what expertise there is out there, who has got what done, who can serve as a resource, and collect it somewhere. Publish it in one place. The problem now is that there are so many, no one really looks or if they do look they are not sure what they are looking for. So to get everybody on the same conveyer belt here pointing at the same place so they all know where to go look. That has not been done, it should be done.

Other ways in which information technology could effect professional development is by improving the delivery of seminars and presentations so that they are more beneficial to the learner.

Another teacher put forth a similar point of view that information technology has not yet been a really dynamic tool for professional learning other than downloading some information from the web or getting information about a conference. However, one of the learning resource teachers confirmed that many teachers were using information technology to look for information on topics they were teaching. Sometimes teachers search web sites and other times they post messages to a discussion group, or e-mail someone to get information. There is a teachers' area in the Library with three computers reserved for teachers.

The Use of E-mail to Talk to Other Teachers

Most of the teachers use e-mail to keep in touch with other teachers and friends. One teacher explained that she has a core group of teachers in her subject area that she is in contact with on a regular basis. E-mail has been very useful for things such as organizing conferences and talking back and forth on various things.

Another teacher explained that e-mail is the main way he attempts to keep current, keep track of what is going on and to keep in touch with other people in the profession. A third teacher comments on how important e-mail is for him:

> I use e-mail for 80 to 85 percent of my communications because most of the people I communicate with are as busy as I am and they prefer it. And again it is convenient and you can answer it on your own terms. So, yes, the school I work in has a LAN and everyone here has e-mail and the expectation is that if I send a message I know everyone here has gotten it. I communicate with people regularly in New England, Ontario, Winnipeg. You know, I would be lost without e-mail. I have my phone too. If I had to, I would use that but I prefer e-mail.

Other teachers mentioned that it would be useful if they could get a list of e-mail addresses for teachers across the province who are teaching the same courses they are. In some subject areas, teachers were already working with such a list and using it to keep in contact with their peers. For example through e-mail, learning resource teachers were identifying training needs and pushing to have a workshop created in the area. They also use technology to discuss course content and to see if they can collaborate in developing material. Another teacher who uses e-mail frequently also encourages students to build networks by e-mailing teachers who are experts in a particular aspect of a course they are doing. Two other teachers said that when they were developing courses in specific areas they used information technology to talk to experts in distant locations and to scan information in the many magazines that are now online.

Another teacher stated that although she used e-mail she preferred talking to people on the phone. She noted that it was her personal preference and that technology was not always a time saver in this regard. Another teacher had an opposite opinion. She thought e-mail was more convenient because she doesn't have to worry about the time or that she may be imposing upon people. She said she feels comfortable e-mailing knowing that the person on the other end will reply when it is best

for them.

Several teachers mentioned that they were e-mailing people in distant parts of the world for various reasons. The cost of these interactions, through alternatives such as the telephone, might be prohibitive.

How Teachers Developed the Skills to Use IT

Although some teachers had done university courses or programs in the area of technology, most of the teachers explained that they learned how to use technology on their own or through training programs organized at the school itself. A number of teachers said they taught themselves by just "fooling around with it". Others mentioned that they had often learned things from some of their students. One teacher mentioned that he was involved in organizing a conference for the summer related to information technology.

One teacher explained that when he started teaching at this school he found there was a lot of support for training in information technology. The first thing to learn was how to make a homepage because it was expected that teachers have a homepage. Other staff members were there to give initial instructions and available for follow up consultations as the homepage was constructed. This teacher felt supported by the fact that knowledgeable staff could be called upon if help was needed.

Another teacher explained that the school had made a concerted effort, in the last five to ten years, to have those teachers who are very knowledgeable and somewhat expert in certain areas to help those on staff who are not as proficient as they would like to be. The school holds professional development days and has professional development opportunities during examinations. At such opportunities members of staff have taught each other how to use technology. This teacher said that

90% of what he had learned about the use of technology had been from in-servicing within the building; the other 10% he had picked up on his own.

Another teacher described the in-house training program developed at the school. Between 1990 and 1992, the school was moving towards a fully electronic learning centre, instead of the old library. In the process of doing that, some other opportunities came up and business partnerships were formed. Within a few years, the building became totally wired and had Internet access and all kinds of opportunities developed for the school. Several of the people on staff were skilled in that they knew the typical Internet e-mail programs and how to create web pages. The school administration attempted to get professional development help from the school board and other places, but found that the people with the board did not know as much as some of the staff at the school. Within the staff at the school there were vast differences in ability and rate of learning. Because of the different levels amongst the staff and their strong demand to get ahead in the use of technology, formal classes were not working. So a different approach was tried. During non-routine times (such as during examinations), several people who were free at the same time would get together and learn from each other through a mentoring process. After two or three years of this informal kind of learning opportunities, all teachers were familiar with the technology and several staff members had high levels of ability. This broadening of the base of expertise in the school then led to a period of rapid growth in the general level of technical knowledge because there were more people available for teachers to ask for help.

A member of administration at the school emphasizes the role of training in the use of technology.

I think a lot of it has happened basically when we started to do this four or five years ago we

quickly recognized having all of this technology in the building was only about a third of the battle really. A third of it is keeping it. and the other third of it is trying to get people up to skill. up to par. so they can utilize all of the technology.

He went on to explain that one of the learning resource teachers at the school during the period when the school got access to increased technology was instrumental in setting up a "just-in-time" training program and a "train-the-trainer" program. The basic objective of the program was to provide teachers with training that they would be able to put to use immediately and also to provide people with a level of informal support that would allow them to pursue an individualized learning program. He says although the training program is not perfect there is strong evidence that it is working. This assertion was backed up by the number of teachers who expressed the opinion that this school was a good place to learn how to use technology.

Many of the teachers said that they had taken outside courses either at the local university or other institutions. Several teachers comment that those courses were of an introductory level and that one of the most important things they had gained from doing the course was becoming more confident in their ability to figure out the technology on their own.

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Availability of Professional Development in IT

All teachers thought that there was not enough professional development opportunities available to them. Courses that were available did not meet the specific needs of teachers or they were too expensive. One teacher made the point that the training that is now being provided does not meet teachers' needs. He felt that for the kinds of things teachers do at school. they don't need to be really good at programing, or anything like that. What they need is training on how to maintain a homepage and how to use software programs that related to their subject area. Also. he felt that

teachers need to be able to keep current on software programs and other material which is being developed for their field. So in his view, for a course to be useful for a teacher it would have to be specifically tailored to the teachers' subject area and his or her classroom needs. This teacher said that, at this point, such a course is not available and teachers work things out themselves and depend on other teachers for help.

Another teacher expressed a similar view saying that professional development related to technology integration will have to take a much more flexible approach. Because of the fast pace of change, traditional methods of delivery of information technology courses do not work and many of the traditional sources of training for teachers have not realized that yet.

Several teachers said that they were making real efforts to get training but had difficulty getting any. One teacher said she had been looking for training programs she could do over the summer related to her field and was having great difficulty finding anything in Canada. Another teacher pointed out that even when more general programs were offered it was sometimes difficult to get educational leave because of the type of institute that would be attended.

Some teachers commented on the cost of courses in information technology and lack of time in a teachers' work week that make it difficult for teachers to take courses that are available. For those reasons, they believed the training offered in the building has been especially successful: the timing is flexible, and it is free. They think that a lot of teachers at the school value the opportunities that they have.

A member of the administration expressed his concern about the lack of training opportunities for teachers compared to other professions.

As a profession we have never invested time in retooling, if you look at any other industry

they spend a significant amount of time on retooling their workers, making sure that the workers are well prepared for the next generation of products that will be coming to market. In education it has never, in the history of education, never happened, and it is not happening right now.

To emphasize how urgent the need for retraining is, he says an argument could currently be made for closing the school system down for a year to train people and prepare them to move into the next generation or into a knowledge-based society. He thinks that things are beginning to change now but he is not sure where the training will develop.

> Whether it is institutes through the NLTA or through the Board or through the provincial government or whether the private sector looks after it, I don't know. But I think there is a market out there. But the market will only be successful if it is supported by the provincial government and school boards through teacher time for in-service. But if they free up the purse strings on these thing, yes, I think there is a market out there. Somebody could have a very viable business doing this type of training. And it is very necessary. There is no doubt about it. It is very, very necessary.

Professionalization and Intensification

Deskilling

Teachers say that it requires more skills, not less, for them to integrate information technology into their teaching. They make reference to the extra skills needed to operate new equipment and software but they also talk about how the added presentation options demand that they be more creative in their teaching. One teacher said:

> I think you need to have more skills to be a teacher with technology because now not only are you concentrating on getting the content across to students and you are broadening your perspective and looking at different ways to present it to the students and the technology is there. We can't ignore it.

They dismiss the idea that teachers become deskilled and the idea that the machinery does all the work.

It is not like you are sending them freely out into the resource room and saying, "Okay search the web". There is work that goes into doing stuff like that before hand.

One teacher made the point that the skills required by a teacher are not static. Another said he had witnessed that the creativity level of teachers is way up "and the ideas are just sprouting up all over the place." A teacher explains why the use of technology does not deskill teachers:

> I have to have a really structured program in order for actual learning to take place. So it takes a lot of work, so to take technology and bring it into the classroom to develop a valid learning environment, takes a lot of work. You have to have a lot of ideas and you have to be very creative.

It is significant that no teachers thought that technology deskilled and many were able to provide examples of how technology required more high-level skills such as creative presentation design and delivery.

Teachers' Time

Teachers stated that information technology was taking more of their time and placing more demands on their time. Teachers noted that extra time was needed to learn new software and also to create new things for teaching.

> I need more time for my own development. I need more time to create stuff. I don't have enough time to, you know, the students are demanding, the presentation quality that can be done at high ends with this thing and I don't have time to do it. I don't have time. I wish I had. There are things that I know I can do I don't have the time to do.

Teachers mentioned that they could foresee when the use of information technology might save them time.

> At this stage in my career, it is something that is taking more time, but I can see, in a year or maybe two years, certain things will lessen the amount of time that I have to do. I know I am still going to have more time because new things are coming on line everyday. I have to choose what I want to keep up to date with, what I can use in my classroom.

One teacher said technology would normally add more time to his day because he could do most things more quickly with technology, but the reality is that he does not have as much time as he did in the past. The reason is because he does more things faster, he is able to take on more.

Another teacher explained that she spent a lot of time using technology but enjoyed learning to use the new technology and learning new things. The same teacher viewed the situation as a paradox in that it takes a lot of time but it saves time because the product that is delivered is so much better. Teachers involved with the maintenance or training related to a technology rich school had additional demands on their time.

> It doesn't generate any free time for me. It just allows me to do more things. It does not generate free time, that is an absolute misconception. Don't buy a computer if you want free time. But just don't expect to do as much.

Two teachers mentioned that they did not have as much time as they would like to devote to learning new technology. One teacher described how she had divided her life into "intense time management slots." She is a teacher from 8 to 5 and uses that time to get her work done and then she goes home to intensely focus on being a parent again.

> For me personally it is how much time do I have to give to teaching. When I didn't have a child it was 14 hours a day and now that I have a child it is 10 to 8 so that is what I give. Do I get more done? Yes, in some ways because I don't have to spend as much time writing tests and rewriting, and I don't have to spend as much time photocopying and stuff like that in certain degrees but because you have more time in this area you transfer it to another area.

Another point mentioned by many teachers was the feeling that you can never keep up. The amount of new material and the new demands being placed on teachers time was so overwhelming.

Barriers or Gaps Between Teachers

Some of the comments made during the interviews demonstrated an attitude or expectation

that suggests a possible divide or gap between teachers who use information technology and those

who do not. One teacher said:

> I give presentations at another school and I talk to them about information technology and I told them, "here is the bottom line. You either get involved with this stuff and learn how to use it or watch the enrollment in your classes drop, because the kids will be bored. ... You know, if you can't get involved with it now and you don't get involved with it you are going to see a decline in your enrollment."

Another teacher said:

> I think IT can really help professional development but it can't be done in old fashion ways. If I go to a PD and somebody I know has been teaching it for 37 years or something, stands up there with overheads with a position that is as dull and boring as it was 30 years ago, I am checked out and gone. And a lot of teachers that I know now that are specifically younger generation, that are mid-early career, say less than 35 for argument sake, they are becoming more and more impatient with senior management for the lack of a better word. That are not in the loop, with respect to IT but yet expect everybody else to be there.

There seemed to be evidence of and intolerance or impatience with the pace of change from

some teachers while others talked about the difficulties in adapting to technology. One of the

teachers thought because of this there was a potential for a divide.

> Well, it has the potential for some kind of a divide, because of the language that gets developed around it and the experience and expertise as opposed to teachers who are not using it as much. Yes, I think there is the potential for that. Do I see, is that a real problem at this point? No, I don't think it is a problem at this point. Because I think everybody has to find a level at which they're comfortable and their subject is best taught.

With regards to a correlation between likelihood to use technology and various factors such as age,

gender, or subject taught; most teachers recognized that it may be there, "but it is flimsy". Many

teachers felt that the likelihood to use of information technology was an individual thing.

One teacher gave a reason why older teachers might be in a better position to experiment with

using information technology in their teaching. Because they were more settled away in their

programs, they had more time to learn things such as new technology programs. People new to the

profession would be too busy just getting their classes in order. Someone noted that just because a

person is younger does not mean they will already have technology skills. Some of the new teachers

starting at the school had not used information technology in the past and they had to learn to use

it.

Many teachers made the point that at this school there was a helping and understanding

atmosphere rather than that of conflict between teachers who use information technology and those

who do not use it as much.

> We accept that people are at different levels and everyone moves at their own pace. Where
> everyone is accepting of that, nobody feels that negative component because it is quite a
> relaxed atmosphere. There are lots of things that I may not know how to do and I will go to
> somebody else and say, "gee, can you show me how to do this?" and the next week I'll then
> turn around and show somebody else. But I don't find that negative attitude. Everyone seems
> to have the same level of commitment. There is not a lot of that kind of thing.

One teacher thought that any barrier or gap might disappear as the technology gets easier to use and

becomes more suited to educational purposes.

Some of the teachers presented a strong statement of the schools efforts not to create barriers

or gaps between those who use technology and those who do not.

> We take great lengths to tear these barriers down to shred them, to trample them, to destroy
> them, burn them, annihilate them. We really try, and I think we have made great strides, to
> bring all the staff up to, if not beyond, at least a novice level of computer literacy, I hope
> there aren't any walls.

Many teachers talked about the type of vision and spirit of cooperation at the school which helped

alleviate some of the potential barriers or gaps. They talked about the fact that teachers were

accepting of the fact that teachers were at different levels in relation to technology. Also, many

teachers noted that they felt comfortable asking another teacher for help if they had a problem using

technology. Several teachers said they felt bad for colleagues who did not welcome computers and

who felt technology was being pushed upon them.

This school two female teachers are responsible for the Learning Resource Centre and much of the training related to technology. In spite of this, two female teachers said there may be a bit of a male bastion with regards to technology. One thought that the explanation might be that the use of technology evolved out of male dominated professions such as computer science and industrial arts. The other teacher thought the explanation might be that men and boys spend more of their recreational time with computers than women. The games that are available are more appealing to characteristics generally associated with males. One teacher also had noticed that female students aren't as confident with computers as their male counterparts.

Questioning and Challenging the Authority of Teachers

Teachers were not only open to being challenged, but viewed it as a positive thing if done properly. Teachers viewed it as an "opportunity for growth for the whole class." If teachers have a problem dealing with challenges to one's authority in the class it was seen as being the teachers' problem rather than a problem with the students.

> If you can make a student confident enough to challenge an authority in an appropriate way then you have made that person, you have made their maturity and personal confidence level to take leaps and bounds. And that is what teaching is all about I think.

Other teachers were not sure if the questioning was because of technology or because of revelations of abuses by professionals and people in positions of authority that have received wide publicity.

> I don't see that as a negative thing, and yes, I do see it in our school and in our education system. I see a debate where once there would be no debate. I see teachers also, you know, opening themselves up and encouraging discussions and questioning and again, isn't that what education should be. There is a correct way to do it, however. You know, with mutual respect, hopefully.

A number of teachers felt that the use of information technology meant less discipline problems in the classroom. Problems might arise if a teacher were inexperienced and dealt with questioning in a dictatorial way. The teacher went on to say that teachers should be ready for hard and fast questions and the bluntness that goes with people who are hungry learners and he would not consider that a challenge of his authority in the class. He explained, "If a kid gets up and tells me where to go, that is a challenge to my authority." One of the other teachers who thought the questioning and challenging the authority of teachers was a good thing also believed that most teachers at the school thought it would be a good thing adding, "the bottom line is we have some kids here who are brilliant."

One teacher thought it would be a good thing if parents were more questioning of teachers and had more input into their children's education. This would be particularly important in cases where students have special needs, the teacher explained, because the parents know their own child better than anyone else.

Discipline and Students' View of the World

Discipline in Class

Teachers expressed the opinion that there were less discipline problems in the classrooms where technology was being used. The principal shared his experience and thoughts on this matter.

> I have never, not once, ever noticed or been consulted on a discipline problem in a technology class. Never. Not once. Not once. I have some thoughts on why that is. I think the teacher in most of these situations becomes more of a facilitator than a lecturer and the students become more involved as active learners and they are interacting, yes, with the technology, with the person next to them, and with the teacher.

Several teachers noted that it is still necessary to establish certain rules and consequences.

One teacher said, "We have to have structure. Kids still have to know when to act one way in one place, when to act one way in another. We don't want to raise Bart Simpsons either." Some teachers said they thought discipline problems would only arise if teachers were trying to teach in a dictatorial way, sticking very closely to a narrow set of goals and refusing to deviate.

Local Content

One teacher described a way in which the use of information technology was enhancing local content. By creating his own material for class the teacher was able to use local examples of animal classifications used in biology. By putting local examples on a website he thought it was more meaningful than students looking at strange examples in a textbook published elsewhere.

Other teachers felt that the Internet made the world a smaller place and the idea of a global village was mentioned by several of the teachers. One teacher said she thought the students did not have a good understanding of their local environment. She said many of them would not be able to pick St.John's out on a map of the world. She thought students should have strong roots based in history, geography, and social studies related to their local area before they start to look at the globe.

Socialization versus Virtual Reality

There were many diverse and interesting views expressed on the student's need to socialize versus use of virtual reality. Teachers saw the potential for technology to be isolating and realized that classroom and other activities had to be arranged in such a way as to reduce the isolating possibilities involved with one student and one computer screen. Many teachers explained that they usually use technology in teamwork situations.

A teacher who makes extensive use of technology in the classroom to help with physics experiments explained that students still have to manipulate equipment to do experiments. In other cases simulation programs allow students to do things that they would not be able to do in a classroom. She gives the example of using video clips to analyse motion.

Other teachers made the point that there have always been people who enjoy socializing with other people and those who would rather be alone. One teacher draws on his own recollections to make the point.

> I remember when I was in school, you know, you had your bookworms and you had your jocks, and there were all kinds of different characters in between and all we are seeing, is just the generational, just the evolution of the bookworm, that is what we are seeing. Those that were social before are social now.

Explaining further that some people prefer social contact while others don't, a teacher explained that he had once done a distance education course and did not like the format. He said, "I need face-to-face."

Another point made was that in some ways the use of new technology may be increasing socialization in some ways. People may be able to find someone who has interests similar to their own to converse with through the Internet. Some teachers expressed the opinion that even if the communications are totally virtual, where there previously had been none, then it was a good thing. One teacher seemed to have mixed feelings about this, saying that students who do not socialize much are always a worry, but notes that even when these students are not using computers they are alone and not socializing.

One teacher recognized the situation as a problem and made the point that computers are not unique as a diversion which students use to waste time.

Yes, it can happen. You know I see and there are lots of kids I tell them they need to get a lot more sunshine because they are spending too much time, it is quite apparent that they are spending too much time, with a computer. Still, you know, you can spend too much time watching TV, you can spend too much time reading books, you can spend too much time doing anything, and the computer is no different than any other habit forming thing.

Other teachers point out that there is sometimes a level of interaction going on as students use technology. One student shows another how to use a program or talks about something they saw or did using technology. Although the same teacher noted it is sometimes quite amazing how silent computer classrooms are compared to a literature class where there is a lot of discussion.

One teacher put forth the idea that the use of technology in the classroom will mean that training in other areas will increase in importance to give the balance needed. The Arts and Music as areas for students to interact will become more important as a means of increasing socialization. Another teacher warned that teachers have to be careful when deciding where technology really fits, noting that "some kids have their technological competency very well developed but the rest of their life is a mess."

Acceptable Use Policy

Many teachers said that they saw inappropriate use of the computer as a potential problem but most had not experienced any problems in the classroom. Several teachers said it was very easy to inadvertently find pornographic sites while looking for material related to high school subjects. Teachers thought this was a serious problem with the Internet in that even if a student is not looking for something like that it can come up.

Teachers take precautions to insure that websites they refer students to have no links to unacceptable sites. They explain that it takes a lot of time to investigate the site and all the links

before telling students to go there. Other teachers expressed that just their presence in the classroom, walking around and asking questions, would be enough to deter students from going into something they are not supposed to be in.

Some teachers thought that while it was not a serious problem for them in the classroom it could be more of a problem when students work on their own. One teacher pointed out that once they leave the school students can go to all kinds of Internet cafes where they can access, download and e-mail things to themselves. Another teacher said that it was important that parents be involved in this issue along with society in general.

Teachers explained that the schools' acceptable use policy is very clear and that it is posted next to computers. If students are caught accessing unacceptable sites they are given one warning and then they lose their computer usage privileges. By tracing the history of some sites that students have accessed, problems have been identified. Network administrators and other teachers have blocked certain sites they deem to be inappropriate but because of the rapid change taking place this has very limited success. One teacher thought that in the future the problem might be solved through the use of protective software.

Other teachers advanced a less technically based solution which involved instilling in students a good moral code of conduct to follow. One teacher explained, "we create an environment here, a social place, where we help students choose not to go there, to make the right choice." Another teacher emphasized that providing a proper role model is the most effective way of doing this.

Some teachers thought that one explanation why there had been so few problems with regards to acceptable use at the school might be because of the time demands on the computers at the school.

There is no time for students to be into unacceptable sites because there are other students waiting to get some serious work done. Other teachers said that it was important that teachers always be monitoring what students are doing while using the computer. One teacher said that by just moving around the classroom a teacher should be able to eliminate those problems because students respect the learning environment. Also, teachers explained that someone is supervising the resource centre and computer laboratory from the time it opens in the morning until the time it closes in the evening.

Issues Related to Technology in Schools

Ten issues related to the use of technology in schools emerge from the interviews. These issues deserve special attention because they could determine the success or failure of the use of information technology in a school and are outlined below.

Maintenance

When asked about potential problems which they thought might arise from the use of information technology, the problem most often noted was the maintenance of the equipment needed to operate a technologically enhanced school.

Teachers were concerned about the time and the cost associated with having a couple of hundred computers in a building. The technology is changing quickly, new equipment is being added and there are problems with breakdowns. At the present time a small group of teachers are responsible for administering the LAN of almost 200 machines and they can also call for help, if necessary from some of the business partners the school has developed.

One teacher was amazed that the school staff had been able to maintain the infrastructure for

information technology used in the school. He explained that it had only been through the dedicated

work of people at the school who had accepted responsibility for it and their hours of volunteer time.

However, he stressed that somewhere along the line someone has got to make the commitment to

maintaining the infrastructure. He made the point that if a business had 200 computers online, they

would probably have three or four full time technicians. He also said that school boards will have

to look at this issue or otherwise in five years time there are going to be schools with obsolete

equipment that is not able to do the job required.

Some teachers felt very strongly that it was not the teachers' responsibility to maintain

computer equipment. One teacher made the point by making reference to other repair work done

around a school, such as keeping the desks repaired.

> No more would it be acceptable for me to get out in the corridor and paint the wall, and I don't think it should be acceptable at all for me to have to go and fix my own computer. Teachers' time is so eaten up by doing things that they are not necessarily good at. I could be making a problem worse, and I could spend five hours doing something that would take someone who knows what there doing two minutes to do.

This same teacher said there seems to be an attitude that technology, and the equipment associated

with technology, is the teachers' responsibility to maintain and that upsets her. She explains that

teachers who do not have the proper training in this field could cause problems while trying to repair

the system. Also, even though there were some teachers who were qualified to maintain the system,

it is not the best use of their time to have them spending "two thirds of their day unplugging paper

jams and checking to make sure the system is O.K." She felt very strongly that it was definitely not

something for teachers to have the responsibility to maintain.

> We don't maintain the phones, you know, we don't maintain the gas line system here that feed the labs. But yet we are expected to maintain, upgrade, keep running hundreds of

thousands of dollars of worth of computers and software.

Inequalities

Another frequently mentioned problem was the disparities between students who had access to computers at home and those who did not. In this regards one teacher thought schools were presently in a transition stage where students are starting to get more access to computers but the point has not been reached where all students have access whenever they want. There are still problems because students need and do not have access at home. Even in leading edge schools, such as the one being looked at, the access for everyday class use is not as good as it could be.

> I think we are in this stage right now, we have this certain number of students who have that stuff and a certain number of students who don't. So as a teacher you are sort of in a state of limbo saying "O.K., can I assign this project knowing that all these students have access to it? But these students, because of financial situations or whatever, they don't have access to it." So really it wouldn't be fair to put this requirement on the work when you are not being equitable to all students.

The teacher said that these limitations are holding teachers back from doing what they want to do in class. Even when setting assignments which require a lot of research work outside class, teachers have to consider bussing problems and access to the schools computers during off hours. Other teachers thought that economic factors have always been a concern for teachers and computer technology is just another aspect of that long existing problem.

Security of School Information

One teacher expressed great concerns about the security of information that was being kept on computers. She wondered if it is possible that records of private files might be accessed by

hackers and considered this as being very dangerous. This teacher said that she had such concerns about security on the Internet, and that generally she would never consider buying something online.

Cost and Need for Training

Another teacher thought that the biggest potential problem or challenge was training and keeping teachers up to date and current. To keep staff professionally current the teacher thought a concentrated province-wide initiative on teacher training was needed. Such an initiative would have to receive guidance and leadership from the Department of Education or the school boards and involve teachers who are currently teaching in the system.

Two other teachers made comments related to the cost and the need for training. The concern was that a lot of money was being spent on computer systems which may not meet the needs of an educational environment. One of these teachers pointed out that the computers being used were designed for business use and suggested that schools should be moving towards greater access through the purchase and use of cheaper units. There was also concerns about time needed for teachers to retrain and keep abreast of new products so they can integrate leading edge information technology into their teaching. The teacher said, "we can't expect teachers to learn sophisticated systems in such a short time with no time for training."

Information Overload

Two teachers commented that information overload might be a problem for them and for their students. Sometimes students are overwhelmed with the amount of available information and with the task of filtering through the information to find what they are looking for. For example, the

skills involved in site evaluation will become more important because there is a tendency for students to accept something as accurate, simply because it is in print or because it is on the computer screen. They felt it is important that teachers and students question the validity of the information that is on the Internet and that people have the skills to effectively sort through all the information that is available. One of the teachers thought that search engines and the organization of the Internet might mature to the point where finding good information could be made easier in the future.

Pace of Change and Stress

One teacher commented on the pace of change and the fact that technology is moving at such a pace that teachers have a hard time keeping up with the new things coming out. Another teacher questioned the whole support services available in schools to help facilitate the integration of technology into their teaching. It was thought that teachers needed support in administering the computers in the school and time to think and work with other people to figure out how to best use information technology. One teacher commented on the increasing stress level in part caused by technology.

> You are in a very rapid changing society. It is very stressful. People are stressed. Families are stressed. It is that things are just coming at you, so quickly, and people expect you to be almost super human.

It was felt that this level of stress is also being transferred to young students. The teacher pointed out that some students, even as young as those in elementary school, have schedules that include sports, advanced placement courses, and other extra curricular activities that give them little time to just play.

Plagiarism

One teacher raised the problem of increased plagiarism because technology was making it easy to reproduce and revise someone else's work. She also felt that sometimes the product looked great because of the technology that was used to produce it, but the thought and the work did not go into it, "there is a lot of cutting and pasting going on".

Control by Big Business

Control by big business was also a concern for one teacher.

> Bill Gates, you get these people and they got the monopoly and there is a lot of money involved. So the money, I worry about that, money, power, monopolies, business competitiveness, all these things, these are the negative things I see coming out of technology. We need to have better laws, even the Internet, it is like our laws haven't kept up with the technology.

Some teachers, however, pointed out that private businesses were valuable partners in bringing technology into the school. They noted that the more than 150 partnerships that the school has formed have been important in bringing a lot of computers and technical support into the school.

Finding Good Software

Two teachers noted that they were having trouble finding good software and good Internet sites for classroom use. The teachers said they had difficulty finding material ready made for use in class that was any good. They ended up adapting material they could find and using that in class.

Do the Benefits Outweigh the Disadvantages?

Teachers overwhelmingly expressed the view that the benefits very much outweighed any problems caused by the use of technology. While recognizing that there are some problems and difficulties with integrating the use of information technology, teachers thought that the effort was paying off and was worth continuing. One teacher put it very forcefully:

> It's very exciting, its very empowering. The benefits just obliterate any negatives. Right now, in our context, right here, the positives just blow away the negatives. It's not a balancing act at all, it's a blowout.

When talking about the benefits of using technology some teachers took a broader perspective than just the impacts on schools. One teacher thought it was going to be fun to watch peoples' views on life change as they became learners again. He expects that information technology will bring about major changes in individuals and in society in general. Another teacher thought that the use of technology in schools would play an important part in the economic development of the province.

CHAPTER FIVE

IMPLICATIONS AND DISCUSSIONS

Given the amount of public attention and the number of government policy statements endorsing the use of information technology in schools, this study was undertaken to get a better understanding of how the use of information technology across the curriculum affects teachers' work at the high school level. Semi-structured interviews were conducted with the staff at a school at the forefront in the use of information technology. The openness of qualitative methods allowed for an in-depth examination of the situation being experienced by teachers at this high school and a summary of findings was provided to participants in order to verify the findings and quotations used.

Before undertaking the interviews a review of literature on this topic was undertaken. From this review of the literature a number of potential areas for investigation were identified. These areas were incorporated into major categories which were then used in the interview protocols in the analysis of the data, and finally in the presentation of findings.

Teachers' Work and Attitudes

In the area of teachers' work and attitudes, many writers predict drastic changes in the way teachers work and live. Through the interviews, teachers provided examples of how the use of information technology was changing their work. The varied examples that were given, such as posting class material at websites or getting students to create their own web pages supports the transforming aspect that information technology can have on teachers' work and attitudes. At this

school, the way teachers prepare for work and interact with students has been changed dramatically through the increased use of information technology. The use of information technology allows students to do more meaningful work and frees them from the more tedious time consuming preparation that would limit the amount of material that could be covered in a class.

For the most part these teachers felt they were just beginning to change their work through the use of information technology. Many of them noted that they were planning further changes to their teaching next year to build on what they were now doing. For example, many teachers mentioned that they would like to experiment with video conferences, use Power Point to make presentations, and move to more resource-based teaching. It was also pointed out that the transition to the use of information technology might be taking place quicker in some subject areas than in others. For example, the science department at this school seems to be at the forefront in integrating the use of information technology into teaching activities.

Another aspect of teaching which is changing because of the increased prevalence of technology is the relationship between teacher and student. Teachers recognized that in many cases their students knew more about technology than they did and often they would learn things from students. Teachers described technology as the "great equalizer" and used terms like "co-learner" to express the new relationship. Most teachers considered these changes to be very exciting and considered the new environment to be very rejuvenating.

Technology is also changing the administrative work that teachers do. For example class attendance will now be recorded electronically and forwarded to the school office by e-mail. Much of the material previously dealt with at staff meetings is now resolved through e-mail. These changes were welcomed by teachers.

The Future of Teaching

In the literature reviewed there were many divergent views on how information technology would impact upon the future of teaching. Some of the writers see information technology totally transforming the future of teaching in a positive way. Others offer warnings that information technology is having a negative impact upon teaching. Given these differing views on this issue the opinions of teachers interviewed were particularly enlightening in this area.

Some of the information gathered through the interviews support the view put forward by Perelman (1992) that computer technology will bring about an era of "hyperlearning", totally changing the way schools are organized. But findings did not support the view that teachers would become obsolete as Perelman (1992) had also suggested. The view from most teachers at this school was that information technology allowed teachers to be more creative in preparing material to help students learn. The teachers think that while the role of the teacher will change, they will not be replaced by computers. Technology is seen as something that enhances the teachers' ability to do the job they have always done, which is to help students learn.

The view put forward by Stoll (1995) that the changes to the physical classroom could limit the teachers interaction with students was not supported by these teachers either. Teachers thought that while chalkboards might be replaced and the physical set up of the class might change, the actual classroom time could be used more productively because of the use of information technology.

Responses to questions about the future of school buildings were mixed. Some teachers thought that innovative ways of offering courses, such as on-line, would become more prevalent. Others thought that because of the socialization role that schools have come to play in society the delivery method for courses would change very slowly. Some teachers thought that the socialization

role played by schools and the role teachers play in the social development of students might become more important because of the prevalence of the use of information technology in our society. Given the other methods of content delivery some predicted that the emphasis for schools in the future would be on values and ethics.

Some teachers thought dramatic changes would come in the future, the 9:00 AM - 3:00 PM, 30 students in a classroom for 50 minutes, would change. It was suggested that when people who understand the possibilities for alternative methods of delivery get in positions of power, changes in the structure of schools will come about. The fact that teachers could suggest alternative delivery methods such as private lessons offered by experts over the Internet as acceptable options for some parents and students is a good indication that these options are possible.

Apart from the possibility of dramatic structural changes in education delivery most teachers accept that technology will change the delivery of traditional type programs. Teachers see technology allowing teachers and students, "to do old things in new ways". For example taking notes, doing research for a term paper, preparing for a field trip, and conducting physics experiments can all be enhanced through the use of information technology.

Some of the criticism of information technology is based on how computers would obstruct teaching in a traditional classroom. Stoll (1995) for example talks about teachers surrounded by students "behind" computers. This view does not take into account how the physical set up of classrooms and the structure of lessons could change to accommodate the use of information technology. One teacher at this school notes that in the future schools are going to need classrooms that are more like the school library is now. Many teachers noted that the essence of teaching will not change and that teachers will still be needed to add the human aspect.

Professional Development

One of the items highlighted in the literature reviews was the importance of professional development as teachers adapt to changes brought about by the use of information technology. Both Tapscott (1998) and David (1996) point out the critical role that professional development plays in the use of information technology in teaching.

The findings of this study support the importance of professional development for teachers in making the use of technology successful. Teachers provided evidence of the importance of the efforts in-school to promote professional development in integrating information technology into classroom teaching. The professional development days held and the flexible mentor type training that is happening at the school was viewed as being very important by the teachers interviewed. The importance of professional development and also the importance of the delivery method was clearly evident in the findings of this study and could provide valuable insights for other schools wanting to increase the use of information technology in classroom teaching.

Another point that was clear from the interviews was teachers are not happy with the availability of outside opportunities to get professional development in information technology. Courses that would meet teachers needs were either not available or too expensive. Several teachers and administrators noted that the present need for training in this area is chronic and the lack of it reflects poorly on the NLTA. School Boards. the provincial government. Memorial University. and private institutions. The use of information technology as a delivery method for professional development was also considered a possibility. While teachers were not currently using information technology to access professional development opportunities there was a realization that this might be an undeveloped area. As an informal form of professional development. most teachers were

already using e-mail to communication with other teachers and people in their field of study.

Professionalization and Intensification

Some of the literature focused on what information technology would mean in relation to professionalization and teachers' time. Apple and Jungch (1992) thought that the use of technology would take the skill out of teaching and reduce the teacher to a technician who dealt only with machines. Also the pressure on teachers' time was an item that some writers felt was becoming more crucial in periods of change.

The findings of this survey contradict the view that information technology would deskill teachers. The views expressed were that while teachers needed new technical skills they also had to be more creative in using the additional presentation options that are now available to teachers. Those interviewed rejected the view that students could just be given the technology and learning would take place. They provided examples of how technology required high-level work on the part of teachers such as creative presentation design and delivery.

In relation to teachers' time, the findings were somewhat of a paradox. Technology was placing more demands on teachers' time but it was also saving them time and allowing them to be more productive. Teachers state that there are many more things they could do with the technology if they had the time. Teachers also note that they are more productive because they use technology so now they "take on" more. Some teachers explained that they had to limit the amount of time that they spent on work so they would have some time for their families. Teachers who were responsible for equipment maintenance or training had additional demands placed on their time.

The feeling of not being able to keep up with the changes and of being overwhelmed was also

a common concern raised by teachers. However, some teachers thought this period of rapid change and increased demands on time might not be a permanent situation, but rather a transitional phase while they were learning to use the technology more effectively.

The findings demonstrate that increasing demands are being placed on teachers' time and this is a factor which should be taken into consideration as schools move to increase the use of information technology in the classroom. Further investigation into teachers' capacity to adapt to change brought about by the use of information technology and the stress being placed on teachers is certainly warranted given the findings of this study.

A potential for a barrier or gap to develop between teachers, who use information technology and those who do not, is indicated in the findings. There was certainly an expressed feeling amongst most of the people interviewed that those who use information technology in their teaching were more professional. At the school where the interviews were conducted it was also evident that great efforts were being made to prevent any divide from developing and several teachers made mention of those efforts.

In some of the literature it has been suggested that the authority of professionals were being challenged more. All teachers saw this as a positive development, if, indeed, it were happening. The general feeling was that if students questioned information being given by teachers in an appropriate way, then it was a positive development. An increased role by parents was also seen as a positive development, especially in cases where the children had special needs.

Discipline and Students' View of the World

Some of the literature reviewed pointed to problems which would arise with the use of

information technology in the classroom. Stoll (1995) thought it would be easier for students to "goof off" when technology is used. However teachers in this study found that there were less discipline problems in classes using information technology.

Stoll (1995) also raised the concern that students would lose touch with reality and local content, thus being left with a distorted view of the world. Some teachers in this study thought that local content in teaching might be enhanced because teachers could develop their own material using local examples, whereas in the past, textbooks or other material were mass produced and often used examples far removed from the everyday experience of students. Teachers noted that the world was becoming a much smaller place and several teachers mentioned the concept of "global village". This was seen as having many positive aspects but other teachers lamented the fact that a lot of students had no knowledge of local geography or history.

A related idea of socialization versus virtual reality was something discussed in the literature reviewed as well. Teachers recognized the potential for technology to isolate people and realized that classroom and other activities had to be arranged in such a way as to encourage interaction with other people. Some of the examples given by teachers showed that the use of technology could enhance the experience of the real thing or allow students to explore environments or situations that would not be available to them given the constraints on time and resources. Stoll (1995) talked about astronomy and the fact that students turn on the computer to look at a picture of the sky rather than going outdoors and looking up at the sky. While looking at the sky would seem to be the best option, one teacher pointed out that in class the alternatives would not be looking at the sky or at an image on the computer screen, given the constraints of how the education system is arranged the options would be a drawing of the universe on the chalkboard or the most recent picture taken from the

Hubble telescope that was down loaded to the web. Another teacher, who used web pages to enhance field trips, noted that by using information technology to prepare students he was able to make better use of the time spent on the actual field trip. This was important again because of the constraints placed on teachers by how the education system is arranged.

Other teachers took issue with the argument that students are less social today than in the past saying there have always been social and less-social people. Others put forward the case that information technology might, in some cases, lead to more socialization. The example of a student finding a person in a discussion group on the Internet who shared a common interest was raised as a counter argument. Left alone in their local environment they might not be able to find anyone with similar interests or compatible dispositions.

In relation to students using computers as a diversion or "goofing off" as Stoll (1995) describes it, teachers did recognize that some students do spend too much time with a computer. Some teachers thought that a possible reaction to any isolating trend generated through the use of information technology might be an increased focus on arts, physical education and music as areas which encourage interaction and the building of social skills.

Acceptable Use Policy

Acceptable use is something which has received a lot of attention in the mass media as well as in academic literature. While most teachers could not give instances of cases where they were confronted directly with this problem, all of them recognized it as a potential problem and were doing things to prevent or discourage students from accessing pornographic material, hate literature, and other unacceptable material.

The impression from the teachers interviewed was that the problem of unacceptable use may not be as chronic as it is sometimes portrayed in the news media. Teachers at this school are very vigilant in the way they plan and monitor their classroom activities, but they noted that once students leave the school they often have unregulated access to unacceptable sites.

Issues Related to technology in Schools

During the course of data collection and analysis several issues related to the use of information technology in schools became evident. The most pressing problem was that of maintaining the equipment used to operate a technologically enhanced school. Teachers were upset that they were expected to maintain the computers. They pointed out that anywhere else with that many computers on-line they would have significant resources dedicated to maintenance. The fact that this school is a leader in the field and ahead of others in the adoption of information technology seems to bring with it problems that could be solved if other schools were at the same level of usage. Resources might be available at the school board level, for example, if all schools in a board were using information technology.

If school boards and governments see the use of information technology in schools as a good thing, they will have to allocate resources which allow for the maintenance of these computer networks. This problem could become more serious as equipment ages and breakdowns become more likely. Teachers were upset that they would be expected to maintain computer equipment and that this was seen as being different from maintaining the buildings or other facilities in the school. The anger which is present indicates that as schools adopt the use of information technology, they will have to allocate resources for maintenance and repair.

Another problem was the inequality of access for students. Some students had computers at home but other students did not. Even in a leading edge school such as this one, students do not have as good access as would be needed to make this a non-issue. Teachers were unable to assign projects involving computer work knowing that some students would have an advantage over others. Given the potential of technology to improve the learning environment, school boards and schools should investigate the possibility of options such as laptop sign out for students, after hours access to computer labs, purchase plans and any other methods which might eliminate these inequalities.

Although there had not been any problems of security at this school, the issue of security of records and personal information was raised by one teacher. Given the personal information schools maintain on students and the important records being kept electronically, this is an issue which should be given attention by school administrators.

The staff at this school thought that a concentrated province wide initiative on teacher training was needed. The teachers thought that neither the Department of Education or the Board were doing enough at this point. It was felt that the pace of change was placing great demands on teachers' time and causing a great deal of stress. If government, school boards and school administrators are going to promote the use of information technology in schools they will have to pay more attention to teachers' ability to adapt to change. This could mean support services in schools or the allocation of extra time for teachers to adjust to using the new technology.

Some teachers noted that there might be a problem of too much information. This may lead to the increasing importance of preparing students to make value judgements; what is reliable information and what is not? Another point mentioned by one of the teachers is that more stress is being placed on some students. They are expected to do more at an earlier age and the implications

of this are not fully understood yet.

A concern of one teacher was gender discrimination with regard to the use of information technology. At this point the teacher thought that girls would be disadvantaged by a move to increased use of information technology. If her assertion is correct, then this is an issue which should be addressed. Teachers should be made aware of any biases and be trained in strategies to overcome this problem.

Another emerging issue, mentioned by two teachers, that the public and educators will have to deal with in the future is the possible loss of control of the education process to business partners. It was noted that the school where these interviews were conducted had more than 150 partnerships. Business partners brought a lot of computers and technical support into the school. While one teacher mentioned this as a positive thing another was concerned about possible negative implications. Balancing the interests of these partners and that of the students might be an increasingly challenging role for administrators as business involvement in education becomes more common.

Teachers overwhelmingly expressed the view that increased use of information technology was a good thing despite some of the problems associated with its use. From the evidence gathered it is clear that the use of information technology has had a very positive impact on education at this school. Rather than limit the role of teachers, it enhances their role as professionals and gives additional opportunities for teachers to be creative in the design and delivery of material.

Conclusion

The views expressed by the teachers at this school point to a potential growth in alternative

delivery methods in education. Home schooling, private tutoring, flexible schedules, individualized programs are all possibilities that seem viable given the views of these educators interviewed.

Given the prevalence of computers in work and everyday life it would be unreasonable to expect that schools and the work of teachers could be isolated from these changes. This technology has the potential to change schools and teachers' work in very profound ways. It would be equally unreasonable to expect that computer technology will be a natural fit, not requiring any planning or adjustment time. The perspectives of teachers in this leading edge school that have been expressed, discussed, and analyzed should provide valuable insights into what may be ahead for other schools and provide clues to how they can adapt to the changes.

References

Apple. M. and Jungck, S. (1992). You don't have to be a teacher to teach this unit: Teaching. technology and control in the classroom. In A.Hargreaves and M.G. Fullan (Eds). *Understanding teacher development* (pp. 20-42). New York :Teachers College press.

Breen. C. (1995). *Integrating technology and teaching at a technical institute: An internship report.* St.John's, Nfld: Memorial University of Newfoundland.

Bruno. J.E. (1997). *It's about time: Leading school reform in an era of time scarcity.* Thousand Oaks: Corwin Press.

Bryman. A. (1988). *Quality and quality in social research.* London: Unwin Hyman.

Carroll. A. M. (1995). *Professional development and the teacher - librarian: An internship report.* St. John's, Nfld: Memorial University of Newfoundland.

Carroll, J. and Broadhead. R. (1994). *Canadian Internet handbook.* Scarborough,Ont: Prentice Hall.

David. J. L. (1996). Developing and spreading accomplished teaching: Policy lessons from a unique partnership. In Charles Fisher. David C. Dwyer and Keith Yocum (Ed.). *Education and technology: Reflections on computing in classrooms* (pp.237-250). San Francisco: Jossey-Bass Publishers.

Gayeski. D. M. (1993). *Multimedia for learning: development. application. evaluation.* Englewoood Cliffs: Educational Technology Publications.

Gibson. D. V. , George Kozmetsky and Raymond W. Smilar (Eds)(1992).. *The technopolis phenomena: Smart cities. fast systems. global networks.* Maryland: Rowman & Littlefield Publishers.

Glesne. C. and Peshkin. A. (1992). *Becoming qualitative researchers: An introduction.* New York: Longman.

Gooler. D. D. (1986). *The education utility. the power to revitalize education and society.* Englewood cliffs: Educational Technology Publications.

Hargreaves. A. (1994). *Changing teachers. changing times: Teachers work and culture in the postmodern age.* Toronto: OISE Press.

Hargreaves. A. (1997). New ways to think about teachers and time. In Nancy Adelman. Karen Panton Walking Eagle, and Andy Hargreaves (Eds). *Racing with the clock: Making time for teaching and learning in school reform*. New York: Teachers College Press.

Hathaway. W. E.(1990). *Education and technology at the crossroads: Choosing a new direction*. Toronto:Captus Press.

Hebenstreit. J. (Ed). (1992). *Education and informatics worldwide: The state of the arts and beyond*. Jessica Kingsley Publishers.

Heterick. R.C. and Gehl. J. (1995). "Information technology and the year 2020." *Educom Review*. *30*. 24-26.

Hlynka. K. and Belland J .C.(Eds). (1991). *Paradigms regained: The use of illuminative semiotic and post-modern criticism as modes of inquiry in educational technology*. Englewood Cliffs: Educational Technology Publications.

Johnston. D. (Chair). (1995). *Connection community content: The challenge of the information highway: Final Report of the Information Highway Advisory Council*. Ottawa.

Laver. M. (1989). *Information technology: Agent of change*. Cambridge: Cambridge University Press.

LeCompte. M. D. and Preissle J. (1993). *Ethnography and qualatative design in educational research* (2nd edition). London: Academic Press.

Martin. P. (1998). *Federal budget 1998*. Supply and Services. Ottawa.

Meadows. J. (Ed). (1991). *Information technology and the individual*. London: Printer Publisher.

Miles. M. B. and Huberman M. (1994). *Qualitative data analysis: An expanded sourcebook*. London: Sage Publications.

Naisbitt. J. and Aburdene P. (1990). *Megatrends 2000. ten new directions for the 1990's*. New York: Avon Books.

National Association of Secondary School Principals. (1984). *High tech schools. the principal's perspective*. Reston.

Newfoundland and Labrador Government. (1995). *Technology in learning environment: Enabling tomorrow's learning today*. St.John's: Department of Education.

Nickerson, R. S. and Zodhiates P. P. (1988). *Technology in education: Looking toward 2020.* London: Lawrence Erlbaum Associates.

Noble, D. (1998). "Digital diploma mills: The automation of higher education", *Educom Review.* *35.* 23-26.

Northcott, C. A. (1995). *A school principal's leadership: Vision to reality.* Masters Thesis. St. John's, Nfld: Memorial University of Newfoundland.

Pereiman, L. J. (1992). *School's out. Hyperlearning, the new technology, and the end of education.* New York: William Morrow and Company.

Postman, N. (1992). *Technopoly: The surrender of culture to technology.* New York: Alfred A. Knopf.

Postman, N. (1995). *The end of education: Redefining the value of school.* New York: Alfred A. Knopf. .

Rawlins, G. J. (1992). "The new publishing: Technology's impact on the publishing industry over the next decade." *The Public-Access Computer Systems Review. 3.* 5-63.

Salisbury, D. (1996). *Five technologies for educational change.* Englewood Cliffs: Educational Technology Publications.

Salvaggio, J. L. (Ed). (1989). *The information society: Economic, social, and structural issues.* Hillsdale: Lawrence Erlbaum Associates.

Senge, P. M. (1990) *The fifth discipline: The art and practice of the learning organization.* New York: Currency / Dobbleday.

Schwier, R. A. and Misanchuk E. (1993). *Interactive multimedia instruction.* Englewood Cliffs: Educational Technology Publications.

Stoll, C. (1995). *Silicon snake oil: second thoughts on the information highway.* New York: Doubleday.

Tapscott, D. and Caston C. (1993). *Paradigm shift: The new promise of information technology.* New York: McGraw - Hill Inc.

Tapscott, D. (1998). *Growing up digital: The rise of the net generation.* New York: McGraw-Hill.

Toffler, A. (1990). *Power shift: Knowledge, wealth, and violence at the edge of the 21st century.* New York: Bantam Books.

Tulk. J. and Steinfield C. (1990). *Organizations and communication technology*. London: Sage Publications.

Wallinger, L.M. (1997). "Developing technology training for teachers." *Kappa Delta Pi Record. 34.* 18-20.

Warger. C. (Ed). (1990). *Technology in today's schools*. Association for Supervision and Curriculum Development. USA.

Weinstein. N. (1997) "Socrates at the terminal: Emotion's neglected role in high-tech education." *Educom Review. 32,* 53-55.

Yocam. K. (1996). An essential element of teacher development. In Charles Fisher. David C. Dwyer and Keith Yocum (Eds). *Education and technology: Reflections on computing in classrooms* (pp265-279). San Francisco: Jossey-Bass Publishers.

Appendix A
Letters of Approval and Consent Forms

Scott Reid
44 Nash Crescent
Mt. Pearl, Nfld
A1N 3G7

Dear (name of teacher):

I am a graduate student at Memorial University involved in research related to how the use of information technology across the curriculum will affect teachers' work. As part of my research, I will be conducting interviews (approximately one hour in length) with administrators and teachers at [your school] on this topic. I am requesting your participation in this study.

Your participation will consist of answering questions related to the use of information technology in teaching. The interviews will be approximately one hour in length and, if acceptable to the interviewee, will be audio recorded. Participation is completely voluntary. You have the right to withdraw from the study at any time and are free to refuse answering any question which you would prefer to omit. All information gathered in this study will be held strictly in confidence, and at no time will individuals be identified. Audio tapes will be erased at the conclusion of the study.

If you wish to speak with a resource person not associated with the study, please contact the Associate Dean, Research and Development, Memorial University, at 737-3402

This study has received the approval of the Faculty of Education's Ethics Review Committee. Dr. Jean Brown (737-7561) is my supervisor for the study. An opportunity will be provided for participants to review summary reports of the findings for the accuracy of any quotes.

If you would kindly agree to participate in the above study, please sign one copy of the attached form and return it to me in the envelope provided. If you would like to contact me, my telephone number is 368-0527.

Thank you for considering this request.

Sincerely,

Scott Reid

Consent Form

I _____ agree to take part in the study on the impact the use of information technology on teachers' work. I understand that participation is entirely voluntary and that I may withdraw permission at any time. All information is strictly confidential and no individual will be identified. All audio tapes will be erased at the end of the study.

Date_____   Signature_____

Scott Reid
44 Nash Crescent
Mt. Pearl, Nfld
A1N 3G7

[Name and address of School Board]

March 17, 1998

Dear (School Board Official):

I am writing to request approval to conduct interviews with administrators and teachers at [Name of school] as part of the requirements for the Masters of Education degree at Memorial University of Newfoundland. If approval is granted, I will seek the consent of individual teachers to arrange interviews at a time that is convenient for them between March 23, 1998 and May 30, 1998.

As a graduate student, I have been studying how the use of information technology across the curriculum will affect teachers' work. As part of this research, I would like to conduct interviews (of approximately one hour in length) with teachers at [Name of school] on this topic. The research proposal I have prepared is under the supervision of Dr. Jean Brown, Educational Leadership and approved by the Faculty of Education Ethics Review Committee.

At this point, [Name of school] is a leader in the area of the use of information technology. The situation in this school may provide some valuable clues as to what lies ahead for other schools in this province as they move towards increased use of information technology. Also, the findings might be useful to the people at [Name of school]. It might provide insight on how to improve things they are doing or alert them to potential problems.

The data collection for this research will be conducted within the following guidelines.

-Participation is completely voluntary. Participants have the right to withdraw from the study at any time and are free to refuse to answer any question which they prefer to omit.

-The interviews will be approximately one hour in length and, if acceptable to the interviewee, will be audio recorded.

-A copy of the thesis will be given to the school at the completion of the study.

-All information gathered will be held strictly in confidence, and at no time will individuals be identified. All audio tapes will be erased at the end of the study.

If you have any questions, please feel free to contact me at 368-0527. If you wish to speak with a resource person not associated with the study, please contact the Associate Dean, Research and Development, Memorial University at 737-3402. A copy of the completed thesis will be made available to the School Board upon request.

Your consent will involve signing the attached form. Thank you in advance for your cooperation in this matter.

Sincerely,

Scott Reid

Consent form

I_____, give Scott Reid permission to conduct research at [Name of school] as described in the attached letter dated March 17, 1998. I understand that participation is entirely voluntary and teachers may withdraw permission at any time. All information is strictly confidential and no individual will be identified. All audio tapes will be erased at the end of the study.

Date_____ Signature _____

Scott Reid
44 Nash Crescent
Mt. Pearl, Nfld
A1N 3G7

[Name and address of school]

March 17, 1998

Dear [Principal]:

I am writing to request approval to conduct interviews with administrators and teachers at [Name of school] as part of the requirements for the Masters of Education degree at Memorial University of Newfoundland. If approval is granted, I will seek the consent of individual teachers to arrange interviews at a time that is convenient for them between March 23, 1998 and May 30, 1996. As well, I have written the [Name of school board] to request their approval.

As a graduate student I have been studying how the use of information technology across the curriculum will affect teachers' work. As part of this research, I would like to conduct interviews (of approximately one hour in length) with teachers at [Name of school] on this topic. The research proposal I have prepared is under the supervision of Dr. Jean Brown, Educational Leadership and approved by the Faculty of Education Ethics Review Committee.

At this point, [Name of school] is a leader in the area of the use of information technology. The situation in this school may provide some valuable clues to what lies ahead for other schools in this province as they move towards increased use of information technology. Also, the findings might be useful to the people at [Name of school]. It might provide insight on how to improve things they are doing or alert them to potential problems.

The data collection for this research will be conducted within the following guidelines:

-Participation is completely voluntary. Participants have the right to withdraw from the study at any time and are free to refuse to answer any question which they prefer to omit.

-The interviews will be approximately one hour in length and, if acceptable to the interviewee, will be audio recorded.

-All information gathered will be held strictly in confidence, and at no time will individuals be identified. All audio tapes will be erased at the end of the study.

If you have any questions, please feel free to contact me at 368-0527. If you wish to speak with a resource person not associated with the study, please contact the Associate Dean, Research and Development, Memorial University at 737-3402. A copy of the Thesis will be made available to the School board upon request.

Your consent will involve signing the attached form. Thank you in advance for your cooperation in this matter.

Sincerely,

Scott Reid

Consent Form

I_____, give Scott Reid permission to conduct research at [Name of school] as described in the attached letter dated March 17, 1998. I understand that participation is entirely voluntary and teachers may withdraw permission at any time. All information is strictly confidential and no individual will be identified. All audio tapes will be erased at the end of the study.

Date_____ Signature _____

Appendix B
Interview Protocols

Teachers Work and Attitudes

How has the use of information technology changed the work you do? How do you feel about the use of information technology in the school? How do you use it in your teaching? Preparation for class? Class projects? Has your attitude towards the use of information technology changed? If so, how?

Does the introduction of this type of technology lead to the de-skilling of teachers? Or does it require teachers to acquire new and different skills? If so what are the new and different skills?

Professional Development

With regard to teacher development in knowledge and skill development: Does the use of technology help you as a teacher develop in this way? Are there any examples of how you have used the technology in this way?

With regard to teacher development as self-understanding: Does the technology lead to more communication among teachers? Is it a tool for self understanding? Are teachers in the school talking about how to learn to use it effectively?

With regard to teacher development as ecological change: Does the use of the technology change the context of teaching? For teachers? For Students? How?

Who has helped you obtain the new knowledge and skills you require in the area of information technology? (What individuals and groups, ie. STEM~NET)

The Future of Teaching

Teachers' opinions on the future of teaching: Some people are saying that the introduction of information technology will change the whole nature of schools. How far do you think such changes will go? How much do you think teaching will change?

How has the introduction of information technology affected the work that you do in the classroom?

How has it changed the work you do outside the classroom? Preparation? Grading?

Professionalization and Intensification

Has the introduction of information technology left you doing things which require less skills? Are you doing more menial labour? Are the skills you used as a teacher in the past now becoming irrelevant? Does it require more or less skill? Different skills? Lower or higher level skills?

Has the introduction of information technology meant more or less demands on your time? Is there an initial demand on time. then a levelling off or decrease in the demand on time?

Can you estimate how much time you have spent adapting to the use of information technology?

Some people talk about changes in how teachers feel about their work in relation to the adoption of information technology. What do you think about that? Have your feelings about your work changed since the use of information technology? If so how?

Will the use of new technology put more demands on teachers? Lead to more teacher burnout? Will it lead to more collaboration? The breakdown of barriers between subject areas? Do you see any barriers developing between those who use the technology and those who do not? The avant guard and the rearguard? The old and the young? Men and women? Or any other demographic?

Some have said that the availability of knowledge given by the use of information technology will call into question the role of professionals as experts and authorities in a field. Patients are now more likely to ask questions of their doctor and research their own aliments. Is anything like that happening with teachers? Are you being challenged in any way as professionals? By students? By parents? On the basis of content or methods being used? Are students now finding information themselves they would otherwise have asked you for?

Discipline and Students View of the World

Is the professional authority of the teacher is being questioned and expectations of them changing? If so is this leading to more or less discipline problems in class? In what ways?

How is the fact that students can be connected to other people around the world changing the concept of teaching local content? Is location becoming irrelevant to the students? Can they get a greater appreciation or understanding of the local through the contact they have with other regions?

Do some students use the information technology as a diversion? If yes. how is this affecting your work as a teacher? Is it distorting their perception of reality or adding to a clearer picture of reality? Are people / students forsaking the real world for a sort of "virtual world"?

Acceptable use Policy

Have there been any problems with acceptable use policy? What is the school's policy on acceptable use? Have there been any problems with hate literature or sexually explicit material?

Conclusion

What problems do you see developing as a result of the introduction of this new technology into schools?

Is there anything that I have not asked that will help me understand how the introduction of information technology is affecting your work?