INTEGRATING COMPUTER TECHNOLOGY

WITH TEACHING AND LEARNING

IN A SMALL RURAL SCHOOL

BY

BRUCE H. BACKHOUSE

A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

MASTERS OF EDUCATION

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Abstract

This study describes the process and experience of designing a new school, both figuratively and literally that established integrated applications of technology as a focus. The study began in a small rural school constructed in 1930 and evolved to a newly constructed school built in 1996 designed to facilitate the integration of technology for students, staff, community and business stakeholders. Although much has been written about the potential of computers to enhance teaching and learning the educational community has experienced little significant change relative to integrating computers with learning.

The study offers descriptions of experience related to initiatives that created change in our school. This thesis is organised in themes that emerged throughout the study as significant in creating change within our school. The themes include:

1. Creating staff appreciation of technology
2. Writing grants
3. Professional development
4. Developing community and corporate support
5. Computer use in classrooms: Software applications and Technology continuum

These stories and the conclusions outlined from the experience serve as one model for other educators and communities to draw upon in creating an appreciation and acceptance of technology. The fact that this occurred without access to traditional resources provides inspiration to others who refuse to accept "no" as an answer.

Acknowledgements

A number of people were personally and professionally affected throughout the course of this study. Without their help, support and understanding I would not have been successful. I wish to thank all of these groups and individuals for their patience. Benjamin Levin, Tony Riffel and Denis Hlynka as members of the committee provided help and guidance throughout the process. Parents and members of the Oak Bluff Community offered enthusiasm and encouragement over the past four years. The Technology Board of Directors demonstrated courage and initiative, believing in and supporting the initiative. Oak Bluff Students, past and present, were eager learners accepting the challenges of technology. Oak Bluff Community School staff are the best professionals I have had the privilege of working with. They participated throughout the process offering considerable time and energy to achieve our success. Joanne Rempel, the chairperson of the school board, provided support, her time and encouragement helping drive the vision to reality. My wife, Mary and children, Stephanie and Bret provided encouragement and sacrificed family time while I was involved in the process. My sincere thanks to everyone who helped bring the project to fruition.

Chapter 1 Introduction

Technology in education has the opportunity of changing the process and structure of teaching and learning in schools. For computers to have a significant impact as a foundation learning tool I recognise the need to facilitate the integration of technology. I write as an advocate of technology, not as a technophile. I became principal of a small rural school in 1993 bringing a variety of experiences using computers and teaching technology. This created the opportunity of developing a school focusing on using computers to support teaching and learning.

Throughout the process I recognise the difficulties of implementing and integrating technology and relate our school's attempts to confront these problems and develop practice supporting computer use. Students are encouraged to move from passive recipients of information to creators, constructors and presenters of knowledge. It is understood that the mere presence of computer technology does not ensure that it will be used effectively to enhance teaching and learning.

Moving from a situation where technology was not used in classroom teaching and learning to one where technology is an integral part of the school day involved a number of factors and steps. No single step or strategy effected this change alone. Rather many actions and initiatives worked in concert to create an environment accepting of and embracing change. I focused on this process co-ordinating the efforts, activities and interests of a number of stakeholders over the past four years as principal. This thesis

relates these experiences creating understanding of the events to serve as one example for others to draw upon.

This thesis is organised in themes that emerged throughout the study as significant in creating change within our school. The themes include:

1. Creating staff appreciation of technology

2. Writing grants

3. Professional development

4. Developing community and corporate support

5. Computer use in classrooms: Software applications and Technology continuum

The themes of developing an appreciation of technology and professional development are recognised in the literature. The literature suggests examples of computer use in classrooms. This study draws on these issues and examples and extends them to meet the needs and requirements of a small rural school. As the study progressed creating community and corporate support and grant writing emerged as significant issues. The study describes these processes developing conclusions related to their significance in our experience.

The second chapter includes stories of our experience with implementing computer technology within our school. They describe the transition of teachers and students working in an old school making little use of computers to one where students, staff and the community are learning together with computers in a new school with a technology focus. Stories are described chronologically within each theme. With a number of

events occurring simultaneously, as I move from one theme to another it is often necessary to return to the beginning of the story, 1993, when I first joined the school as principal. The following charts present events in the categories of (1) events (2) grants (3) professional development and (4) technology use, to help the reader understand the sequence of events. A school profile section is included providing a brief history of the school as it relates to technology and includes a background of the staff as primary participants in the study.

Year	1993-1994			
	Events	Grants	P.D.	Tech. Use
September	-become principal -Lori hired -sell old computers -acquire 4 PC's			
October				-I begin using computers in class
November				-other staff express initial interest
December				
January				
February			-I attend P.D. Session and learn Internet potential	
March	-word-processed reports			-all staff prepare reports on word-processing template
April				
May	-new school planning approved	.		
June	-1ˢ school home page developed -planning committee tours schools			
July	-develop education specifications for new school			
August				

Year	1994-1995			
	Events	Grants	P.D.	Tech. Use
September	-Kate transferred -Sheila hired -7 PC's added		-Technology staff meetings start	-technology classes taught by Teacher Assistant
October				
November				
December				
January				
February				
March	-1st meeting with Mike to involve business	-1st submission for Nortel award		
April				
May	-May 24th Public meeting, school planning and technology			
June				
July				
August				

Year	1995-1996			
	Events	Grants	P.D.	Tech. Use
September	-1 PC added		-technology staff meetings continue -mini in-school computer workshops	-teachers expected to teach computers without teaching assistant
October	-meet with local business and farmers to invite their support	-CAP grant written and submitted		
November	-new school construction begins		-technology continuum developed	
December		-CAP awarded ($30,000)		
January			-lunch hour technology staff meetings begin	
February			-all staff session on HTML	-2nd school home page developed
March	-Technology Board structure developed	-2nd Nortel submission "CommuniQuest"		
April	-ISDN line installed	-Multi-media grant awarded "Prairie Tour"		
May	-Community meeting on Technology Initiative and to elect Technology Board	-MANACE "Pan-am" project and MTS "Virtual Newspaper" submitted. Nortel awarded		
June	-move out of old school	-MANACE and MTS grants awarded	-lunch hour technology staff meetings end	
July				
August				Nortel team attends Dallas conference

Year	1996-1997			
	Events	Grants	P.D.	Tech. Use
September	-move into rented school -Betsy transferred -Susan hired	-corporate donations and alumni and community fund-raising on-going	-Monday and Wednesday staff meetings	-Prairie Tour implementation
October	-move into new school			-CommuniQuest implemented in Early Years
November	-Computer network installed. 28 stations available through-out the school -six staff receive notebook computers		-Hyperstudio session -Network orientation sessions	-all reports prepared with new word-processing program
December				
January	-Tracy hired -Sheila ½ time		-voluntary staff Monday and Wednesday sessions -HTML session	
February			-LOGO session	-Pan-am project implemented -Time sheets developed
March			-Divisional technology PD session	-all reports prepared with Access database
April				
May				
June				
July				
August				

Developing an appreciation of technology is the initial subject. One person alone may create a climate of change but in order for a different way of doing things to be institutionalised all affected stakeholders must participate in the change initiative.

> "At the outset of a reform effort, teachers need time to *learn about and practice* the new behaviours that will be expected of them, whether the reforms are imposed from above or organically developed at the school level. At a middle stage—usually called implementation—teachers need time to *introduce and institutionalise* the new strategies fully into ongoing daily life in the school and the classroom. Finally, because of the fragility of the change process, teachers need time to reflect on the reform initiative, assess its outcomes, and keep moving on the school improvement continuum." (Hargreaves 1997 p. 93)

Implementing technology involved students, teachers, parents, community members, division administration and corporate partners. Describing the change initiative I relate stories of actions and activities that included these groups and their involvement. One on writing grants follows this section. During the process of developing an appreciation of technology I discovered that grant writing forced an articulation of how technology could be used in our school. This process generated some of the most productive professional development sessions we experienced.

Following this section I describe the process of developing technology skills for the staff through professional development and training opportunities. As the community and

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corporate partners were important contributors to our technology initiative I relate our experience with developing their support. Finally I relate stories of technology use in early and middle years classrooms identifying the successes and frustrations staff experienced as they worked to integrate technology with teaching and learning. The concluding chapter provides my analysis and understanding of the significance of these events as they relate to our experience and the literature.

Throughout the thesis I describe the process of developing, implementing and analysing computer technology applications in early and middle year's classrooms. I study computer integration and implementation steps collaboratively with staff. Visiting other schools and educators who have addressed some of the same issues and working with Department of Education consultants provide background for this study.

REVIEW OF THE LITERATURE

My understanding of the literature suggests that there are several factors inhibiting integration of technology in the classroom. I describe our experience with issues in the literature of providing technical resources and ongoing professional development and training opportunities for teachers. The literature review also addresses issues of staff collaboration and sharing with students in developing an appreciation of technology and technical fluency among stakeholders.

As the study developed other factors emerged as challenges. The issue of facilitating integration of technology within the existing school day structure emerged as another issue throughout this study. Teachers experienced frustration, developing ways to make

effective use of computers within their classrooms while providing other learning activities for students. Encouraging teachers to break from traditional methods and providing support and an atmosphere to develop meaningful uses of limited computer resources is investigated. Examples of this are described outlining a variety of strategies teachers developed throughout this study to challenge the structure of classroom time in an attempt to facilitate integration of technology. How computers are used to support teaching and learning is an important element in this investigation. The review gives examples of appropriate and inappropriate uses of technology and provides an operational definition of technology integration through examples. This study attempts to address these issues in a small rural school with limited resources.

My reading of the literature divides it into two general categories. A number of authors describe the promise of technology giving examples of how it can and should redefine teaching and learning. A second group takes a more cynical view citing examples of how massive investments in technology have done little to change the complexion of schools today. This led me to organise the literature review in two sections (1) The Promise of Technology and (2) Current Reality of Technology in School.

Integrated Technology Applications: The Promise of Technology

A conversation with a Department of Education consultant identified four areas to consider in moving the use of technology from skills to process and outcomes. These include (1) research and accessing information (2) communicating with others (3) constructing knowledge and (4) presentation. Integrating technology applications can occur in many areas across the curriculum.

"When the curriculum is integrated around a theme with proper attention given to brain compatibility, teaching strategies, and curriculum development, then the learning will come alive. The student will become a passionate participant in education. The goal of educational technology is not to make teaching more difficult, but to enable students to more easily access great amounts of information, manipulate the information, and use it to solve problems." (Allison 1995 p. 20)

Using these four outcomes with learning provides concrete terms to gauge technology integration. Students use the computer to access information, use the information to develop understanding and present their understanding to others using the communication and presentation facilities of the technology.

Research applications of technology involve creating conditions where schools provide learners with understanding of how to identify a need for information, how to locate and gather relevant information and how to apply that information to resolve a question. CD-ROM, Database and Internet search capabilities expand the research base far beyond what was possible a few years ago. Teaching the skill of finding and using information in meaningful ways can be integrated throughout the curriculum in projects requiring research and information.

Communication involves using technologies to share understandings and collaborate with others. Integrating technology with writing is more than simply replacing the pen

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with a keyboard. Evidence of improved editing and revision through word processing is well documented.

> "The characteristics of a word processing software effectively lead students to focus more on the actual content and editing of a text. Once students have acquired this skill, they also use it with more traditional tools. Through greater metacognitive and metalinguistic awareness, writing with a computer can also give students an incentive to think about language and to better assess the suitability of the terms they use." (Grégoire *et al.* 1996 p. 12)

Technology provides the means for more collaborative writing opportunities both within the classroom and beyond with e-mail. E-mail conversations provide a valuable collaborative tool among students and teachers. (Curtiss and Curtiss 1995) Students have the opportunity to share and comment on each other's writing electronically. Teachers are no longer the sole judge of quality of student writing. A real audience of student peers is created providing motivation for student writing.

Technology constructions may be physical or intellectual. Learners create physical constructions with robotics tools. Problem-solving and logic activities with Logo programming and creating robotics constructions can be integrated in the math and science areas. The opportunity to create interesting projects involving structured and higher level thinking moves students beyond what they might achieve without technological applications. Intellectual constructions occur when learners use

information they have accessed to create understanding of a concept or issue. "Real learning occurs when students, through inquiry and investigation, apply their conceptual understandings to new scenarios and unfamiliar problems." (Thomas 1994 p. 14)

Students involved with integrated technology applications gain meaningful experiences. Learners present and share knowledge in a variety of formats demonstrating the creativity and organisation of the learner. Interactive multimedia can be defined as "the integration of text, audio, graphics, still image and moving pictures into a single, computer-controlled, multimedia product" (McCarthy 1989 p. 26) Technology provides the opportunity for students to demonstrate and share understandings in creative ways with multi-media presentations.

> "Revised pedagogues are increasingly concerned with fostering learning and performance in students that is: i)'higher-level' in the sense that students apply their knowledge to analyse, understand, solve problems rather than simply recall facts, ii) 'authentic' in the sense that it is relevant to student activities and situations beyond the classroom, and iii) 'independent' in the sense that students can apply their knowledge and skill as appropriate to different subject matters. These general objectives motivate a pedagogy in which students carry out and present projects (rather than, or in addition to memorising facts), interact with peers, teachers, and other people beyond the classroom as both learners and sources of information, and are responsible for planning activities and co-

ordinating multiple sources of information in the pursuit of knowledge."

(Grégoire *et al.* 1996 p. 12)

Learning technical skills is necessary to create multi-media presentations and those skills develop while learning in other areas of investigation. This requires a sophisticated and highly motivating platform of communication providing depth of understanding. Presentation applications may take the form of creating multi-media presentations, Web pages or computer presentations and slide-shows.

To understand questions they are studying students need to use technology for a good portion of the day.

> "Technology clearly has the potential to vastly transform relationships
> between teachers and students and even what schools look like. However,
> the history of education reform provides scant evidence that such a
> transformation will occur simply because the technology exists. Schools
> have demonstrated an unyielding resistance to change over the decades.
> Reforms that are adopted tend to be those that readily fit existing
> organisational structures and practices." (Sandholtz 1995 p. 18)

To achieve this, with a limited supply of classroom computers, requires a serious examination of practice and how the school day is structured. Activities that we perceive require the attention of all students limit the use of technology in the classroom. Teachers are trapped by the history of experience and practice. Technology encourages change from large group instruction. "Teachers will have to confront squarely the

difficult problem of creating a school environment that is fundamentally different from the one that they themselves have experienced." (Sheingold 1991 p. 23) The restrictions of having to learn the same knowledge at the same time with the same resources in the same way need to be re-examined. It means that instead of creating classroom timetables we develop structures and a climate of learning that facilitates student investigation and learning.

Teachers' prior practice is a significant indicator of how technology is used in the classroom. It is important to understand whether technology is adding to learning, not replacing other valuable activities. (Miller and Olsen 1995) As teachers move from providing answers to coaching students in acquiring understandings some discomfort will occur. Structures and practices that make the unfamiliar valid and meaningful will have to be developed.

> "Although technology can serve as a catalyst for teacher change and can help teachers move toward a more constructivist approach, the professional journey from instructionism to constructionism—and to effective integration of technology—is generally slow and arduous, and requires a high level of support. Typically, teachers begin using technology to replicate old patterns of instruction; it is often years before they progress to the stage in which they truly integrate technology and use these tools to their fullest potential. In some cases, teachers do not move far beyond using technology for drill and practice." (Ringstaff et al. 1996 p. 5)

Our students are most likely to be motivated to learn when they are challenged by teachers who themselves are learning. By focusing on individual student success and creating a structure to facilitate this our school can create opportunities for students to succeed.

Creating integrated technology applications matches the development of assessment practices. Technology provides a means for students to demonstrate understanding by developing electronic portfolios allowing a variety of means to show understanding. "Their major roles (students) are collaborator and active participator...before learning, students set goals and plan learning tasks: during learning, they work together to accomplish tasks and monitor their progress; and after learning, they assess their performance and plan for future learning. As mediator, the teacher helps students fulfil their new roles." (Tinzmann et al. 1990 p. 5) The student's role in setting goals and establishing a means of achieving them will be enhanced.

Technology is dynamic and relatively new. "A variety of studies, however, tell us that computers in themselves do not automatically change the nature of teaching and learning; rather, it is the way teachers integrate computers into classrooms, the content of technology-aided lessons, and the quality of software programs selected that determine whether and how computers in schools really benefit students." (Woronov 1994 p. 9) More than any other curricular area, a framework with suggestions for the integration of technology needs to be developed. The potential of technology is recognised. "Technology would enable students to become collaborative workers, critical thinkers,

and evaluators of information, especially as they gained access to a wealth and variety of external and internal data sources." (Buckley 1995 p. 65)

Demystifying technology, putting it in the hands of teachers and students, effects change and improvement in teaching and learning. The classroom teacher working and learning with students throughout the day provides guidance to students in an integrated pursuit of understanding. "One of the most significant impacts of the use of computers in the classroom is change in teaching style. Teachers can go beyond the traditional information delivery mode where they are presenters of ready-made knowledge and become facilitators of students' learning (Ringstaff *et al.* 1996 p.27) A first step in "Staff development means helping teachers fearlessly dream, explore, and invent new educational experiences for their students." (Stager 1995 p. 79) Finding ways to guide teachers and students in using technology to enhance teaching and learning is the goal of a professional development program.

Integrated use of technology considers previous activities and practice in the classroom. Computers cannot baby-sit, or replace worthy learning activities. Identifying successful classroom experiences, and discovering how technology can serve as a resource in these leads to integration. "Computer-related staff development should immerse teachers in meaningful, educationally relevant projects. These activities encourage teachers to reflect on powerful ideas and share their educational visions in order to create a culture of learning for their students. In brief, teachers must be able to connect their computer experience to constructive student use of computers." (Stager 1995 p. 78) Constructive

use, enhancing classroom practice ensures that technological resources have an encompassing effect.

Rather than identifying a technological skill or application and designing a classroom activity around that application the process is reversed. "Facilitator facilitating involves creating rich environments and activities for linking new information to prior knowledge, providing opportunities for collaborative work and problem solving, and offering students a multiplicity of authentic learning tasks." (Tinzmann et al. 1990 p. 3) The first step is developing meaningful classroom investigations, and identifying technological supports to develop these processes. Successful teaching and learning involves developing classroom experiences that immerse students in questions and investigations supporting their search for answers and understanding with the appropriate resources. Technology is a powerful resource in the pursuit of these answers and understandings. Once teachers have developed educational experiences they need time and training to learn how technology can support student learning with these experiences.

An element that cannot be ignored is the opportunity for staff to network and collaboratively develop integrated learning experiences. "Perhaps the biggest barrier to technology use is time: time for training, time for teachers to try out technologies in their classrooms, time to talk about technology." (O'Neil 1995 p. 11) Developing a culture of sharing and providing time to make it practical is an important component of the technology professional development plan. Barth (1991) proposes that little change will take place in schools unless teachers are observing, helping, and talking with each

other. Teacher interaction in effective schools tends to be frequent, task focused, and widespread. However, in many schools, opportunities for interaction are limited, and communication tends to be informal and infrequent even though teachers believe their teaching could be improved by working with colleagues. Access to computers and professional development opportunities for teachers are the two biggest obstacles to effective integration of technology.

By identifying areas of technological skill development and sharing these among the entire staff a broader base of technology expertise and collaborative climate is developed. Just as student learning of skills is most effective when they are taught within the context of a question they are pursuing, staff understanding of a technological skill is best learned when the connection between their practice and the skill is evident and immediate. "Technology would (1) enable teachers to develop new instructional practices as they experimented with its potential as a pedagogical tool and (2) increase internal school communication and, thus, increase professional dialogue among teachers." (Buckley 1995 p. 65) Providing a broad source of expertise fosters development of technological fluency.

The responsibility for developing technological fluency among staff needs to be shared. "If energy and resources are focused on creating a few successful models of classroom computing each year, the enthusiasm among teachers will be infectious." (Stager 1995 p. 80) Good teaching practice and use of technology develop interactively as teachers develop and share successful models of integration.

A school-based teacher development project took place in New Zealand in the early 1990's. (Allison 1995) The teacher development model included access to computer facilities, information and software and focused on classroom practice in the belief that this would create long-term change in teacher behaviours. A core of teachers was established, ideally from the same school, to create a cluster of peer support. The training focused on the development of individual action research projects. While the teachers were initially given background information on technology, they were expected to develop and implement an action research project utilising some aspect of technology in their classrooms. During the project they were provided with technical support and encouraged to share questions and understandings with their peer support group. At the conclusion of the block, cluster teachers were brought together with other teachers involved in the project to share their experiences. The data gathered from a study of this project suggests this classroom-based model was well accepted by teachers and promoted integration of technology.

Students provide a valuable resource in developing technological skill and literacy. When provided with time to explore technology they develop expertise and skills that can be shared with their peers and teachers. "Moreover, when students see that their experiences and knowledge are valued, they are motivated to listen and learn in new ways, and they are more likely to make important connections between their own learning and "school" learning. They become empowered." (Tinzmann et al. 1990 p. 2) No longer can the teacher be expected to know it all. Technological explorations develop collaborative relationships between teachers and students. The student assumes a

more direct role in the development of the curriculum as this power is shared more equitably. Teachers and students investigating real problems together develop a stronger rapport and motivation for learning.

Current Reality of Technology in Schools

Technology in education has the opportunity of changing the process and structure of education in schools. Historically it has fallen short of achieving any real change for teaching and learning. Questions of computers in classroom or labs remain unresolved. (Snider 1992, Cuban 1994) Integration of technology to improve student learning and understanding is badly done. Thousands of dollars poured into technological resources has created little difference in teaching and learning. Failure to address professional development for teachers and a focus on skills based training cause ineffectual technology applications. (McKenzie 1993) "This is based on the belief by many decision makers that learning how to use technology within the context of instructional delivery is simply a naturally occurring & osmotic process; & that users are willing & able to learn how to use technology by proximal association to the technology." (Jukes and Holmes 1996 p. 2) As with other trends in education, technology will be treated with a cynical view unless educators demonstrate real benefit for student learning through technological applications in education.

Technology plans rely on access and availability of computer and hardware resources. "What too often happens is that technology plans are not education plans at all, but indeed, shopping lists of techno-stuff. And this stuff is often located where it will not provide the best support for learning-, in labs down the hall, away from the direct point

of instruction and learning, the classroom." (November 1995 p. 1) Computer labs with scheduled times are currently used in many schools. Student access to technology, supporting integrated use, in areas of investigation is unavailable. This structure encourages the teaching of computer skills, as the students need something to do during their time in the computer lab. "Too often, in elementary schools they (computer labs) are used as pull out programs, with little or no connection to support the learning in the classrooms." (November 1995 p. 1) Technology programs driven by software rather than students pursuing individual questions often gives students artificial tasks to learn software applications. Very little carryover occurs unless students have access to a computer outside of school.

Previously all other technologies were passive, i.e. filmstrips and VCR's. Computer technologies are the first interactive technological innovation on the educational scene. (Dockterman 1995) Seductive technology misleads people, causing them to think that students sitting in front of computers manipulating software applications with apparent ease is productive use of technology. New interactive technologies and multi-media applications allow for exciting possibilities for learning. These programs, used well, enhance learning opportunities in the classroom. Hyper-media presents students with information removed from the narrative context through which we derive understanding. (Snyder 1994) Teachers need to maintain choice over educational materials used in the classroom.

Powerful software can become a crutch to shelter teacher's discomfort and lack of experience with technology. "Many schools look at technology and decide to buy lots of

computers and lots of software, then make a schedule." (Hancock n.d. p. 6) Well-developed software appears to supplement classroom practice and areas of investigation without really challenging student thinking or supporting curriculum and learning. Over-reliance on pre-packaged software can have a negative effect, as teachers lose important skills in curriculum choices and planning. (Apple 1992) Teachers are less likely to adapt software to student needs than with other teaching materials. (Borrell 1992; Callister and Dunne 1992)

Integrating technology with curriculum is difficult in schools where few computers are placed in classrooms. The attempt to integrate technology with daily learning has its own set of problems. Scheduling computer time on only one or two computers for a full class means students get only short and sporadic time on the computers discouraging thorough and diligent use of technology. With short and varied time available student use of computers is often for remedial or software driven applications.

> "Perhaps the saddest occasion for me is to be taken to a computerised classroom and be shown children joyfully using computers. They are happy, the teachers and administrators are happy, and their parents are happy. Yet, in most such classrooms, on closer examination I can see that the children are doing nothing interesting or growth-inducing at all! This is technology as a kind of junk food - people love it but there is no nutrition to speak of. At its worst, it is a kind of "cargo cult" in which it is thought that the mere presence of computers will somehow bring learning

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back to the classroom. Here, any use of computers at all is a symbol of upward mobility in the 21st century." (Kay 1996 p. 8)

When times arise where technology enhances and supports investigation, it is difficult to demonstrate the application to several students gathered around a single computer. Student time to use the program in their study is limited with many students vying for one or two computers. Understanding the importance of integrating technology and providing the hardware, software and staff development does not solve logistical questions of computer use in schools.

Examples of successful technology applications are reported in the literature. These often reflect a few classroom successes developed by energetic and technologically literate teachers in well-equipped schools, with technology resources. These are important achievements and serve as inspiration to educators interested in technology. Many reports of technology enhancing learning and understanding in significant and meaningful ways do not reflect the experience or practice of the majority of educators. These isolated examples sometimes create a false sense of technology contributions to teaching and learning. Creative success stories also contribute to the mystique of technology removing it from the grasp and scope of "average" classroom teachers. More attention needs to be paid to the "average classroom". (Borrell 1992; Miller and Olsen 1995)

People are often overwhelmed with technology and ignore it, as teachers cope with everything else on their plates. "Though teachers may be knowledgeable and fully

capable of fulfilling their responsibilities, the sheer volume of work often required in an increasing number of areas forces them to perform a juggling act daily. As a result, time, rather than competence or ability, is often the key issue." (Hargreaves 1997 p. 100) Technology specialists may inhibit integration. Technological skills and applications, taught outside the classroom, remain the domain of the specialist with little transfer to the classroom. Specialist skills and resources assisting the classroom teacher to integrate technology with learning investigations cannot be achieved in a single professional development sessions.

Integrated Technology

Two stories of technology use that occurred recently serve to illustrate integrated, educationally relevant, applications of technology. In these examples the teacher and the students identify technology use. Rather than asking how the computer can be used, teachers ask what are we thinking and learning about today, and how can technology help? "Instead of asking teachers, 'What technology do you need?' ask them 'Which concepts are the most difficult to teach and what information would help you teach these concepts?' " (November 1995 p. 1) With the area of investigation identified, students and teachers have accumulated experiences with technology to understand how it can support their learning. Increasingly, extensions of technology are discovered when students and teachers ask; can the computer help? At these moments resources need to be provided to support learning computer applications in the context of questions the students and teachers are studying.

The first example of integration of technology occurred in a middle year's class. In preparing for a literature study the students and teacher were encountering difficulty selecting books for a theme from growing classroom libraries. A need to 'get organised' was expressed. One of the students suggested that they could type the titles on the computer and print out a list of all the titles they had. More discussion led to the identification of additional information they wanted to keep track of. It was at this point that a database application was introduced. Students were shown how the information they wanted to track could be organised into fields and how the class could work together to get the information into the computer so that searches and reports could be generated. A comment field caused the students to think about how they could respond to books in meaningful ways using a limited number of words.

Some of the students in this group were previously *taught* databases in a computer class. None of these students noticed the potential to use this application for the classroom library. Teaching the database out of context, presented as a solution to invented problems, caused limited understanding of it at best. Interest in the application is more genuine in the context of a problem the class needed to solve.

This example illustrates several of the features I regard, as successful integration of computer technology is classrooms. First, the teacher and students identified the problem in the classroom. It is important that technology be integrated within the context of daily classroom investigations rather than introduced as a solution to a problem introduced to provide a reason to use technology. Second, experience caused the students to understand that their classroom computer had the potential to help with

their problem. This is significant as it suggests acceptance of the role of technology and understanding that it can help. Third, the application was introduced within the context of a classroom task. The opportunity to learn technology applications while solving real problems improves learning and understanding. Finally, the technology supported and extended student learning of the original question. In this instance the database not only helped with the original organisation problem but also extended the learning by causing the students to review their responses to ensure they were meaningful and concise.

Sometimes students and teachers are unaware of technology applications that support classroom activities. Here a resource person outside of, but familiar with the classroom can suggest integrated applications of technology. An example of this occurred in an early year's classroom. A teacher introducing data management in mathematics to prepare students for mathematics standards exams looked for resources in technology. Through discussion with the teacher, a link was identified between a classroom science activity and graphing activity. Students weighed themselves and using information from research, calculated their mass on different planets. To help students compare their mass on different planets the graphing features of a word processing program was used. This allowed the students to view and compare the data in a variety of formats.

The classroom teacher understood what she wanted to do, but was unaware of this feature of the computer application. Discussion allowed it to be introduced in a meaningful context. As in the previous example, this is an effective integration of technology applications because the application supported a classroom-based activity even though it was introduced from outside the classroom. Once the teacher was

provided with the support to learn the application it was easily taught within the classroom. This application also extended student learning by giving them the ability to create a variety of graph formats. This in turn led to discussion of how to compare information graphically and provided an intermediary step in moving from the concrete to the abstract.

Methodology

The study began as an action research to examine the development of strategies for integrating applications of information technology in classrooms. Action research may be defined as "Systematic inquiry that is collective, collaborative, self-reflective, critical, and undertaken by the participants of the inquiry. The goals of such research are the understanding of practice and the articulation of a rationale or philosophy in order to improve practice." (Anderson *et al.* 1993 p. 3) As a participant the study remained true to the principles of action research as it related to my involvement in addressing the questions and achieving the initial goals. Because the process included a number of other persons and groups, it also involved a description and reflection on the actions and experiences of all participants in the project. Collaboration with the staff, questioning and reflecting on practice provides a variety of perspectives. Reflections on the frustrations, experiences and successes of integrating technology allow for analysis of our experience in developing an integrated technology program.

Three main sources of data were included in the study.

(1) personal reflections and descriptions of the process, staff writing, conversations and interviews sharing their experiences with the process

(2) conversations and informal interviews with business and community representatives and

(3) notes and minutes of staff meetings and meetings of the Technology Centre Board of Directors.

The study took a descriptive and narrative form. Writing and sharing reflective stories of experiences framed within daily experiences leading towards achieving change in teaching and learning with technology helps create understanding of the process. Participants in the study read pieces of my writing during the study commenting and providing reactions. Their reactions were used as data throughout the study. Understanding our educational action and practice becomes evident in the construction and reconstruction of shared stories of experience. Through formulating and sharing these stories a common understanding of our practice developed. As this is a study in progress and not an evaluation of completed experience it involves continual reflection and analysis. Reflection includes a spiral of cycles.

To develop a plan of action to improve what is already happening.
To act to implement the plan.
To observe the action in context in which it occurs.
To reflect on these effects as a basis for further planning and subsequent action through a succession of cycles. (Anderson *et al.* 1993 p. 13)

Our staff accepted the challenge of integrating technology with their work in classrooms. Conversations, observations and interviews as they worked towards the integration of technology provide information for others to consider in understanding the implementation process. Staff stories and writing of experiences with integrating

technology were carefully considered. Participating staff members frequently shared their experiences, successful or otherwise, with integrating technology. It was understood and seen as desirable, that there was variability within the school in terms of integrating technology with learning and teaching. A number of factors led to differences in scope and depth of integration in classrooms, including; student age, class composition, teacher's technical experience and subjects and curricular year of instruction. This study was not critical of varying levels of integration but seeks to understand, through narration and analysis, patterns of movement towards integration.

Stories included in the thesis were chosen because they provided insight to the central question of what strategies and practises lead to integrated applications of technology in the classroom. Notes of points discussed during staff meetings and issues raised during casual conversations with staff are also included. Observations of technology use in classrooms were discussed with teachers to develop an understanding of how technology worked in the classroom. Listening to student voices and observing reactions as they lived through the process helped me to develop understanding of the impact and potential outcomes of the experience. The three data sources provided a chronological account of events throughout the process.

(1) I kept journals and personal records throughout the process. Journal entries include notes outlining the discussion and various staff members' contributions during staff meetings. After staff meetings I wrote reflections, raising questions and outlining my understanding of the meetings. The frequency of staff meetings varied throughout the study. Over the course of the four years there were periods with staff meetings focusing

on technology twice a week that included all staff members. While writing proposals for grants the meetings were more frequent, focused and intense. Other times meetings with technology as the main topic occurred monthly. The variance was the result of the variety of issues occurring throughout a typical school year. In total the data includes records from over twenty meetings.

Journal entries also included reflections after conversations with individual staff members about their experiences with integrating technology. Causal conversations with individual teachers occurred frequently throughout the school year. As the atmosphere of collaboration developed it was common for teachers to talk about their experiences and plans for using computers, seeking advice and reactions from peers. I was sometimes an active participant in these conversations and sometimes chose to observe and listen. After these conversations I wrote a summary of the dialogue and a reflection of my understanding of its significance. I used these summaries and reflections to guide my descriptions and analysis of developing experiences with computer technology. The content of these conversations provided insight into individual teacher's experience and feelings on technology integration.

In the spring of 1997 I provided a questionnaire to four staff members who had signed letters of informed consent agreeing to participate in the study (appendix A) and conducted interviews with each of them focusing on their written answers and experiences with the technology integration process. I took notes during these interviews while the participants elaborated on their experiences with technology. The

notes and interviews guided my writing of descriptions of their specific experiences with integrating technology.

Following this I circulated a further technology questionnaire to all staff members and met with them afterwards to discuss their responses and experiences. The questionnaires and notes taken during the interviews provided additional data for the study. The questionnaire included the following three questions.

1. What are you/we doing with technology that we are ready to institutionalise as 'the way of doing business' in Oak Bluff that no longer needs attention?

2. What are your short term- now to June- 'achievable but need to be worked on' goals related to technology?

3. What supports do you need to help you achieve these goals? I will direct my efforts into providing supports to help.

During sessions to write grant proposals all staff contributed writing related to technology integration. The process forced articulation of goals, beliefs and strategies of computer use and applications in our school. These pieces were shared and discussed among the staff, providing additional insight and data for me on the issue of technology use and integration. The specific grant applications describe strategies for integrating computers with teaching and learning. Follow-up reports on the grant implementation process identify successes and frustrations with integrating computer technology. In total six grant applications were written during the study with five awarded and

implemented. The text of the grants and follow-up reports guided my description of the grant writing process and specific implementation strategies.

(2) Conversations with business and community members add to the understanding of technology integration in the classroom. Their perspective on what we achieved and their understanding of the role and importance of technology provided valuable information. To the extent that availability of hardware and software supported integration of technology a description of how this was achieved is included. The process of providing these materials is not the significant portion of this study but their impact on successful integration is considered.

(3) To develop our Technology Centre a board of directors was elected and met at least once a month. Broad and varied representation on the board added perspective to the study. Members of the board include representatives of the business community as well as parents and educators. Conversations with these stakeholders provide a perspective beyond the education community. The impact of the board in achieving significant levels of technology is described. Notes, proposals and minutes from board meetings are included as they relate to the question.

In the thesis actual words of participants are recorded in quotation marks. Events that are related from my recollections of conversations are paraphrased and not quoted directly. Throughout the study a series of reflections on events that held significance towards achieving technology integration are included. These journal entries provide an

account of events and an opportunity to reflect on impressions and preliminary analysis on how events unfolded.

Participants

Participants are staff members of our School. As principal I facilitate the implementation of the technology vision. Willingness to be involved and contribute to the study was the choice of individual staff members. A cross-section of contributing staff members was selected to provide a broad range of experience with technology in the study. Two early years and two middle years staff members signed informed consent forms and are primary participants in the study. Other staff and technology board members are mentioned as their actions and experiences relate to the narrative. As an active participant in the project I interact, plan with staff and students, include stories of my experiences with technology in the classroom and continually reflect on and analyse our progress.

Initial Assumptions

Reading and teaching experience with a variety of technology structures raised the following preliminary ideas and issues.

1. Effective use of technology requires broad commitment to a vision articulating the importance and advantages of using technology to enhance teaching and learning. Acceptance of this vision is critical for teachers and extends beyond to include students, parents and community members.

2. Professional development is important to foster teacher's comfort with technology. In-service education and training needs to be ongoing with resources provided while teachers are developing integrated learning activities with technology.

3. Interest, adaptability and willingness to challenge existing teaching practices must be present, or developed, among teachers to change how technology is used in schools.

4. Teachers need a supportive school climate allowing them to use technological innovations in a non-threatening environment. Opportunities to collaborate and share ideas are important.

5. Adequate and functioning hardware and software resources must be close to classrooms. Ideally a number of computers in each classroom will be present.

6. Implementing technology in learning places considerable demands on teacher's time preparing to use it effectively.

Research Questions

Initial questions framing the study include the following.

1. What examples of computer use in participants' classrooms enhance learning and teaching?

2. What factors account for differences in the extent that technology is integrated within and between classrooms?

3. How is technology integrated with classroom activities to extend and support teaching and learning in the classrooms?

As the study progressed different questions emerged focusing on the five themes outlined in the introduction. (1) Creating staff appreciation of technology (2) Writing grants (3) Professional development (4) Developing community and corporate support (5) Computer use in classrooms: Software applications and Technology continuum. The understandings that evolved related to these questions are addressed in the conclusion.

Time line

The study encompasses the years 1993 - 1997. Describing from 1993 - spring 1996 I rely on my recollections and understanding of how events unfolded. From spring 1996 - spring 1997 descriptions are primarily based on notes, minutes, interviews and records. The development and articulation of the vision among staff and community has occurred. Teachers developed their awareness of technology while creating and using classroom applications. These applications are analysed, built upon and extended. Reflections on several experiences provide a balance of information for analysis.

Significance of the Study

This study is personally and professionally significant as it provides a structured forum for analysis of Oak Bluff School's Technology Initiative. Our small schools experience with technology is unique in many ways and serves as one model of experience for other educators to draw upon. Three and one half years spent in the planning and development stage are completed leading to the implementation stage. This study helps develop understanding of the implementation process.

School Profile

Oak Bluff School is a small rural school located just outside of Winnipeg. Since 1889 four different school buildings have existed in Oak Bluff. The current school completed and occupied in October 1996 replaced a school serving the community since 1930. Historically the student population was comprised of rural children from Oak Bluff and the surrounding area. Two housing developments in the community created increased enrolments and a shift in the make up of the student population from rural to suburban. The majority of students in 1997 are children of parents living in Oak Bluff and commuting to work in Winnipeg.

Oak Bluff enjoys the support of an active parent body and community. In 1988 when the school threatened to close due to low enrolment, parents and community members rallied together petitioning the school board and investing volunteer hours and dollars to renovate the school. In 1995 the student population grew to over ninety from a low of twenty-two. With new development in the area the student population grew to the point where the existing school was inadequate. Parents actively exercised political pressure to add portable classrooms while waiting for approval from the Minister of Education to begin construction of a new school.

In 1994, during the Provincial boundary review process, parents prepared a delegation to the Review Commission and a majority of community members wrote in support of their local school. They felt very strongly that Oak Bluff School must remain rural to maintain its roots and community values. "Oak Bluff school is a wonderful rural school which provides our children with excellent teaching and programs. A small school with

high standards and high moral values, which is what we have now and are striving to maintain." (Dusik 1994) Parents understood the social capital they enjoyed as a part of small community with strong support and involvement of parents. "We as parents watch out for the other children as if they were our own children" (Vanwynsberghe 1994) The sense of closeness of the community is evident and valued by its members. "That lifestyle is exhibited in the attitude of residents toward each other and their community. We prefer to live where neighbours know and look out for each other." (Ferguson 1994) Within the community there is a shared responsibility for its members and common values, norms and expectations.

Parents currently expect and enjoy an active role in their school. Parents comment frequently that; "Our participation in school activities is encouraged and meaningful." (Glass 1994) Fundraising activities are well supported. Parents volunteer in the school assisting in their children's education on a daily basis. Parents and community members participated in a series of education meetings, during the 1994-1995 school year, to articulate the values of the school to develop a mission statement for their school. The community worked actively in the design and planning of the new school raising over $100,000.00 to purchase additional land, build a baseball park and increase the gymnasium size facilitating community use outside of school hours.

Staff

I joined the school in 1993 meeting the existing three staff members and adding one additional teacher from the school I was leaving. Deidra, the school secretary, worked at

the school for twenty years. Sarah, a middle year's teacher with seven years experience and Debbie, an early year's teacher with fourteen years experience taught in the school since 1989. Kathy, an early year's teacher with seventeen years experience, transferred with me from another school where we taught together four years before moving to Oak Bluff. Lori, a teacher with one year's experience, transferred from another school in the division as a kindergarten/music teacher. During the 1993-94 school year Debbie taught a grade one, two class, Kathy taught a grade two, three class, Sarah taught a grade four, five class and I taught a grade five, six class.

In 1994-95 Kate joined our staff as a middle years teacher and Sheila joined us as an early years teacher. Kate had eighteen years teaching experience, four of which were in a school where I was the principal. Sheila came from the Department of Education and Training with one year of classroom experience. During 1994-95 Lori was the kindergarten/music teacher, Debbie and Sheila taught multi-age classes of grades one, two and three. Sarah and Kate taught grades four, five and six. I taught grade seven. Kathy taught grade seven and trained as a reading recovery teacher. The same teaching assignments held for 95-96.

In 1996-97 increasing enrolment created a third multi-age grade one, two and three classroom. Susan was hired to teach kindergarten and music after completing her certification year in our school the year before. Betsy transferred from another school in the division as a physical education and middle year's teacher with eleven years experience. During 1996-97 we moved out of our old school into the new school. We rented a school in the city for the first six weeks while waiting for completion of the

construction of the new school. The teaching assignments for 1996-97 included Susan teaching kindergarten/music. Debbie, Sheila and Kathy teaching grade one, two and three multi-age classes. Sarah and Kate teaching grade four, five and six multi-age classes. Betsy and I shared the grade seven/eight class. In January 1997 Sheila chose to work half time and Tracy, a recent graduate was hired to job share the early year's position. In 1996 - 1997 the school served 153 students.

Historical Background related to Technology

When I joined Oak Bluff School in 1993 there were two MacIntosh computers and one 286 P.C. Some older students used computers for word processing and computer assisted instruction. Oak Bluff was the only school in the division with MacIntosh computers. The school division established a policy mandating PC computers but provided no professional development plan or software support. A computer purchase plan supporting the program provided six computers from 1993-1996. I decided to sell the existing computers using these funds and money from the home and school association to provide additional computers for the school.

Prior to1993 staff use was low for the following reasons:

- lack of training
- little encouragement or expectation by the principal for staff to use the computer
- limited software available
- too few computers to allow for integration
- poor staff morale

The degree of staff use affected the level of student use. Computers were used as an enrichment tool for bright students. Students who had computers at home made more direct use of the schools computers than those without.

In the first year, 1993, I placed computers in the middle years area and the school office. Local school funding provided four computers and software in 1994, with no support from the school division. I taught a computer class to all middle years students. In the weekly class I introduced simple word-processing and Logo programming. Though access was limited, with only four stations, all students were presented with a basic computer background and introduced to applications they could use in their daily work. With this introduction students began using the computer more often in their assignments and investigations. The staff encouraged student use and began to recognise how computers could be used in the classroom. The school division provided four computers in 1995 and local fundraising added three more. In 1996 the school division provided an additional computer.

There was still difficulty with integration beyond the problems of accessibility with a limited number of computers available to students. Computer technology was added on rather than used to extend and support learning in the classroom. Assignments were word-processed but not composed at the computer. Most of the editing and revision occurred on paper with the computer used as a tool to generate a published copy of student work. Other applications including Logo programming were in addition to and unrelated to the curriculum. Students used keyboarding and CAI programs when they had extra time or as enrichment activities.

In 1995 more time was allocated to computer instruction. I hired a Learning assistant with special expertise in computers to teach computer classes 2-3 times a week. This proved a difficult undertaking, with only six middle years computers spread throughout the school. Although more time was allocated the issue of classroom integration was not addressed. Prepared exercises structured to teach application skills unrelated to classroom studies and investigations provided the focus of instruction. Students used these skills, but for the most part these were students who either had computers at home or were academically involved. Two years and nine additional computers had done little to change the level and depth of computer use in the school.

Staff understood the importance of computers in the classroom but lacked experience and confidence to utilise them fully. As long as others, the principal or a learning assistant, were delivering instruction staff had little need to work towards implementing computer technology in their regular classroom program. Changes in staffing allocation in the fall of 1995 removed the technology skilled learning assistant from our staff. Rather than replace this support I expected individual teachers to become responsible for their own computer implementation in the classroom. This caused staff members to become more aware and responsible for computer integration in their classrooms. Sarah described the experience as being poised at the end of the 10-meter diving tower, wanting to, but afraid to jump. The removal of the support was analogous to being pushed.

At this stage some staff became more interested in what I was doing with technology in my classroom. Watching students working in my classroom provided ideas and guidance for teachers on how they could adopt technology. Some teachers visited the classroom

while I taught an aspect of technology and used these ideas and applications in their own classrooms. By providing an example of technology use in the classroom these teachers became more confident trying computer applications in their classrooms. When asked for advice on how they could use technology I provided advice and occasionally helped them with their technology-based lessons.

Chapter 2 Stories of Experience

Creating Staff Appreciation of Technology

Developing a sense of staff commitment takes time. Over a number of years staff members changed from low use of computers to frequent and committed technology users. No singular event created this but a series of changes caused incremental change among staff.

For technology to become an established priority in Oak Bluff School, staff and community members participated in the development and articulation of a technology vision. Staff developed our technology vision through daily experience with the computer and participation in the planning and design process of the new school. My interest in technology created initial staff interest. Their interest grew with staff and student experience and success with technology. It is difficult to say when the staff as a whole began to articulate their commitment to technology as a priority in Oak Bluff. In the early stages staff recognised the importance of technology but did not consider it as the most significant priority. Through the new school planning process all staff understood technology to be a cornerstone of Oak Bluff School and committed their support.

The school division allocated me half release time as principal during the design process. This involved a number of meetings during the day that focused on technology as I attempted to develop an understanding of how computers would integrate in our school.

As part of the planning process for the new school I wrote and presented a set of Educational specifications to staff and members of the planning committee in July 1994. Technology formed two paragraphs of the fifteen-page paper. All members of the planning committee participated in discussions meetings and toured five schools in Winnipeg and southern Manitoba. Using these observations and discussion a list of fundamental principles for the school design was composed. The main points in the list used throughout the planning process included:

- ease of communication
- efficient flow of traffic
- meeting space for adults and students
- technology and a community library
- flexible use of spaces
- ancillary space that can be used beyond traffic flow
- non-institutionalised atmosphere
- storage allowing sharing of resources
- large classrooms
- activity based classrooms
- space facilitating observation of students
- community and parent space

My previous experience using internet in the classroom with a modem and regular telephone line led me to conclude that this did not work well. Slow speed, unreliable dial-up and the restrictions of too few computers with access caused me to look for alternatives. The resources of the Department of Education and Training, Manitoba Telecom Services and private computer consultants suggested a high-speed line with direct Internet access. At the time this service was not available in Oak Bluff at a

reasonable cost. Our interest in technology caught the attention of technical representatives of Manitoba Telecom Services. They were looking for a rural trial site to test ISDN switches. Oak Bluff's location and expressed interest in technology led to the formation of a partnership with M.T.S. In the spring of 1996 we became the first rural site in Manitoba with ISDN connectivity. This partnership made our project more credible and tangible with staff and the community.

Implementing change in practice and thinking among our staff follows an established and accepted pattern. Since joining the school in 1993 I sought staff and community involvement in significant decisions in our school. Changes initiated in assessment, parent communication, development of a mission statement and multi-age groupings involved providing staff with research and literature. In weekly discussion group's staff questioned the articles I provided and how they related to our school. Sharing insights and concerns among staff led to collaboratively developed implementation plans. Separate meetings to discuss business items were held as needed so that educational discussions were not overwhelmed with management issues.

The pattern for technology unfolded similarly. Beginning in September 1994 I circulated articles on technology to the staff for discussion. Initial articles dealt with the promise and potential of technology focusing on examples of highly technical schools. The upcoming high-speed connection created excitement among the staff and I and its potential in the new school. Our early discussions were general and did not deal with specific teaching and learning applications of technology in the classroom. Attendance

and involvement in these meetings was good. The discussion tied directly with design issues we were considering in the building plan.

During one staff meeting, before an upcoming community meeting announcing the progress of the school design, I asked staff if they were comfortable with the technology direction. I did not want to share and build the expectation of a highly technical school in the community without staff commitment. Staff responded that they understood the importance of technology and agreed with proceeding in that direction. Sarah wrote me a note saying that at this stage she thought, "We all saw technology as the direction we needed to head to give our students skills for the future. I think the staff had different ideas about what 'computers in the classrooms' meant. Some saw it as another tool to be used by the teacher and students but were unsure how to implement it."

In September 1995 the tone and content of staff discussions changed. I asked more specific questions on computer use in the classroom. Articles focused on experiences of teachers in classrooms using technology. I asked the staff frequently how they were using technology and what plans they had to integrate it with their teaching. To gain community support I stressed the importance of demonstrating our use of technology. I encouraged applications that supported the curriculum giving students opportunities to exercise more direct control over the computer. I gave mini professional development sessions on Logo, e-mail, web searches and web design to help provide examples of how technology could be used. I consciously and continually asked staff if they supported our technology direction.

Differences in staff involvement began to emerge during these meetings. Sarah, Debbie and Kathy freely expressed their interest in using computers and asked for help understanding specific difficulties they were having. Kate stayed on the periphery of the sessions, noticeably silent in the discussions. Sheila frequently offered comments and suggestions during both discussions and application sessions.

Teachers participating most in the sessions were those who had a computer at home and had the most years of service at the school. These teachers asked my and other teacher's advice with particular applications. The questions related to classroom applications they wanted to, or were in the process of implementing in their classrooms. Teachers on the periphery were those without computers at home, and with less technology experience. They did not use the computer to prepare teaching materials or directly in the classroom.

My questions on technology use expressed the expectation that teachers begin to use computers in meaningful ways in their classrooms. As teachers were involved with other activities and programs it became difficult finding time to hold weekly meeting focusing on issues related to the entire staff. I decided to change the form of support in January of 1996. Meeting time is at a premium in a small school with teachers continually on recess and lunch duty. Noticing that reluctant teachers seemed more comfortable admitting their need for help to other teachers in similar classrooms I introduced a plan to facilitate this communication. From January to June I took the lunch hour recess duty providing all teachers with a 40-minute duty free lunch. I was straightforward in requesting that at least ½ of this *new found* time be spent discussing technology. I offered to act as a resource in classrooms once applications that made sense to their classes were developed.

Providing time, peer support and the expectation that implementation and integration is an important factor of teaching in Oak Bluff School was the reason for the change.

During recess duty I missed the time sharing problems and successes with teachers. Strolling around the playground I hoped teachers were actively engaged in technology discussions. The staff was honest telling me they appreciated the time and used it to work with students or collaborate with peers on other issues but not much time was spent specifically discussing technology. Missing these meetings made it difficult to offer suggestions or classroom help having missed the initial planning. In September 1996 we moved back to holding meetings twice a week on Monday and Wednesday mornings to discuss technology.

In 1996 I introduced a series of staff meetings focusing on technology. Initially the agenda was open during these meetings, with teachers invited to bring issues and ideas relating to technology and teaching to the meeting for discussion. During these meetings we referred to the technology continuum (Appendix C) to guide discussion on specific uses of technology in the classroom. In September Kate shared an idea on using a database to track student reading. In the same meeting Sarah suggested using a spreadsheet to calculate horsepower and work, extending it into a graphing activity. Betsy shared an idea using spreadsheets as part of a data-management exercise. Kate said, "Can I see that when you get it running?" Sheila talked about getting early year students to practice writing their names in cursive writing with the mouse in Paintbrush. All of these applications were in the early stages of implementation.

In late September, as teachers began to use technology ideas in their classrooms the discussion changed in staff meetings. Kathy raised the need to focus on the continuum and expressed the potential problems she saw with implementing too many software programs at once. Debbie talked about the struggles of trying to get her early years students using the computer throughout the day for extended periods of time. She said they were doing pretty well in the mornings but struggled for a way to extend this into the afternoons.

In October involvement and participation in meetings began to drop. As we were more involved with the school year, in an unfamiliar rented school, teachers needed time to deal with preparation issues for their daily teaching. Meetings started late with low participation. I raised the issue with staff. Sarah suggested that articles relating to technology would provide a focus and some common ground for the discussion. Beginning in mid October and continuing through November I provided articles once a week with the expectation that staff read the article and be prepared for discussion in meetings. The discussion became less specific to using technology in the classroom as we focused on questions and issues raised in the articles.

Debbie expressed genuine enthusiasm during these meetings. During a meeting on October 20th discussion focused on an article referring to problem based learning. The idea of post-hole problems caught Sarah and Debbie's interest. "Post-holes are short problems that can be used when teachers don't want to design their entire course around problems but do want to introduce one occasionally." (Aspy, Aspy and Quinby 1993 p. 27) Kathy suggested that she felt cynical about the article and didn't see how it fit with

issues of standards testing. She said, "We read all this material about divergent thinking and then we're faced with tests designed on convergent thinking." Debbie suggested that she liked the idea of post-holes as they allowed her to take a risk by jumping in with small steps. She asked if anyone wanted to work with her to create some post-holes to start students using technology. Sarah volunteered and she and Debbie met after the meeting. In an interview with Sarah in December she said, "I really appreciate Debbie's interest and enthusiasm. It's infectious!"

On October 28th we discussed an article by Sheingold on technology and restructuring. Kate started the discussion by asking about active learning vs. adventurous teaching, two concepts mentioned in the article. "The students can't be active learners if the learning is all text-based." said Kate. Debbie expressed concern on how active learning matches with external expectations and exams. "Active learning is process based, but will exams test these skills or will they be content based?" asked Debbie. I suggested that we had to be accountable and if we didn't think these teaching strategies were the best for our students we shouldn't be using them. As the students learn with active learning strategies and technology they will succeed on tests as well.

Sarah read, "But technology is not likely to have a qualitative impact on education unless it is deeply integrated into the purposes and activities of the classroom." (Sheingold 1991 p. 20) "I know we need to integrate but where do we get started?" she asked. Kate said, "We are ready to go. We just need to dive in but I don't know where to start. It feels like the pool is empty." Debbie jumped in offering, "That's where the post-holes come in." Sheila stated, "We need to work in teams to develop this. We need concrete projects

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to work on." One of the staff reminded, "We have three formal integrated technology projects currently running in our school." Sheila reread the part of the article describing schools of the future. Sarah and Kathy suggested that except for a few minor things our school was just like the ones described.

Throughout the fall meetings different teachers expressed frustration on how to make the most effective use of computers in the classroom. Questions of how to maximise student time on the computers and have others productively involved came up. Teachers talked about using schedules and the problems with students forgetting their time or having a scheduled slot at a time when they didn't really need the computer. This led to discussion and attempts by some to change the structure and organisation in their classrooms.

In January 1997 voluntary meetings were scheduled in the library twice a week. Teachers working with technology met to share their experiences and learn from others actively using it. There was no specific agenda and teachers gathered and worked on the computers using one another as a resource. Kathy, Betsy and Sheila attended infrequently. Susan, Tracy, Sarah, Kate and Debbie learned from one another in these hands on sessions. The participating teachers received encouragement and ideas from each other in a supportive environment.

Writing Grants

With visions of a new school fully equipped with current computer technology we realised the problem of funding. Grants were a potential source. The first grant we

attempted, as a staff was the Nortel, "Excellence in Education" program submitted in March 1995. The award provided a cash prize and a weeklong professional development session in Toronto for successful applicants. The writing process involved the whole staff, Barb, the school trustee and Mike, a local businessperson.

We were generally inexperienced but enthusiastic about writing grant proposals. Initially the writing process focused on the importance of receiving funding, providing hardware and software. This motivation encouraged involvement of all staff, business and community representatives. Grant writing provided a focused forum generating discussion of computer use forcing articulation of the technology initiative. This was valuable in creating understanding between the school, community and business of the importance of our goals.

We met after a school design meeting to begin the writing process. I circulated background information on the project to provide the group with a starting point. I shared key words and phrases I thought needed to be included in the grant. "Technology as an essential enabler", "integrated applications of technology" and "technology to facilitate life-long learning" were phrases referred to in the grant application. I hoped that the group was ready to write sections of the grant identifying how technology would achieve these principles in our school. Talking as a group provoked questions. Lori asked, "What do they mean by essential enabler and how does that work in my kindergarten class?" "How will we integrate computers in the classroom with twenty students and four computers in my classroom?" remarked Debbie.

The background information I shared was from university papers and other reflections on computers in classrooms. Its general nature did not offer specific suggestions or applications of technology in the classroom. Sarah stated, "I understand that computers have a role to play in the classroom and we need to find ways to use them but I have trouble relating them to everyday classroom activities. You've been thinking about this so long Bruce that you know what you want to do, I think we need to talk about examples of how we can use it." Mike was relatively new to our discussions and asked, "How will technology tie in with the curriculum and the subjects the teachers have to teach?"

The discussions carried on for the rest of the evening. The final deadline for the grant application was two weeks away. Teams from the group volunteered to write specific sections of the grant application. Selecting five of the nine members to form the final team was a challenge. The grant criteria mandated the team composition include two teachers, one senior division administrator, one board official and one parent or community member. I filled the role of division administrator as our superintendent was retiring. Barb and Mike filled two more positions. I suggested that the staff draw straws and include one early years and one middle years representative to fill the two remaining spots. The staff agreed and Debbie and Kathy drew the lucky straws.

Smaller teams spent the next two weeks writing their sections. Kathy was travelling over spring break so Debbie and I pulled the sections together for the final submission due the last day of spring break. During the break we met a number of times completing the grant and meeting the deadline.

We received news in May that our submission was unsuccessful. The writing process affected staff enthusiasm for computer integration. Writing the proposal generated discussion of how computers could support and extend learning. It was evident in reviewing the application, that like the existing level of computer integration in the classroom, it was still visionary and philosophical rather than pragmatic and classroom based. Considering educational and philosophical reasons for including computer technology in the classroom was easy without struggling with the practical realities of implementation. This unsuccessful attempt focused our understanding and generated discussion of technology in the classroom.

The next grant we applied for was a Community Access Site sponsored by Industry Canada. Being turned down for the first grant application steeled our resolve to become more successful. I asked for volunteers from the staff to work on the grant submission rather than involving all staff. Sarah volunteered and I asked Sheila to join us as she suggested she had previous experience with grant writing. We met at Sarah's home in October with the intention of composing the grant in a daylong meeting.

Sheila outlined key points she considered important as we attempted to work on specific sections. Sheila phoned people she knew throughout the day looking for contacts and information to help with the submission. At the end of the day a number of the grant sections were outlined. We divided these sections among us and met to review the draft two weeks later. The process improved our grant writing skills but the nature of the grant did not focus on classroom applications of technology.

Our award of $30,000.00 to develop a Community Access Site was received in December. This success was rewarding and exciting for the staff and community. After sharing the news with the staff I called Mike and Alan, the two community members most involved with our project. I believe the success boosted their resolve to accelerate the fundraising initiative to support the technology centre. We raised our profile in the school division through grant successes. External recognition helped gain divisional support for our technology initiative as a whole.

A consultant with the Department of Education informed me of a new multi-media pilot project sponsored by Manitoba Education and Training in the fall of 1995. Successful schools would receive $20,000.00 worth of computer hardware and software to implement an interdisciplinary project focusing on the grade five curriculums. I asked Sarah to apply for her multi-age 4,5&6 class. She was enthusiastic and interested in computers and was involved with the previous two grant submissions. We prepared the five-page grant application together submitting it October 1995. Sarah's classroom and teaching strategies were highlighted in the grant so the entire staff was not involved in the writing process. Providing innovative examples of Sarah's teaching were the key criteria for this grant.

Identifying Sarah's creative teaching strategies helped raise her esteem as a teacher. Previous activities she took for granted were included in the grant application. Sarah is a hard-working dedicated teacher. Letters of support from parents of Sarah's students articulated this. Her teaching was validated and recognised in the grant proposal. It took several months to receive final approval for this project. Several months after receiving

the grant Sarah asked me if I knew of any political reasons for our success in receiving the grant. I reminded her of the acceptance letter that stated the key criteria for choosing successful applicants was evidence of creative teaching. Winning this grant substantiated and reinforced Sarah's teaching in her mind, developing her confidence.

With two successes under our belt confidence developed and we wrote three more grants during the spring of 1996. The early years teachers, Debbie, Kathy and Sheila, joined to prepare a submission for a MANACE (Manitoba Association of Computing Educators) grant focusing on the Pan-am games. The proposal involved early year's students researching countries participating in the upcoming Pan-am games and preparing Hyper-studio stacks presenting their findings. Early year's teachers identified a specific classroom activity using technology to gather and present information in this project. The submission successfully received $900.00 for implementation software. More significantly the proposal outlined a strategy for early years teachers to use technology in support of a collaboratively developed learning project.

Although the dollar amount of this grant was small, early year's staff developed ownership for the implementation of a project integrating technology. We received grant approval in June 1996 with implementation taking place during January and February of 1997. Early year's staff developed a three-week project integrating research and the study of participating countries with student created presentations based on their understandings. Guest speakers developed student interest and excitement in the project. The communications co-ordinator for the Pan-am games was impressed with the

students' work and their pages were linked to the official Pan-am games site. As students realised the audience their project would receive they were diligent in editing their pages.

While the early years teachers prepared the Pan-am project, Sarah and Kate from middle years partnered with Lori, the kindergarten teacher to prepare a grant submission for M.T.S. (Manitoba Telecom Services) "Partners in Education". This grant developed around the creation of a virtual newspaper including scanned kindergarten contributions. The plan was to develop a community newspaper and post it electronically on the World Wide Web. The motivation for this grant was to acquire a scanner and OCR software. I suggested the virtual newspaper idea and the team generated the proposal along those lines to justify the scanner. We were successful in receiving the grant and the scanner is used frequently by students to prepare presentations.

In February of 1996 we decided to make another attempt at the Nortel "Excellence in Education" project. After the first experience we understood our thinking must be classroom based, addressing how technology impacts on teaching and learning. Driving back from a meeting Sarah and I discussed potential integrated projects. We invented the name "CommuniQuest" for the project and took the idea back to the staff. We made a deliberate choice to develop a project including activities for the whole school, based on a similar theme. I hoped this would facilitate collaboration providing the opportunity for all staff to contribute.

The basis of CommuniQuest is the belief that individual communities are the building blocks that together form the global community. Communication and technology are

driving forces enabling individual communities to develop an appreciation and tolerance of one another.

CommuniQuest provides students an opportunity to enhance understanding of themselves as citizens of their community, the Canadian community and the global community with technology and communication. Using Social Studies as the project cornerstone, concepts from other curricula create an interdisciplinary theme for the entire school to explore. This project provides real-life connections with technology for students while learning about other communities and sharing our community with others. A common thread throughout this project is the understanding of how communities meet their needs (food, shelter, communication, transportation, and conflict resolution). The influences of history, geography, weather and population on communities is explored.

CommuniQuest creates the opportunity for an in-depth study of communities. Different groups investigate similar aspects of community with a slightly different focus. Early Years (K-3) study their community in depth. They investigate history and geography exploring how present day needs of their communities are met. Student's research pioneer families learning their families' roots and what pioneer life was actually like. Geographically, the students examine landforms and use mapping skills. Studying 'needs' is an important aspect at the Early year's level. After exploring their community's needs the study expands, using communication technology, to include another Manitoba community—a Hutterite colony and a community in Japan. The

students discover similarities and differences through studying the needs of these three diverse communities.

Grade 4, 5, & 6 students extend this examination of communities including Canadian communities in different regions of the country. Connections, using technology, with students in the North, the Atlantic region, British Columbia, the Prairies, Quebec and Ontario provide a broad perspective. Looking at weather and weather patterns across the country, and studying geography creates understanding of its far-reaching effects on populations and their needs. Through real and immediate communication with other communities about how their needs are met students discover our similarities and differences as Canadians. The historic roots of the communities are investigated leading to a deeper understanding of what it means to be a Canadian citizen.

The grade 7 & 8 Social Studies curriculum focuses on civilisations from ancient to modern times. The basic format followed by the early years and middle year's students in studying communities can apply to a study of civilisations through time. Studying people satisfying their needs will be the thread woven through history into modern times. The ancient civilisations of Europe, Asia, Africa, and South America are studied as students attempt to link with modern communities in China, Mexico, Egypt, Rome, Greece and France. Comparing and contrasting these communities, the students will discover patterns of meeting basic human needs and how they have changed through time. They will consider how technology is influencing the needs and communication patterns of modern day communities. The older students will look at similarities and

differences across time and international boundaries to understand what is to be a citizen of the global community.

All staff was invited to participate in the discussion and generation of ideas. In regular meetings discussion focused on specific applications of technology related to the principles of CommuniQuest. Rather than drawing straws, for this submission I chose the staff participants. I asked Sarah and Debbie to participate as the team members. Of the staff these two teachers put the most effort into integrating technology with their teaching. I felt it would be unfair for their efforts to go unrewarded through the luck of the draw. They were most enthusiastic and enjoyed the chance to discuss and develop the project. After the choice other staff members continued to express interest but were more sceptical about how it would develop in the classroom. This was possibly a result of not being a part of the in depth discussion leading to the project development. The cause may be rooted in a sense of resentment for not being chosen and thereby missing the opportunity to participate in the conference.

Our team was selected to participate in the "excellence in Education" forum for the Communiquest project. Although the dollar amount of this award was not the highest of our grant successes this project and the Pan-Am project are the most successfully implemented projects in our school. The opportunity for the team to participate in the weeklong conference in Dallas during the summer of 1996 had a significant impact on team members. The intensive weeklong conference featured many high profile speakers and the interaction with other educators across North America generated many questions and discussion among team members. Although we attempted to share some

of the insights and the enthusiasm generated during the conference with the rest of the staff afterwards it was difficult to encapsulate the experience in a few one-hour sessions.

Professional Development

As teachers are the primary implementers of technology in the classroom, facilitating the use of computers is a key issue. Training and professional development, in the use of applications integrating technology with learning in meaningful ways had to be developed.

> "...The common experience is that training programs are of limited success in that they can tend to be disruptive to school schedules, frequently lack specific instructional focus, and often do not meet the individualised needs of the affected teachers in that they are, of necessity, generic rather than specific in nature. Additionally, the skills taught are commonly introduced in isolation without regard to the necessary context to professional and instructional tasks." (Jukes and Holmes 1996 p. 2)

The distinction between training and professional development is an important one. In professional development a new paradigm with implications for what knowledge is valued, the structure of the school day and assessment is developed. This process of challenging existing teaching practice is on going and develops over time. Training on the use of software and hardware applications supports integration of technology but the need is more immediate as particular teaching and learning strategies emerge in the classroom.

Training with a computer function is most timely while it is being used in the classroom. The training is fresh in the teachers' and students' minds and they have a broader understanding of what they need to know while they are involved with the program. This presents an interesting dilemma in developing a long range training plan. On the other hand teachers may not know that a particular software program has an application for the classroom without exposure to it. Developing a balance between training on a just in time basis and exposure training to maximise teachers limited time is an interesting challenge.

Our technology implementation strategy didn't include extensive formal professional development. Limited time, money and resources caused us to create other opportunities for professional development. Most often we looked to one another to help learn new applications. Sometimes the learning was accelerated as we worked on an application for a specific need with a deadline.

In 1994 I made the expectation that all staff would generate anecdotal report cards on a school-wide, word-processing template. This caused staff to get involved with the new computers and learn word-processing features. Through this experience staff learned the frustrations and the power of word processing and desktop publishing and gradually began to use these features in more of their teacher-generated material. Sarah commented that before this experience she felt little need to utilise the computer in preparing materials. Her drafting experience made it easier, previously, to simply draw and write the teaching materials out. The *forced* computer exposure created confidence causing her

to realise the potential of applications in her teaching. After this experience she began using the computer for teacher preparation.

On three different occasions in our technology experience, linking computers with report cards occurred. Each of these instances had the effect of accelerating the acquisition of staff skills and expertise. "There is no escaping the fact that not everyone will want to join in on efforts to become computer literate. Some school wide goals have to be mandated, both as to type and degree." (Haubrich 1996 p. 21) The first instance of using the word-processing template for report cards gave a purpose to learning previously unexplored word-processing features. These included tables and other formatting functions. Writing our anecdotal reports using the computer was an expectation forcing staff members to use computers. Report card deadlines caused staff to work intensively with the word processor. As problems came up a solution had to be found. Staff frequently contacted each while writing report cards to seek technical advice. Support while using the word processing application helped staff learn a computer skill when and while they needed it to solve a problem. This helped develop a network of technical support for teachers to turn to within the school.

The second change with report cards came in 1996 when we moved from a stand-alone to a networked system. With this change we switched software packages to Microsoft Word. Teachers were aware of many functions of word-processing through their previous experience but continued to use the familiar software package in producing instructional material. Forced to create report cards with the new software bridged the

transition from one program to the other. Again, the report card deadline forced staff to learn functions of the new software rather than use the more familiar program.

With much of the familiar software gone staff and students began using the new operating system and software. Coincidentally this occurred at the same time as our first reporting session. The new word processing program was used with the familiar previous report card format. Learning the new system while struggling to meet a deadline immersed staff in the new program. As we encountered problems, each staff member became an 'expert' sharing discovered solutions with others. With everyone busy preparing reports, questions were fielded to the staff as a whole with everyone contributing to the solutions. Buzz sessions involving two or three staff members were common while staff learned more about the program. This created more collaboration and openness regarding technology as no one felt his or her questions were silly or too obvious. Collaboration was high as staff learned and shared their experiences with different quirks in the program. This provided a technology equaliser between more and less experienced staff.

For the spring 1997 reporting period a parent designed a database template using Microsoft Access. Our staff had limited familiarity with the program and databases as a whole. I provided a brief overview of databases and an introduction to Access. Following this, teachers gathered in the library to 'explore' the program. People moved from computer to computer sharing discoveries and new tricks we learned about the program.

The third change involved a move from word-processing to databases. This change was more significant as it involved a move to new and unfamiliar territory. Although the change was made to take more advantage of our network it also recognised the record keeping function of databases. A parent with expertise in this area designed a sophisticated template utilising the capabilities of databases. Both her and I provided staff orientation on the use and function of databases. The change took place after moving into the new school allowing staff to take advantage of both their notebooks and the library media setting with six computers clustered in one area. This promoted collaboration as staff worked together in one common area writing their report cards. Although no transition from report card to classroom applications of databases is evident yet the experience created an awareness of databases.

With the report card deadline looming teachers worked evenings and weekends in the library. Six computers together in one area made it easy to share experiences and problems with one another while working. The parent who created the database helped teachers get started with the program. Teachers transferred files from the network to their notebook computers allowing them to work on reports at home or at school. During one of these file transfers one teacher lost all the previous evenings work. This created frustration but all the staff pulled together to find a way to help out. The experience of using databases in a real application created an opportunity to learn their use thoroughly.

Parents in the community provided technical support in all three cases of using the computer with different programs to create school report cards. Different parents

created the initial template in each of the three instances. These parents provided support and advice during report writing. Staff members felt comfortable contacting these parents for technical help if other staff members or I couldn't answer an encountered problem. The parental involvement in the creation of our different report card formats caused staff to appreciate the importance of this application of technology. Parents appreciated the efforts our staff made in using technology and supported their efforts in learning new applications.

Report cards produced with the computer presented a more polished image of school correspondence. The anecdotal nature of the reports, in concert with student-led conferences provided parents with the information they needed in a professional looking format. A subtle and unintentional message was sent to the community through the new report card format. The new reports included more information, in a clearer format, than the previous hand written report and created the image that Oak Bluff was a technical, computer literate school.

Word-processing functions learned while writing report cards began to emerge in teacher created instructional materials. After the report card experience teachers were more comfortable using computers in their preparation. Although they still experienced frustration when charts, tables and other formatting did not print as expected an appreciation of the power of word-processing emerged causing teachers to stick with the application, seek help from peers and parents in a determination to make it work. It was after the initial report writing experience that one teacher designed a daybook template using the computer to create a more personal planning form.

Attending a professional development session, in the spring of 1993, made me aware of the potential of the Internet. The session demonstrated how the World Wide Web provided access to information. Intrigued by other school's presence on the Internet. I decided to learn Hyper Text Mark-up Language (HTML) and create a Home Page for the School. After an introductory university course and hours of trial and error I created a simple page serving as a starting point for staff and student web searches.

To update the page, in the spring of 1996, I asked staff to learn HTML and help with the project. I downloaded an improved web editor from the Internet and offered to teach the staff how to create a web page. We divided the home page into sections and groups of staff prepared the text and found relevant links and images to go with their sections. During two weekly staff meetings I demonstrated the principles of HTML and asked the staff to use the editor to develop their sections. The deadline passed with none of the staff completing their sections. I was particularly disappointed when school was closed for a storm day and none of the staff took advantage of the day without students to work on the home page. I speculated that they did not have enough experience and guidance with web page design to tackle the project.

Shortly after this a parent in the community e-mailed me suggesting a friend of hers, who worked part-time creating web pages, volunteered to help with the school's home page. As the resource person worked shift work the only available time to meet was Sunday morning. I presented the opportunity to the staff and we agreed to meet at school to learn HTML and work on the page together.

I was impressed that all of the staff committed by giving up their Sunday. After an introduction to web design and the new editor we broke into groups to create each of the sections. Staff who had experimented with the web editor was more comfortable troubleshooting their work and continued when they encountered difficulties. Other staff were more easily frustrated and sought help from the resource person and I when they met problems. Interested in learning they needed support and guidance from peers more confident with computer software to use trial and error in the project. Working with partners most of the sections were completed except for some of the fine-tuning required to have the page functioning on the Internet. This process occurred during the spring of 1996.

Early in 1997 the staff participated in two half-day professional development sessions using a new Windows 95 web editor. I participated in the first session with three other staff members. Betsy had no experience with web editing while Sarah and Kate were involved in previous sessions. Kate and Sarah used the editor to create pages for use in their classrooms. Betsy partnered with Sarah to watch what she was doing. We didn't complete a project for use in the classroom during this half-day session. We discovered that one of the applications would not work practically and the others needed work and adapting for use in the classroom. Staff experienced web page construction and began to understand its potential use in teaching. One teacher commented that she learned about tables and formatting functions that could be applied to word processing applications. Future use and page development by teachers will be determined by classroom applications that support their teaching.

The second session involved early year's teachers. Prior to the session they expressed eagerness to learn Front Page web editor in a project based on the Pan-Am games. Earlier they planned to use Hyperstudio to present student research and understanding of participating countries. The time to involve the students preparing presentations seemed prohibitive with little opportunity to share the projects beyond their classrooms. Presenting the projects through the Internet on the school's home page widened the audience. Teachers initially questioned whether the students could handle the page design with the software package. Four of the six teachers in the in-service were participants in the earlier HTML session in 1996.

The day before the session I previewed, with a consultant from the Department of Education and Training, a new software package developed for early years web design. This package lacked the power of Front Page but included stamp functions making page design very simple. With only an evaluation copy of the new product I decided to proceed with the planned session using Front Page editor. The format was similar with a brief orientation and demonstration followed by guided exploration as the teachers created sample pages based on the project they were developing for the classroom. The enthusiasm was higher and more dynamic during the afternoon as teachers moved from computer to computer sharing their learning and helping others problem solve their pages. Teachers frequently commented on the ease of the program and how they could see using it in their classrooms.

Towards the end of the session I demonstrated the new web editor and suggested that we decide which program to use. I expected them to be impressed with the new program

and thought the problem would be to help them see the need for the more sophisticated program. Staff was interested in the new program but patiently waited for the opportunity to go back to the pages they were writing using Front Page. They continued to explore and learn with the first web editor. Although Front Page is more complicated it is still easy to use and the problems encountered require and create more thorough understanding of the Internet and web design.

Both groups of teachers had the same mix of enthusiasm and experience with computers and web design. The success of one session over the other may be accounted for by the problem that each group brought to the session as it related to their classroom planning and practice. Although both groups were asked to come prepared with thoughts and material that they would like to develop for web pages, the second group had specific applications in mind. The development of a page based on the Pan-Am games was an immediate issue for their classroom teaching. The other group listened to suggested applications but wasn't making the immediate connection to their classroom teaching.

In November 1996 we devoted a professional development day to Hyperstudio. With this program 'cards' and 'stacks' are created to form presentations. It is a powerful piece of software allowing the creation of interactive presentations included text, graphics, sound and animation. Sarah, Debbie and Kathy had some previous experience with the program gained by exploring on their own. A computer consultant from Winnipeg #1 School Division was the resource person for the session. During the session the resource person introduced features of the program to allow teachers to begin designing cards and stacks. There was no specific focus for the session other than trying some of the features

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of Hyperstudio. Overall it was an informative day. Teachers used the information in different ways.

The Hyperstudio session didn't help Sarah as she already learned many of features by using it with her class. The session helped Kate develop the confidence to encourage her students to create Hyperstudio presentations on towns they studied in social studies. Using the tools she learned in the session Kate introduced the program to her students and guided them in the project.

In February 1997 I presented two sessions on Logo to early and middle years staff. In the early years session we reviewed the rationale for using Logo in the classroom. I demonstrated how to use commands to create graphic designs. Together with the staff we developed patterning activities and the sequence of skills students need to experience success with the program. In the middle years session I used a similar format. After introducing the basic commands and constructing some simple shapes we experimented with writing procedures to tessellate the shapes. Both the early years patterning activity and the middle year's tessellation activity were attempts to integrate the use of Logo with Math activities.

Since the session none of the teachers have tried using Logo in their classrooms. In a half day in-service session there wasn't enough time to develop the base set of skills required to use the program comfortably. Some of the teachers experimented on their own with Logo. During twice-a-week hands on computer sessions in the library I helped interested teachers prepare Logo activities for the classroom. Practising with the program and

learning more of its features during mini after school sessions develops teacher's skills to a level allowing them to use it in the classroom.

With the focus on technology in Oak Bluff School we were asked by the division to host a divisional professional development day in March 1997. All of the staff was involved in preparing and presenting sessions on different aspects of technology. Sessions included; the Internet, developing a technology continuum, word-processing, multi-media applications and Logo and Lego robotics. Our staff did not participate in any of the sessions as they were acting as presenters. Teachers were very active at school the weekend before preparing for the session. To get ready, staff prepared handouts and presentation materials for their sessions.

Meeting after the professional development day the staff raised two observations. First they commented on their surprise at the low level of computer experience and expertise in the division. This observation caused our staff to appreciate the skills they had developed over the past few years. Secondly, preparing presentations for other teachers caused our staff to clarify and articulate their understandings of how they were using technology in their teaching. I noticed computers used more frequently in teachers' classrooms after the experience.

A partnership between teachers and the Oak Bluff Community Technology Centre Board of Directors created an opportunity for staff to obtain notebook computers. I recognised the importance of ready access to computers for staff if I expected them to learn and use technology in the classroom. As a number of our staff did not have current

computers at home they experienced difficulty in learning applications we used at school. The portability of notebooks is an asset that comes with a price premium. I developed a proposal and presented it to the staff and the board. In the proposal the staff made an initial down payment with the remaining cost of the computer split evenly between staff and the board. Staff was expected to use the notebooks in school on a daily basis. The board agreed that the notebook becomes the property of the staff member after the three-year term of the purchase plan. Six staff members choose to participate in this plan. The following is a portion of a proposal made to staff and board members envisioning how notebook computers could enhance teaching and learning.

There is a need to change the metaphor of technology in the classroom from that of the computer as a 'tool' to the computer as a 'medium' assisting in communication and developing understanding and learning. The challenge is to move from doing the same things in new ways to learning new things in new ways. Traditional instructional resource materials include passive (Dockterman 1995) materials and technologies such as; textbooks, overheads, films, tapes and VCR recordings. In a classroom setting these often involve delivering the same information at the same time to a class. "The introduction of new technologies in schools will also have a notable influence on our actual conception of teaching and learning. Now, in principle at least, students all learn the same thing in the same way at the same time, whereas the new technologies make different learning patterns for each student possible and natural." (Grégoire et al. 1996 p. 34) There is little opportunity for choice by the student about whether the information is helpful to them or the pace that it is delivered.

New information technologies, especially the resources of the Internet, are an interactive medium allowing students to choose how they will use information, what information they receive and how much time they spend with the information. "Technology planning becomes much more complex than providing students with access and skills with computers or even with the Internet. And, integrating technology into the existing curriculum may be an awkward and perhaps misguided retrofit....we will need to re-engineer the organisational design of learning." (November 1994 p. 1) Utilising these resources allows teachers and students to make choices of material most suitable for topics they are studying. The process of selecting appropriate materials is a key skill for the information age. Involving students in learning how to search for, assess and judge the quality of and select information from available sources requires extensive experience and preparation on the part of the teacher. This selection process places new demands on teachers in terms of preparation.

Preparation

In the past teachers prepared lessons by reading the textbook and looking for supplementary materials to support core material and meet individual student needs. This provided for limited variety in knowledge transfer and made it difficult to address individual learning styles. Preparing learning interactions with students using current technology involves considering traditional resources and going beyond to include materials available on CD-ROM and through the World Wide Web. After making the selection the information needs to be organised to help students develop understanding from a wide variety of information sources. "In most traditional classrooms, the teacher

is largely, if not exclusively, responsible for setting goals, designing learning tasks, and assessing what is learned. Collaborative teachers differ in that they invite students to set specific goals within the framework of what is being taught, provide options for activities and assignments that capture different student interests and goals, and encourage students to assess what they learn." (Tinzmann *et al.* 1990 p. 2) The teachers role in preparation changes from a scene of print materials spread out on the table and a path of understanding developed, to a situation where the teacher can select a variety of resources and links and customise these to meet individual and class needs. The teacher maintains their role of guiding the student but the relationship becomes more dynamic. The student selects from a wider variety of learning resources becoming a more active participant in the development of knowledge and understanding as they have equal access to the information available to the teacher.

Teacher preparation of electronic resources during school often involves pulling a computer from student use as the teacher prepares. Notebooks eliminate this while adding a number of stations to the school technology equation. The notebook becomes available to students while the teacher is engaged in other teaching activities increasing the computer to student ratio in our school. Flexibility and portability of notebooks promotes efficient use of resources.

As the medium of sharing and communicating information becomes more electronic the method and manner of teacher preparation changes. Two possible examples serve to illustrate the change. Preparing a unit on Owls, an early year's teacher, searches the Web discovering the search tools and key words that produce the best and most appropriate

material for their students. The teacher bookmarks a number of sites to start the student investigation. A variety of images, downloaded from the Web are stored and shared with students and included in presentations. A base set of guiding questions and thoughts are prepared and sent electronically to each students folder. The teacher modifies lessons to address individual student needs and interests electronically in ways that were unavailable through traditional print materials and photocopied sheets. Long term savings in textbooks and consumable supplies are produced. Preparation for the lesson involves a number of hours accessing and selecting material electronically. Presenting and introducing the lesson is done through the computer displayed on the classroom large screen TV. "Among the reasons that contribute to student motivation, there is the fact that technology can be a key vehicle for stimulating learning, primarily because it creates environments and presents content in ways that are more engaging and involve student more directly than do textbooks and more traditional teaching tools." (Grégoire et al. 1996 p. 14) Preparation and presentation of this lesson is facilitated with the notebook computer.

Another possible example illustrates use at a middle year's level. A middle year's class investigates communities around the world to learn about global similarities and differences. The teacher establishes connections with other teachers throughout the world and partners students with other key-pals. The class develops a set of questions and begins to communicate with their individual key-pals to understand life in a community in another country. To monitor and guide the conversations the teacher accesses student accounts to keep the conversations on track and ensure that the

communication is productive. As each student is pursuing similar questions in different areas the teacher includes relevant links and suggestions in electronic communication with the student pairs. The students communicate their understanding through an HTML page or a multi-media presentation. To 'mark' the students work the teacher accesses it and comments electronically. This type of lesson delivery and assessment is facilitated with the notebook computer.

As students become more accustomed to computers the nature of communication between teachers and students changes. Currently students prepare 'work' and pass it in, in paper format. There is little desire or opportunity to edit, revise and improve student work once it is in the 'final' format of hardcopy. As students prepare their work electronically storing it in individual folders the relationship between the student and teacher becomes more dynamic. It is easier for the work to evolve and the student is more likely to be encouraged to make changes and understand teacher comments, as they become a part of the electronic version of student work. Revisions occur on student's work that was previously ignored as comments written on paper drafts. The artificiality and inefficiency of producing an assignment electronically, then printing it out expecting changes and improvements is lost. A wider audience for student work allowing other students, teachers and parents to participate in the guidance and encouragement of the student is created.

The ability to accept and understand change and continually learn are skills for the future. Involvement in the development of our technology centre stresses the importance of continual learning and acceptance of change. Our teachers play a key role

developing and implementing ways for technology to make a difference in student learning. Their position at the forefront means that they will have to learn continually to keep pace with the development of the technology centre. Professional development is a critical element in their preparation. Notebooks, through their easy accessibility, facilitate communication and collaboration among teachers and improve the ability of teachers and the school system to develop a technology skill set for teachers.

Teachers received their notebooks in October 1996. In a November staff orientation session teachers with notebook computers were more competent and comfortable with the new operating system and programs. Teachers often asked each other questions and showed one another new things they learned with their notebooks on their laps in the staff room or classroom. "For one, professionals would engage in and derive the benefits of "natural collaboration." They wouldn't see teaching as solitary work, but neither would they find themselves forced into *contrived collegiality* with partners who do not share their needs and passions." (Hargreaves 1997 p. 174) It was obvious, early, that a great deal of personal time was spent exploring the computers and programs. In staff interviews all staff members with notebooks stated that they spent many hours each week using the computer at home. They suggested that the notebooks make a significant difference in their learning to use software applications. The notebooks attach easily to the classroom large screen television providing an opportunity for teachers and students to present and demonstrate projects.

Several staff replaced their day planning books with the notebook computers. Lessons are planned on the notebook with resources drawn from the Internet and CD-ROM

references. Anecdotal records of student progress are maintained on the notebook for use in report cards later. In the middle years marks are recorded on the spreadsheet providing efficient record keeping and immediate access to individual student progress information. Presentations created with Hyperstudio and PowerPoint are frequently used to introduce lessons.

Developing Community and Corporate Support

Creating Oak Bluff Technology Centre requires a considerable investment of time, hardware and software. The staff and planning committee researched technology use in the classroom and different alternatives for hardware and software. Achieving a significant level of technology within a small school presented problems. To achieve our goal required the support and involvement of the broader community. This process started with a small group of community members and grew to involve the wider community.

In the public meeting held on May 24th 1995 a large crowd responded positively to the early school design, the recreation partnership and the technology initiative. A number of community members, without children in the school, approached me afterwards asking if they could use the technology centre as well. The idea of a community facility within the school had support from the community beyond the school.

I often talked with parents about the role of computers in their children's education. The students demonstrated their developing expertise daily. A number of parents in the community expressed interest in their children's use of computers. Mike, a community

business owner, commented on the level of his daughter's computer expertise. According to Mike, she produced more polished documents in her school assignments than his secretarial staff. Judith, a parent of a grade one student, complained that her daughter dominated her home computer after school. Rick, a parent of two early years children, stopped me occasionally in the hallway or the playground to ask what programs we used at school. He stated that his daughters were coming home asking to use multi-media encyclopaedias and the Internet to find information for school projects. Rick was surprised at the level of technology his children were using especially when he compared it to the experiences of much older nieces and nephews. Sharing technology experiences with parents was exciting. Initially I did not recognise its importance in establishing a support base for our technology initiative.

As the technology focus of the school gathered momentum I found myself juggling time to meet the needs of our diverse group. Issues of staff support, fundraising, hardware and software research, school board and community education and grant writing pulled in many directions. I felt supported by staff and the community but diverse demands sometimes requiring levels of knowledge beyond my experience and expertise made me uncomfortable. I sensed our direction was correct but without a formalised structure the initiative was unsustainable.

In the spring of 1994 I sought support from the business sector. Given the rural location of Oak Bluff, agriculture is an important economic feature. I requested a meeting with Mike, the owner of the John Deere dealership to describe the technology vision for the new school and ask for financial support. With his support of technology I remember

expecting that after our meeting the school would receive a check to buy more computers. During the meeting we talked about the role of technology as an important employability skill. He explained how much he paid in business and home education taxes. He stressed that it was unrealistic to expect business to contribute more to education above what they already paid in taxes. To gain support from his and other businesses I had to offer more than simply placing computers in a Kindergarten to grade eight school.

After the meeting I researched technology uses and applications that had a direct benefit for agriculture and agribusiness. Two information services, DTN and Globalink were commercially available offering current market and weather information. Believing that similar information should be available on the Internet I searched relevant links and attached them to the school home page. Throughout this process I sent literature and information to Mike.

In the fall of 1995, a year after our first meeting, Mike invited me to a meeting with several local farmers. During the meeting we discussed their needs and technology applications that could help in the operation of their farms. Although these farmers were aware of computers they had little knowledge of the Internet. Together we developed a plan for the school to play a significant role providing training and access to the Internet. The notion of creating win-win partnerships between the school and various businesses developed during this meeting.

After the meeting described above I met with Mike and Alan, a local farmer, once every two months to discuss the technology initiative and strategies to attract corporate partners. In these meetings Mike and Alan stressed the importance of developing a sustainable initiative offering value to the school and the broader community. The rapid rate of change in technology required that our technology acquisition plan include a strategy to stay current. They suggested that businesses and community members would not likely donate without a clear long-term plan.

During one of these meetings, in the spring of 1995 Alan suggested the structure to allow credible business and community participation in the development of the Oak Bluff Community Technology Centre. He laid out a board structure that included six elected positions to a nine-member board of directors. The principal or delegate, the local school trustee and the president of the home and school association are automatic members to the board. The remaining six members are elected during a public meeting for a two year term. An annual general meeting held yearly and newsletters published twice a year provide information to the community and supporters of the technology centre.

I left the meeting where the board structure was introduced feeling considerable relief. It took a few days to understand why. As our project developed and grew in scope staff were involved and supportive. The technology initiative began to move outside the regular domain of a kindergarten to grade eight school. Although I believe there were benefits to expanding our vision it was important to seek more involvement from outside stakeholders to include them in significant ways. The technology board

provided a structure facilitating this. A second reason for relief was that as the project grew I needed a broader base than just the staff, to share in the research, develop contacts and decision making. The technology board served well in this role.

At a community meeting held in May 1996 the technology board structure was explained to the seventy attending community members. Elections followed to fill the following positions. The technology board structure included the following positions:

- Chairperson
- Vice-Chair
- Secretary
- Finance Chair
- Fund-raising Chair
- Technology Chair
- Program and Training Chair
- Directors at large (2)

The superintendent and several trustees were in attendance at this meeting. Although we did not ask for or receive formal approval of the school board I kept them aware of our activities and they expressed their support. This formalised structure provided credibility and accountability to community and corporate partners. The technology board brought a new knowledge base to the school. An example of this role is the technology chair and committee.

As principal I conducted extensive research into networking our school and hardware and software acquisition. This provided the school and I with basic knowledge. Taking advantage of the broader community knowledge base made better use of local knowledge

and bargaining power. Rick, the technology chairperson, is employed as networking consultant for a major computer company. He formed a committee including other members of the community employed in the technology field. This group had extensive knowledge in the area of networking through their daily experience in the field. In addition they were responsible for purchasing contracts much larger than ours. This combination of network knowledge and vendor negotiation experience proved invaluable assuring that the technology centre received product suited to the schools needs at the best possible price. We achieved significantly better results taking advantage of this community knowledge base.

I participated with the technology committee in vendor negotiations. Together we met with four different companies to receive quotes on hardware, software and service packages. The experience and technical knowledge of this committee ensured that products and configurations suggested by vendors satisfied the schools needs. Their market knowledge ensured that we were quoted competitive prices. After the purchase, members of this committee helped me troubleshoot the network and participated in on-going negotiations with the vendor and supplier.

The Technology Board attracted corporate partners to participate in the technology initiative. Approaching businesses as a school principal received minimal interest. A request for a meeting from the chair of a formalised board, with school and community issues as a focus, received more serious consideration. Negotiating partnerships, our arguments were much stronger when the voice included business people, sometimes important customers, of the corporations approached.

An unanticipated benefit of these partnerships was the avenue of communication it opened between business and education. This provided greater understanding of issues related to education and business. This understanding led to the sharing of human resources among the groups. A local business took advantage of our networking research to make decisions on installing their business network. Other local businesses benefited from training on software applications offered by the school. Employees of a banking corporate partner provided software to the school and offered resource people to provide sessions on budgeting. A senior vice-president of the bank, impressed with the level of problem solving taught in an early years classroom, asked the teacher to give a session to her managers on problem solving techniques. These open avenues of communication helped both the school and the business partners involved.

Computer use in Classrooms: SOFTWARE Applications and Technology Continuum

Identifying areas of technology integration occurred through the development of a Kindergarten to grade eight technology continuum outlining integration strategies (appendix C). I wrote the first draft of the continuum in 1995 and shared it with staff as a discussion document. Intensive staff discussion throughout this process was a key factor developing understanding of the potential of technology to change the structure and practice of life in the classroom. The technology continuum serves to guide integration of technology with teaching and learning. Staff uses the continuum in choosing software applications for their classrooms.

The continuum is divided into four sections. These include; skills and experience, areas of integration, professional development and suggested resources. The continuum suggests activities in skills and experiences and areas of integration in an attempt to provide guidance on how to use computers integrated with other learning rather than as an isolated skill. The professional development and suggested resources sections provides a guide for providing support and software to incorporate technology with teaching and learning. Rather than isolating skills and activities by grade level the continuum carries across grade levels in recognition of the variety of activities and skills in a multi-age setting. The continuum is a dynamic document requiring revision every few years to assess whether it still reflects our needs. The next revision process is scheduled for the fall of 1997.

Moving from the old school to the new, staff were forced to re-evaluate software's role in their classes and assess its appropriateness. Commonly accepted computer programs in our old facility had questionable value in achieving instructional objectives. Printshop was a popular program in the old school. The program determines the format of the final product with little opportunity for student creative expression. Without Printshop in the new school, teachers and students learned more sophisticated functions of word processing and presentation programs allowing more control over the final product.

Early year's staff recognised other programs as important tools in preparing students to use the computer. Especially in the early years, students need to become familiar with the keyboard and develop their mousing skills to use other applications effectively. Paint programs provide students with the opportunity to develop mousing skills while

learning other program operation standards such as drop down menus and toolbars. With appropriate guidance students' use these programs to learn skills common to other programs. Their use is most appropriate when tied to other classroom activities. In an early years setting paint programs are used in math patterning activities. Students prepare simple drawings included in stories and research reports. These programs serve a dual purpose used in this way. Teachers need to expose students to other applications as they gain skills with these programs.

Exploring new programs and operating systems together created interesting dynamics in teacher/student relationships. Students were less likely to rely on the teacher as the sole source of information when they met difficulty with a particular program. Problems new to the teacher and student occurred. As teachers were unable to 'drop everything' to investigate a solution students became more self-reliant turning to their peers for help. When someone, whether teacher or student, discovered an answer they eagerly shared it with others creating a broader learning network.

Students experienced success and satisfaction knowing their contributions were valued and needed. "In collaborative classrooms where students are engaged in a thinking curriculum, everyone learns from everyone else, and no student is deprived of this opportunity for making contributions and appreciating the contributions of others." (Tinzmann et al. 1990 p. 3) One student discovered she could save bookmarked Internet sites on the network allowing her to access them from other computers in the school. She shared this folder with other students allowing them to visit her sites and contribute

theirs to the bookmark folder. This in turn developed their independence and 'stick-to-itiveness' while using the computer.

Increasingly, students discovered tips and tricks in applications. Some students, drawn by the computer, have always persevered when stumped by a particular quirk in a program. "One of the main conclusions regarding the students is that they are drawn to technology and are intrinsically motivated to use computers. At each site we visited, we saw students who were always eager to have their time at the computer, whether to complete an assignment from the teacher or to engage in activities of their choice." (Grégoire *et al.* 1996 p. 14) Learning a new system caused these students to share their knowledge more readily with the rest of the class. I was frustrated when I noticed a number of different backgrounds appearing on computers in the school. I couldn't understand how this was happening. When I shared the concern with the class one student called the rest of the class and I over to a computer and showed us how images from the Internet could be added to individual students desktops. As the class learned together students explored programs more thoroughly and independently. The satisfaction of solving the problem and the opportunity to share this new knowledge with others accounts for the increase.

Integrating the use of technology with daily classroom teaching causes teachers to examine their classroom practice. As Sarah suggested to her students, "Sometimes we don't seem to need any computers in the classroom while other times we could use twenty-five." To maximise use of three computers in each classroom the structure and organisation of the teaching day needs changing. Challenging the amount of time spent

in whole class and small group instruction to facilitate students using the computer forces a change in planning. Not all activities require the same length of time. Changing the schedule provides students the opportunity to participate in a number of varied activities over the course of the day tied together with a common theme. To become effectively engaged in a computer related activity requires over twenty minutes. The teacher's task becomes one of guiding students in their learning activities with enough structure to permit relatively seamless transition from one activity to the next.

The 'sage on the stage' analogy is frequently criticised. There are times requiring all students in the class to give their attention to large group instruction and directions. More teaching time directed to whole class instruction means less time available for student involvement in computer related or other independent activities. "Multimedia technologies enable the creation of environments in which constructivist learning can take place. They make available to student's original materials instead of pre-interpreted and diluted information. They provide tools for the exploration of that data so those students can investigate a topic and approach it with genuine questions. In the process students create new and examine existing knowledge structures through the exploration of a topic as well as an appreciation of the it." (Grégoire et al. 1996 p. 17) Developing activities and making choices means examining more critically how time is spent in the classroom as teacher's move to integrate technology.

It is often easier to plan and deliver whole class lessons. Under the teacher's direction classroom management is often perceived as better with the increased control of whole class instruction. Providing activities for the students using the computers is relatively

easy. Excluding up to six students from classroom work to use the computer forces the teacher to plan other activities for the rest of the class. Allowing students to move seamlessly from the computer means that a number of activities need to be planned and offered throughout the day. If the computer is used as a tool to enhance and support learning these other activities cannot be ones that are done more easily with the computer. For example, using the time for students to hand write drafts of reports or compositions for word-processing later is not effective use of limited classroom learning time. An additional complicating factor is added when the students are involved in a variety of activities in one teacher's classroom. Here, students must work independently while the teacher attends to other groups. "Teachers are still responsible for students' learning, but rather than being dispensers of information they become guides to the learning process. They act as facilitators and organisers of learning activities. Teachers were also more available to coach their students in how to process information, helping them to make choices and validate their learning." (Grégoire *et al.* 1996 p. 32) The advantage is that as the class learns to work independently the teacher has more concentrated time for individuals or small groups.

Ideally, this creates less rigid distinction from one subject area to the next. In the course of a morning or afternoon student involvement in computer activities often focuses on one application or investigation. Extended student time on the computer requires viewing the day as a whole, rather than divided into forty-minute slots. The teacher plans a variety of tasks, and with the class, schedules individual student time on the

computer or other, limited resource based learning activities. The student is responsible for planning the rest of the block working on other tasks.

"New technologies manage to develop students' interest in learning activities, at least for the time being, and to lead them to devote more time and attention to these activities than in regular classes. Moreover, it is not too surprising that they also increase their confidence in their abilities. In turn, this confidence of the students in themselves undoubtedly explains in part the spontaneously receptive attitude that a large number of them adopt toward an activity in which technology plays a role and the perseverance that they show in accomplishing this activity. Of course a high level of motivation generally facilitates learning; but it is especially important in situations like the new technologically-based learning environments where students are more active in directing their own learning." (Grégoire *et al.* 1996 p. 13)

Congruency is created when the learning activities relate to a common theme. This is a departure from a system of organisation where the teacher determines the tasks and the time period for working on them. Whole class instruction and discussion does not disappear. Time in the block is allocated to entire class involvement in a discussion, lecture or other large group activity. Monitoring the amount of time allocated for these activities ensures that the students have opportunities to use the computer on a regular basis.

Changing the teaching day to create the structure described above created interesting challenges in the different classrooms trying it. There is not one recipe for success and during the fall of 1996 and early 1997, teachers tried different ways to maximise computer use in their classrooms. The following descriptions outline these attempts.

To understand these structural changes I implemented them with the grade seven and eight class I taught. To expect staff to change their teaching practice I needed to change the structure of the day during the mornings I was teaching. "Previous experience in staff development also suggested to program designers that principals' commitment to a changing vision of learning and instruction is critically important to the success of a staff development program." (Ringstaff et al. 1996 p.18) By providing an example of a change model and experiencing the problems and successes I could offer more concrete guidance in helping staff change.

I started by attempting to create a structure that put all students on computers for an extended period of time every second day. Our classroom is equipped with four computers in the classroom and occasionally an additional six located in the library are available. I expected students to use the computer to conduct research, for composition, editing and revision of their writing and preparation of presentations using Power point and Front Page. With four of 24 students using computers at any given time whole class instruction is problematic. Students were grouped for a variety of other activities while not using the computers. These activities included:

- reading novels, short stories and plays

- discussing novels, short stories and plays and writing responses with other students reading the same material
- discussing novel, short stories and plays themes with students reading different material on a similar theme
- completing social studies questions using the textbook

I developed an integrated study, for my grade seven and eight students, involving Language Arts, Social Studies and Technology. Technology supported a novel study, Cue for Treason, and the social studies topics of the Feudal system and Europe. A variety of projects and questions related to the plot of the novel and the historical period (16th century) it represented was assigned. The students and I collaboratively set long term deadlines. I taught daily mini-lessons on topics related to these questions. A rough schedule of the morning was posted on the white board. Students signed up for twenty-minute slots on the four available computers in the classroom providing at least one computer slot for each student every day. The students were responsible for planning their time within the morning block to complete these questions by the deadlines. Students used a variety of text-based, Internet and electronic encyclopædias in their research.

Computers were a required resource for students to complete the assignments. I taught some aspects of the program's students were using in class mini-lessons. While students worked with various programs more specific skills were taught on a need to know basis. After helping a student learn a specific skill on the computer I usually said, "OK now show someone else." Sharing the responsibility of developing the level of computer fluency helped individual students contribute to the class. This is a technique that has been successfully used in other settings.

"For the most part, students functioned individually or in small groups as they worked on interdisciplinary projects, consulting with Harrison on an as-needed basis. Students learn technology skills as their assignments call for them (e.g., creating a graph, designing a graphic illustration, importing or formatting text for a report). When they discover something new about the hardware or software they are using, they are required to teach each other, and their teacher, what they've learned." (Hancock p. 5)

Students frequently acted as peer resource helpers. In the classroom I often heard them sharing tips and tricks as they learned new technology tools.

I introduced the unit to the students with a PowerPoint presentation. I used the introduction project to experiment with PowerPoint and learn it myself. Students enjoyed the sound and animation effects in this presentation. I gave the students a brief overview of PowerPoint and asked them to create a slide presentation on their choice of topic. I wanted them to learn the program by exploring its features. The content of the student presentations ranged from "Dogs" to "Snow-boarding" to "Top Bands". With the freedom to create presentations on topics of their choice students persevered and learned many advanced features of the program.

Familiarity with PowerPoint gave students the skills to create a *"Reader's Digest"* version of the novel they studied. Students created a slide for each chapter including the chapter title, a one sentence summary, and a quotation and picture for each chapter reflecting the key points of the plot. Students became more adept with the program as they created

over twenty-five slides in their presentations. They imported images from clipart libraries, the Internet and scanned pictures from magazines or ones they drew. Through this experience they learned a great deal about compatible file formats and how to manage files within their presentations. Students had the option of completing this assignment using PowerPoint or with text and pictures on pages. About half of the class of twenty-four students choose to complete the assignment using PowerPoint. I noticed interesting differences between the two groups.

The students using PowerPoint were more involved in the creation and presentation of the project. They spent more time focused during class-time and exercised care in the selection of images. "The attention span or concentration that the majority of students are willing to devote to learning activities is greater when they use a new technology than when they are in a traditional setting using traditional resources." (Grégoire *et al.* 1996 p. 16) When one student discovered that she had saved all of her scanned images upside down she reloaded each image and corrected the problem. This required a considerable time commitment. Another student, using the paper format to complete the assignment, lost her file of magazine clippings and quickly gathered a new set of pictures without the same care and thought put into the original set. More pride was apparent in the computer-generated projects than the traditional paper presentation.

Completing the PowerPoint project required more time forcing students to use their computer time well. Many of the PowerPoint students gave up their recess and came in early mornings to work on the assignment. "In settings in which computers have been put at the disposal of students as part of some long-term activity or project, researchers

have reported dramatic increases in students' engagement. When the students performed a learning activity on a computer, the researcher notes that they were willing to devote more time and energy to it." (Grégoire *et al.* 1996 p. 16) One student used an inordinate amount of time searching the Internet for pictures. Too much time spent on these searches caused the student to miss the deadline. This happened to a few of the students searching for magazine pictures as well. It is important for students to monitor their use of time regardless of which method they choose to complete the assignment.

Students chose to use computers for many of the project's assignments. Increasingly they used word-processing to compose written assignments. This requires individual time on the computer for concentrated periods. I prepared a spreadsheet of all the assignments and stored it on the network. Students tracked their progress by entering their marks and storing an individual copy of the spreadsheet in their folders. The final project collection of assignments included a printed copy of their spreadsheet.

Students gained experience, researching topics using information from a variety of sources. Initially students relied heavily on print resources. With the introduction of electronic reference material and the Internet they developed skills in narrowing their research questions and become more discriminating with information yielded through search results.

Using electronic encyclopædias students quickly became adept at searching for information on a particular topic. With my guidance some students began to use the 'outline' and 'related topics' features to investigate more deeply. As students collected

information from the encyclopædia I taught them how to reference material appropriately and use it in composing their reports. Initially I taught students how to copy information from the source over to the word processor. Student projects became longer and contained only small parts of original student work. They were copying large pieces of text over, using a few of their sentences to tie it together and printing it as their own. Sarah suggested that she had the students open the source and the word processor simultaneously and switch back and forth using the start bar. Using this method student's read the material, switch over to the word processor to take notes and save these notes for reference when they are writing their assignment. This works better and many students are using multiple sources, but there is still evidence of incorrect referencing.

The Internet adds another source of information. While encyclopædias limited search results providing frequent success the Internet required an extended set of skills. The class and my lack of knowledge and experience with the Internet limited its use as a research tool. With practice we learned to narrow our searches finding relevant information for most of the topics. Bookmarking these sites provided a starting point for students to begin their research. This planning, although time-consuming, ensured that students have immediate access to relevant material. Without this preparation students can become lost in sites with irrelevant or inappropriate material.

My planning was important but I felt it was a false representation to have all the information pre-chosen without allowing students to conduct searches of their design.

At the middle years level students need guidance and experience to narrow their search terms and conduct successful searches.

> "Unless we are connecting to the Internet for edutainment, student questioning must be intense before, during and after visiting cyberspace. We must teach students to start with what Sizer calls "essential questions" - the kinds of probing inquiries which might extend over a month or a lifetime - questions worth asking, which touch upon basic human issues - investigations which might make a difference in the quality of life - studies which might cast light in dark corners, illuminating basic truths. And then we must teach them how to conduct a thorough research study. Questioning persists throughout all stages of such a study." (Mackezie 1994 p. 1)

Students gain search experience with the teacher's guidance and an acceptable use agreement in place. It is important that the design of the search and the evaluation of the results become the student's responsibility.

Learning to evaluate information quickly, and assessing whether it meets their requirements is an important skill.

> "We must guide our students to become infotectives. What is an infotective?. . . a student thinker capable of asking great questions about data (with analysis) in order to convert the data into information (data organised so as to reveal patterns and relationships) and eventually into

insight (information which may suggest action or strategy of some kind). An infotective solves information puzzles and riddles using all kinds of clues and new technologies. The problem-solving which often follows the detective work then requires synthesis (invention) and evaluation (careful choices from lists of options). An infotective is a skilled thinker, researcher and inventor. (McKenzie 1993 p. 3)

As a class we talked about search terms and using related words in conducting internet searches. Conducting practice searches together as a class helped students become independent in their research. Depending on the topic, students are experiencing more success with their searches. They are more likely to try another way, either a new search engine or a different key word combination now. We still meet dead ends and sometimes invest significant amounts of time for the yielded results. Overall the research skills are improving and the variety of resources available in successful searches make it worthwhile. As more information becomes available digitally students need experience in finding information this way.

Introducing scanner and video capture technologies allowed students to personalise their work and provide a graphic element. The intention was to improve the overall information and content of reports and stories. Including a map, photo or hand drawn picture digitally proved to be a motivating factor for students. This opportunity led them to expand the amount of information included in their work.

"Successful computer-based learning technologies are a component of a larger pedagogical approach that warrants the use of the technology. Viewing computer-based learning technologies as a tool or instrument implies that there exists a pedagogical approach which is well enough articulated so that the inputting, presentation, and communication facilities of the computer are realised as effective aids to student learning and performance. Just as teachers must be knowledgeable about the learning technologies they and their students are using, they must also be knowledgeable and experienced in the pedagogical approach to be taken in their classrooms." (Grégoire *et al.* 1996 p. 32)

Initially students were captivated by the ability to manipulate and include various images. As I challenged them to justify the inclusion of the images in their writing students had to adjust their writing. Questioning students on why they chose to include a particular graphic they either eliminated the graphic as irrelevant or edited their writing to reference the image and use it to build their argument.

I have always encouraged students to use the computer in composing their writing. The benefits of word-processing in student writing are well documented. Word-processed reports are easier to revise and edit. Drafts of work in progress are printed for sharing. I usually pencil in suggestions for consideration in revision and editing. I noticed stories printed several times with editing changes missed or ignored. The ability to share writing through the network creates a different means of guiding the writing process.

The network creates interesting opportunities for students in writing, editing and revising their work. In a stand alone environment students saved work in progress on floppy disks. Problems occurred when the disk was misplaced, damaged or ran out of space. Creating student folders within a class folder on the network solved these problems. Students save their work in student network folder. This allows me, as teacher to read the work electronically and insert suggestions for the student's consideration. Using the highlighting feature of the word-processor I am able to draw the students attention to a particular area in the writing or explain a difficulty the student may be having. Although pencilled in comments on a paper draft may be ignored or missed by the student, they must address the comments and highlights in the electronic version. Students are looking more closely at comments. In the past a story often had a number of draft pages attached. Using the network allows drafts to be saved under different file names with only the final draft requiring printing. Work in progress is saved in a shared directory allowing the opportunity for response from a wider audience.

This does not happen as often as I hoped. Reading other students work requires a computer and students want to work on their own projects when they have time at the computer.

> "Given the potential of these technologies, students' work can easily take
> other forms that than of written text, or combine various forms, and be
> transmitted at any time, virtually in an instant, to examiners in another
> location. These technologies also allow a student's work to be reviewed as

often as necessary, and allows the student as well as other people or authorised organisations, to keep a 'copy'." (Grégoire *et al.* 1996 p. 33)

One of the difficulties I meet as a teacher in this system is the lack of portability of student files. We do not yet have a remote access system in place to allow dialling up to the school's computer from home. To access student folders I need to be at school so marking at home is not feasible. I find it takes considerably longer to respond to a piece of writing on the computer than it does in the paper format. This surprised me as I initially thought it would be faster. Perhaps with more practice I will become more efficient.

The Internet provides the opportunity for students to share their contributions with a wider audience. "Students are valued for their capacity to access information, to add their own valued to it, to work with it like clay on a wheel, and mold it into a knowledge base that is then published on community and/or global nets." (November 1995 p. 1) The familiarity gained through other computer applications transfers to web design projects. Since my early experiences with web editing the software has improved significantly. Our school uses Microsoft Front Page, a user friendly web editor. Borrowing on the experience from PowerPoint presentations I gave the students a brief demonstration of Front Page and then asked them to create a page on a topic of their choice. As a class we decided what elements the page had to contain. The students developed some very sophisticated pages and learned more about web editing than I anticipated.

In social studies I assigned biographies of Renaissance characters from history. Students researched the people they chose using a variety of resources to compose a biographical piece. "Not only do technologies allow access to a broader range of instructional resources, but they also offer students the opportunity to learn to use electronic tools to access information and develop research skills using the technologies they will face in the future." (US Congress, Office of Technology Assessment 1995 p. 59) For this assignment I told students the product must be an HTML document posted on the school's home page. Conducting their research students discovered that many different sources contained similar or identical information. I asked, "What information would you like as a student with a biography assignment to complete?" With this focus about half of the students searched more deeply for information listed in their biography outlines. "The new technologies have the power to stimulate the search for more extensive information on a subject, a more satisfying solution to a problem, and more generally, a greater number of relationships among various pieces of knowledge or data." (Grégoire *et al.* 1996 p. 17) In their search they found information related to the topic and in at least three cases, extended their projects to include this information by linking it to their biographies.

Writing for the web caused the students to pay particular attention to organisation and content. Long pieces of text do not present well on the Internet. The ability to link sections of the biography to the main page means students must clearly identify their topics and write separate sections linked to the listed topics. Half of the class composed more than five different pages included as links to their main page. Information already

present on the web was readily attached to student pages. "Instead of expecting problems to be highly structured and defined and handed to them, these workers (students) have to identify their own problems to solve, manage their own productivity, and seek and structure collaborations from around the world." (November 1994 p. 1) The student biographies included content drawn from other sources. I stressed the biographies must be accurate and correct before they could be attached to the school's home page. Students took care with the style and content of their pieces knowing the potential audience viewing them.

Images added a new element to the student biographies. Students found relevant pictures on the Internet for their biographies. Initially I told students they must write for permission before including an image from the Internet on their page. We composed a sample letter as a class and students e-mailed for permission once they found an image they wanted to include. Some students planned to use as many as ten images in their reports. With twenty-four students I had to change the plan to conserve disk space. Rather than downloading the images and including them in the student pages we linked to pages with images. The number of positive responses we received from our e-mail requests surprised both the students and me.

During 1996-97 Sarah implemented the multi-media pilot project in her grade four, five and six classroom. The 'Prairie Tour' project developed by the Department of Education is an interdisciplinary project integrating technology with the grade five curriculums as the focus. The project is planned to integrate Language arts, math and

science with activities to study the concepts in the curriculum. Students participate in five legs of the journey using technology to support their study. The five legs are:

1. Falcon lake to Winnipeg
2. Winnipeg to Brandon
3. Brandon to Regina
4. Regina to Calgary
5. Calgary to Banff

Sarah shared the material developed with Kate, the other grade four, five and six teacher who used some of the ideas, projects and software in her classroom. Although Sarah had more computer experience, Kate's skills and confidence developed as she saw computers used frequently in Sarah's classroom. "Teacher isolation, a common feature in school settings, inhibits collegial sharing and teacher growth. Yet the formation of teams is not a quick cure. Although teacher collaboration offers many benefits to teachers and students, the process of building collaboration is slow and filled with obstacles." (Sandholtz 1995 p. 1) Ideas developed as part of the prairie tour and other activities Sarah developed transferred to the other grade 4, 5 & 6 classroom. Sarah's mentoring accelerated computer use in Kate's classroom.

With prairie tour as a focus Sarah used technology in a variety of ways in her classroom. The classroom is equipped with four computers, a large screen television, a video camera and video capture unit. Six additional computers in the library are also available when the need for more computers arises. Utilising computers requires Sarah to organise learning so those students have access to computers and have other activities to work on

when the computers are busy. I observed students involved in prairie tour in Sarah's class on a number of occasions.

On one of these occasions students were involved in a variety of activities related to their study of the prairies involving both computer and non-computer activities. Some students experienced a hardware problem and I helped them get back on track. Other students were involved with mapping and research activities. They were generally on task while Sarah scurried about the room helping individuals and small groups. One group of students had difficulty getting information on a map reading activity. The answers they were looking for were not obviously available. I worked with two girls, the atlas, dictionary, and encyclopædia to try and get the answers. Although we never found the right answer the girls learned more about the organisation of an atlas, sought information from other reference sources and did some of their own problem solving.

During the time I was in the class, approximately 25 minutes, Sarah seemed frustrated with the variety of activity going on and how many different and simultaneous demands were being placed on her. "Collaborative classrooms tend to be noisier than traditional classrooms...collaborative classrooms do not lack structure. Indeed, structure becomes critical. Students need opportunities to move about, talk, as questions, and so on." (Tinzmann *et al.* 1990 p. 7) My observations were that students were on task and involved with a variety of activities learning the facts that the activity called for and research, organisation and collaborative learning skills as well.

Sarah asked to see me after school that day and we talked about the classroom activity. She was still frustrated with the number of things and the amounts of work the prairie tour activity demanded. She wondered why in an earlier French activity with an equal number of activities going on she did not feel the same level of frustration. She speculated that the French activity was one of her own design rather than one laid out by others. I suggested she needed to remove herself more from the role of teacher and become more comfortable with the thought of learning along with the students. She expressed frustration with students floundering to find information called for in the project without the necessary prerequisite skills to enjoy success. Staff meetings at this time focused on discussion of constructivist notions of teaching. I wondered if she was so concerned about implementing these that she was reluctant to use a teacher directed mode when that becomes the best and most efficient way of dealing with a classroom activity. To help cope with a less structured environment Sarah developed a system of time sheets to organise the classroom.

"In most lessons or units, students have a clearly defined end product, such as a written document, oral presentation, written book report with drawings, choreographed skit, diorama, or written responses to a set of questions. The bridge between the assignment of work and the end product—what students actually are going to do—is often the vital, missing link in classrooms. This is because the process of giving students the minute details for solving every task takes away the joy of learning, creates a dependent learner, reduces the chance that students will practice

solving problems using their own learning styles, and, in practical terms, is not possible because of time constraints. Thus, we may all know the silent answer to the question of what to do: "I'm not going to tell you. You need to figure that out for yourself!" The implication is that the students have—or should have—the organisational capacities to complete the task. Individual learners *do* have this capacity; they just may not have the tools for *activating* this capacity." (Hyerle 1996 p. 62)

In January 1997, time sheets devised to organise activities maximising computer uses were developed in grade four, five and six multi-age classrooms. The time sheets cover a week at a time focusing on the period from 10:40-12:00. Each student is provided with a booklet including a page for each week covering an extended time period in total. A box appears on each page with space to list all of the weekly activities. At the beginning of the week the teacher provides a list of six to ten jobs to be covered over the course of the week, under the heading, "Jobs to work on:" Examples of these activities over a one month period include:

- free writing
- reading and responding to literature choices
- conducting surveys, analysing data
- spelling and handwriting
- Hyperstudio
- research using the internet and electronic encyclopædias
- literature circles
- typing tutor
- snakes adaptations assignment (a computer based, teacher developed assignment)

- journal activities
- reading comprehension assignments
- science paper on simple machines

The time sheet lists the days of the week with space to schedule twenty minute activity blocks for the eighty minute period between 10:40-12:00. Individual students make choices of activities they will work on, recording them on their daily time sheet. Sarah stated that initially she used a timer to signal the end of twenty minutes and time to switch activities. "Sometimes it was 20 minutes, then 15, and another time 18 minutes. It was disruptive and more problems than it was worth." said Sarah. The timer was soon abandoned and the students monitored their own time.

Both Sarah and Kate suggested they had more concentrated time to work with individual and small groups during these self directed times for students. I asked if there was difficulty ensuring on task behaviour. "At times I wonder about the noise level," said Sarah, "but when you look around there are students reading while others discuss a chapter in their novel while others conduct a survey. There is a busy noise but kids are working. If kids are wandering I ask them what they plan to record in their time sheets for that period. They understand." Kate suggested that the students like the freedom of choice, know what they should be doing and are good about using their time well.

A random sample of 20% of one class's time sheets showed some differences in how the students used them. The weekly list of 'jobs to be done' was complete in all of the booklets. The list was the same for all students regardless of their grade in this multi-age classroom. Some students filled in each time block accounting for all of their time

throughout the week. Other students completed the list of jobs but had nothing entered on their daily record sheets. Both teachers agreed that the incomplete sheets meant the students were working on activities but did not complete their time sheets. Sarah suggested that time sheets helped communicate with parents some of the activities their children were involved with at school.

The time sheets provide a system of organisation allowing more frequent use of the computers for an extended time by the students. They reduced the frustration Sarah felt earlier when students were involved in a variety of activities in the classroom. "Wiring America's classrooms will probably have an insignificant impact on the quality of learning unless we can help student manage their own experiences, including: managing their time, designing their own homework, co-creating assessments of their work, and continuously extending their collaborative work around the globe." (November 1994 p. 1) Kate suggested that the time sheets address the problem she experienced earlier with what to do with students completing a single activity early. With the time sheets students know what to do and move easily to the next activity once they have completed the one they are working on.

I was curious about the choice of language used with the time sheets. "Time sheets" with "jobs worked on" activity recorded every twenty minutes seemed to relate more to the world of work than education. I asked Sarah about this. On a number of occasions in staff meetings we discussed various employability skills profiles. One profile we considered listed, "The ability to plan and mange time, money and other resources to achieve goals. (and) Accountability for actions taken." as important personal

management skills. (Conference Board of Canada 1996 p. 108) "I choose those words intentionally. A situation where students have a variety of tasks to complete without someone watching over them and telling them what to do when is more like what I perceive their world of work to be." Sarah suggested. The time sheets provide the students the opportunity to plan a portion of their day as self-directed learners and demonstrate accountability for their actions.

Students created stacks outlining their understanding of levers using Hyperstudio presentation software. Groups of grade 4,5 & 6 students created cards demonstrating the use of 1st, 2nd & 3rd class levers. In this example students spent considerable time in the presentation of their project. Using video capture they incorporated examples of the application of each type of lever. Presenting these stacks to the class caused them to articulate their understanding of the similarities and differences between each type of lever. While working on the project the teacher was able to identify gaps in understanding in different students and address these in class lessons. "When teachers use the computer to teach, they tend to work with small groups of students or individual students rather than with the class as a whole at any given time. This allows them to develop a much more accurate and realistic impression of what students do and do not understand." (Grégoire et al. 1996 p. 32) As the students explained the function of each lever in their text boxes and orally to the class their depth of understanding increased as they clarified their explanations. Collaboration in the class was high as students shared success and problems in working with the software packages.

In French, students found pictures of animals from clipart libraries and the Internet and created Hyperstudio cards with a French description of the animals. This project went more smoothly because of the experience gained in the previous project. By this time students knew how to save to the more reliable network directory. As a result students escaped the frustration of lost files. Through the two projects Sarah and the students learned the program from one another. Sarah suggested the students were motivated to create thorough projects and seemed to enjoy the control they were able to exercise over the computer with the program. As an end of unit test Sarah presented her own Hyperstudio presentation of animals on the classroom large screen television. Students viewed the cards and wrote French descriptions of the animals. Sarah and the students enjoyed the novelty of this test scenario.

In Kate's grade 4, 5 & 6 classroom students prepared Hyperstudio presentations on various towns and provinces they were studying. They researched information from the Internet, electronic encyclopædias and tourism brochures. With this information they created presentations highlighting the various communities. Students included statistics and unusual features about their communities in the presentations. In the creation of this project students worked in pairs. This strategy helped maximise computer time and provided the opportunity for students to collaborate and learn software techniques together lessening the frustration when problems occurred.

Students spent considerable time preparing their presentations. This is partly a result of learning to use new software. As their experience base grew they became more efficient in their use of time while creating these presentations. Their desire to produce a

professional presentation caused them to pay more attention to the project and present it in a clear and organised fashion.

Using the computer as a presentation tool, with Power point or Hyperstudio, provides an opportunity for students to share their learning with a new medium. Hyperstudio provides a creative outlet for students. They feel in control of their presentations as they design their cards and stacks. Initially, extra time is required for student exploration of the program to learn principles and techniques in presentation design. Students shared frequently at this stage as they were genuinely excited discovering new elements of the program. With practice presentations students discovered important tips on aesthetics of effective presentations. They began to understand that their presentations wouldn't necessarily stand-alone and that they needed to be prepared with an oral presentation to accompany their computer project. Displaying student projects on the large screen television for an audience motivated students and allowed them to sharpen their public speaking skills.

Students learned to make decisions on layout of presentations as they experimented with a mix of text, graphics, sound and animation. For example once students identified a minimum font size that was visible to their audience, they had to evaluate the content of their text boxes to ensure succinct clarity. They began to notice gaps in transition from one card to the next and learned to evaluate their work for continuity. In the early stages these applications were unreliable and work in progress was frequently lost. Although this was a frustrating experience for the students they all continued to persevere and redid their work to create a final presentation. The practice gained in redoing their

projects developed the student's proficiency with these and other Windows 95 programs. Some students learned the importance of saving and backing-up the hard way.

The decision, by the teachers, to focus on Hyperstudio in the grade 4, 5 & 6 was deliberate. The program captured both the students and the teacher's interest. It provided a tool allowing creative development of presentations that are controlled by the students with great opportunity for student expression in the final product. The sophistication of Hyperstudio means that it has a steeper learning curve than other programs. The middle year's teachers decided to invest time learning a flexible program rather than exposure to a number of different packages. Learning Hyperstudio thoroughly provides knowledge transfer to other programs.

Students in grade 4, 5 and 6 use word processing frequently in the writing process. Most students compose their work at the computer when availability allows. The software now used at the school includes features that were not a part of earlier programs. While typing, the word processor automatically underlines misspelled words in red. Most students stop and correct these words while they are writing. Improvement in spelling on both the computer and in written work is evident for a number of students. I wondered if the continual checking interfered with the writing process for these students. Both students are producing longer pieces of text that is freer from grammatical and spelling errors. The ease of editing with the computer may account for this. These students and others are starting to use the computer as a powerful tool in the writing process.

A variety of other software programs were available to the middle year's classes as part of the multi-media project. Programs such as Kidpix studio, Printshop deluxe, Tesselmania and Widget workshop were used occasionally by the students during free time. These programs were interesting but did not really capture the students. Sarah suggested that observing the students using the programs looked like play. Students requested extra computer time to use Hyperstudio, the Internet and for word processing but did not ask to use the other programs mentioned above. The programs seem to have lots of bells and whistles and game elements to them but do not allow the students to really create the way other programs do. The programs that really capture the students are the ones that allow the students to create information from their knowledge and share that information with others.

The younger students in these classes had problems with the electronic encyclopædias available in our school. Students experienced difficulty finding the information they wanted and struggled with the reading level. Students with access to electronic encyclopædias at home were more adept finding their way around. They shared their extra experience with other students. Searching for Internet information in the study of prairie tour the students made some interesting observations. Students commented in class discussions that many sites are simply a collection of links to other sites with very little information. Others were surprised by the lack of information yielded through their searches. Some students are discovering the use of the Internet when sites with a good balance of readable text and information are found but also recognising that

searching can be a big waste of time. This is important information for them to recognise as they begin to compose their own pages linked with the school home page.

There are three grade one, two and three classrooms in Oak Bluff school. The computer experiences of students in these classes are similar to each other in some respects due to participation in joint projects and differ in other teacher-initiated programs. Debbie teaches a class of nineteen grade 1, 2 & 3 students in a multi-age classroom. She has three desktop computers, a notebook computer and access to a network printer shared between two classes. Debbie expresses enthusiasm for technology and shares that enthusiasm with her students and the staff.

Students participated in a weather activity using computers. After previewing Internet sites Debbie showed the students how to use different search engines to find sites for the topic "Manitoba weather". Students typed in their search terms and compared results and different sites. They found the Environment Canada site too detailed with vocabulary and information beyond the needs of these early years students. The class agreed on the City network site. It included short phrases and descriptions giving current daily statistics and the long range forecast. A bookmark was created providing easy daily access to the site.

Debbie created a cloze exercise stored in her folder on the network. The passage asked students to record the predicted high and low for the day and calculate the difference. Students also recorded the predicted high for the next day and calculated by how much the temperature would rise or fall. Using real and model thermometers in the classroom

Debbie helped the students calculate the differences in negative numbers. The cloze exercise was completed each day on the computer and stored in the individual student's folder. Initially Debbie taught the steps to the grade three students. They in turn helped the grade two students. Assessing the student weather reports Debbie reinforced the importance of following keyboarding conventions including correct punctuation and capitalisation. The grade ones participated in the Internet searches but did not complete their own cloze passages.

An extension of the weather exercise developed around the "probability of precipitation" reported. The class checked the probability of precipitation in the morning and marked the percentage on sliding scale hanging in the classroom. The students monitored the weather throughout the day to see if the weather reports prediction matched their reality in Oak Bluff. Debbie used the experience in math lessons to explain probability.

Next, Debbie introduced the students to the times recorded for sunrise and sunset. Using a cloze paragraph Debbie guided the students through the calculation of total hours of daylight. This was a challenging exercise for students subtracting times to arrive at the calculation. With a collection of data students began to recognise a pattern as the days lengthened in the spring. Discovering the Equinox was an exciting experience for the students. The students began the exercise in partners and eventually became independent. Using the graphing capabilities of a spreadsheet provides a graphing extension to this experience. Debbie expressed concern that she was not able to involve the grade one students more and set that goal for herself for the next term.

Students in Debbie's class participated in a challenging and interesting research and writing project on the Titanic. "In a context where new technologies play an important role, teachers begin to view knowledge less and less as a series of facts to be transferred and more and more as a process of continuous research in which they share the difficulties and results with their students." (Grégoire et al. 1996 p. 32) Debbie grouped the students in threes with a student from each grade. She demonstrated how to use the search engines to locate "The story of the Titanic", a 2½ page factual story written by another student about the sinking. Students read the story together in their groups looking for answers to fourteen questions Debbie prepared. The story was a challenging read for early year's students. They had to work carefully and collaboratively to successfully find the answers. Using this information as a starting point, students composed their own account of the sinking of the Titanic. Debbie had various expectations of students ranging from composing a single paragraph to a two-page report.

Debbie and the students discovered a wealth of information on the Internet, through books and other media. Most reports were generated at the computer. Debbie edited the student work offering suggestions and identifying areas for improvement. The students working with the computer found the editing easy and appreciated the polished format of their final piece. "When the students have writing to do now they ask to go to the computer right away." remarked Debbie. One student decided not to do his report on the computer. By the third revision he lost energy and enthusiasm for the editing process. He was going to leave it at that stage. As student-led conferences approached and he noticed the work his peers were including in their portfolios he asked to use the

computer to prepare a final draft of his report. Although the Titanic project took a lot of time, the students were genuinely interested and enthused with the project.

Students in Debbie's room participated in the early year's school wide Pan-Am project. The grade two and three students from all three early years classes partnered in groups of four to research and prepare a report on different countries assigned as part of the project. The students experienced frustration with limited search results on the internet on this topic. This caused them to adapt and modify their research questions to obtain more relevant information. With four students in each group there was less hands-on time for individual students. Co-ordinating activity with two other teachers allowed the students the opportunity to work and learn with students from other classes. The student's final reports were converted to HTML and attached to the schools home page. Linking their work to the Pan-Am games education project motivated the students to edit and revise their work thoroughly before posting it. Including scanned images of student artwork gave all of the students an opportunity to contribute to the project.

Kathy's grade 1, 2 & 3 multi-age classroom of twenty students has three desktop computers, a notebook computer and access to a shared network printer. Kathy uses computers frequently for personal and professional use. When asked during an interview what experiences helped her most with technology she commented, "Seeing other teachers do it. Debbie really has things under control." Kathy used the weather and sunrise and sunset activities developed by Debbie with her students. She extended on the original activity and shared the new ideas with Debbie to use in her class.

Kathy invited parents into the classroom to help students with computers. Two parents came in on a regular basis to help the students with their word-processing assignments. They guided the older students and typed in the stories for the grade one student's while they read them out. The grade three students prepared a Hyperstudio project based on the life cycle of a butterfly. Kathy asked Sarah to work with this small group during a class that Sarah would normally cover to give Kathy a spare. Kathy gave up her preparation time in return for Sarah's help with the Hyperstudio project.

Students in Kathy's classroom primarily use the computer for word processing. She noticed some students taking naturally to the computer with it really helping them develop their writing. Others, she stated, were reluctant to use the computer and seemed unable to help themselves when they got stuck. "The kids aren't independent, they don't take enough responsibility for taking control." Kathy said. Kathy suggested that the students need more time on the computer to explore and learn new applications. One of her goals is to have them develop a Hyperstudio project on some area of content they are studying. According to Kathy the most successful experience her students have with technology were searching the Internet and book-marking sites.

Chapter 3 Conclusion

When I began this study, my review of the literature led me to a general understanding of some of the factors that influenced the integration of information technology with teaching and learning in the classroom. My initial research questions reflected these early perspectives. As the study progressed, however, my understanding of these factors shifted. Some became more significant than I first thought; others, less so. Two factors emerged as particularly significant; neither of these has been extensively reported in the literature.

These included high participation in grant writing seminars and staff meetings related to technology. Staff members who participated in these sessions developed a stronger appreciation of technology supporting the vision of technology integration. As they were an important contributor in developing an appreciation of technology they felt a stronger commitment to develop strategies and take risks in their classrooms with computer integration. Considering factors accounting for differences in the extent that technology is integrated within and between classrooms, staff members sincerely participating in the discussion related to technology integration were more successful in developing activities to integrate technology in their classrooms. They tended to share these ideas with other staff members holding a similar appreciation. After these two conditions were met technology became integrated with classroom activities to extend and support teaching and learning in the classrooms.

The literature on educational change suggests a strong commitment to a vision as instrumental in creating conditions for change. Throughout this study the appreciation for technology evolved collaboratively with staff and community. As members were encouraged to provide ideas supporting the vision their level of commitment developed as they participated in setting the direction. Two unique factors to our situation supported this. Many of our staff previously worked in small older schools with limited resources. They were accustomed to situations requiring them to work long hours to support a variety of activities for the school and community. Developing our technology initiative required staff to invest significant personal and professional time. This was not very different from previous practice and contributed significantly to our success. After working for many years with limited resources the opportunity to share and use a new facility with new resources was a significant motivating factor. After teaching for many years with so little, staff appreciated every new resource and were committed to make the best use without taking them for granted.

The second factor was the design of the new school. All staff members participated in the design process from the beginning. The opportunity to create an environment for teaching and learning developed a commitment to make it work once we moved into the new school. Preparing for a technology rich environment began in the old school as staff developed skills and strategies to make most advantage of the new facility. Providing the opportunity for staff and community input in the design process created a sense of ownership developing commitment to make the best use of the new facility.

As my understanding of the process of integrating technology shifted, the focus of my research became more refined. Five themes emerged as especially significant, and seem to account for the school's present level of technology integration. The themes are; (1) Creating staff appreciation of technology (2) Writing grants (3) Professional development (4) Developing community and corporate support, and (5) Computer use in classrooms: Software applications and Technology continuum. The themes can be expressed in question form:

1. How can an appreciation of technology be developed among staff and the community allowing it to become an accepted and fully utilised part of teaching and learning?

2. What effect does articulating a technology vision through grant writing have on practise and attitudes towards technology?

3. How do teachers develop ideas and acquire the skills to use computers in their classrooms? How can professional development and training be provided in meaningful ways with limited resources?

4. How can the community and corporate sector be encouraged to participate in the development of a technology initiative in our school?

5. What examples of computer use in participants' classrooms enhance learning and teaching? How do computers affect the structure of the school day and classroom procedures? How is technology integrated with classroom activities to extend and support teaching and learning?

These themes and questions are explored in the following sections.

Understanding the process of creating a climate of support for technology

I had an appreciation and interest in computers and technology in the classroom before moving to Oak Bluff. Previously, as both a teacher and an administrator, I taught with computers and took steps to increase levels of software and hardware in the schools and classrooms I worked in. I did not intend to create a highly technical school when I moved to Oak Bluff. I initiated some changes immediately, the move from a MacIntosh to a PC platform and the change to a computer based report card system. Others were slower and less deliberate but still had the effect of creating support for the technology initiative in our school.

Time for discussion is important in any change initiative. Taking the opportunity to discuss the issues thoroughly with staff, using the literature to frame the discussion in pedagogical terms developed their appreciation of computers over time. This provided the teachers with the control and responsibility to develop applications of technology as it applied to their individual classrooms.

> "They (teachers) need time to understand the purposes of the innovations, to read the research literature on the student outcomes that might be expected if the innovations are implemented, to discuss the proposed new strategies with other teachers, to observe the strategies in action if possible, and to practice using them in a risk-free environment. Typically,

however, the decision to introduce change is swiftly followed by a full-blown implementation stage." (Hargreaves 1997 p. 95)

Taking the time to discuss the issues thoroughly and provide opportunities to use technology in small steps was an important factor in building support for technology among the staff without creating an extreme level of anxiety. The previous established practice of making education decisions together as a staff using relevant literature to guide the discussion provided an easy transition to the technology initiative. The staff accepted the practice of using literature to guide education decisions and participated in the readings and discussions.

Earlier discussions related to assessment, multi-age groupings and parent involvement established this culture. Staff participation in the school design also reinforced the practice of completing readings, holding discussions and making decisions collaboratively as a staff. This pattern of using literature and discussion to guide school decision-making invited their participation in the technology initiative.

The fact that the discussions took place over an extended period of time and involved all of the staff allowed them to acclimatise to technology more gradually. The discussions occurred while teachers were using computers in their classrooms allowing them to experience problems and successes and raise these issues with peers during staff discussions.

> "Serious commitment from teachers occurs only after teachers use the
> new program and innovation and see that it really does assist them in

teaching their students. However, these types of changes do not occur quickly but evolve over a period of time. In addition to identifying time as a critical resource, researchers point to the importance of a supportive organisational environment and collegial sharing in moving teachers toward the adoption of innovations." (Sandholtz 1995 p. 2)

Developing a climate of including computers as a tool and medium for teaching was not a mandated initiative. Understanding how computers could be used in the classroom evolved through discussion and practice with various applications. Initially the discussion was general in nature focusing on literature supporting computers in the classroom. The tone of the articles stressed the potential benefits of including computers. As the inventory of computers in the school increased, teachers began using computers with their lessons in small stages. These meetings developed a comfort with computers among staff and time to adjust to the notion of including them.

Providing computer instruction, either myself or with a learning assistant, in the early stages created the opportunity for staff to see how computers could be used in the classroom. Teachers did not have the pressure of immediately learning and implementing new technologies in their classroom. Computers became a part of the learning experience in the school without creating resistance and anxiety among the staff. Throughout this phase, staff was involved in discussions on how computers could be more effectively integrated with teaching and learning in the classroom. "Research has overwhelmingly supported the finding that schools with organisational cultures that support inquiry, learning, and data-based decision making are not only more satisfying

workplaces, but also more productive organisations." (Hargreaves 1997 p. 174) After the initial period, I expected staff to take more responsibility for integrating computers in their classrooms. As the school acquired more computers and they were moved from a central location to the classrooms teachers understood that they needed to begin using them in their teaching. Usage varied depending on different teacher's comfort and experience. All teachers made the effort to incorporate computers with their teaching. As teachers included technology, they discovered pragmatic difficulties with implementation. "As teachers began to experiment with learning experiences based on the technology, the substance of their interactions shifted from offering technical assistance to sharing instructional strategies. Collaboration about instructional topics emerged when teachers ventured beyond using the technology for text-based drill-and-practice instruction." (Sandholtz 1995 p. 8) Discussion during staff meetings became more specific to how technology could be used in the classroom.

Finding time to met and talk about technology was a continual struggle during the discussion process. The commitment and involvement of the staff is evident through the amount of time they devoted to meeting and discussion related to technology. I believe it was an important step in developing an appreciation of technology leading to its implementation in the classroom. I often felt guilty about the additional load these meetings put on the staff given all of the other activities teaching demands of them. The staff understood this and committed their time as they saw the initiative as worthwhile and appreciated the opportunity to develop their skills. They understood that they were beneficiaries of a successful process.

"One very specific, time-related problem that arises from many teachers in sustaining continuous improvement is the tension caused by expanding the definition of what it means to be a teacher. In the old paradigm, teachers were almost exclusively in their classrooms teaching students. In the new one, teachers are instructors, but they are also leaders, mentors, curriculum developers, and staff developers. This brings about the need to set priorities and make choices." (Hargreaves 1997 p. 101)

Providing the additional time during lunch was an attempt to address this. I was surprised that it was not successful in creating more 'technology talk'. In January 1996, when the meetings began, there was not any specific technology projects in place to provide a focus for implementation discussion. With no specific agenda and my unavailability to prod the discussion, the lunch hour meetings were unsuccessful.

The initial experience discussing literature created a climate of challenging thinking in a safe atmosphere. Challenging external ideas developed dialectic as we learned to accept and reject other strategies and paradigms of learning and teaching. "First, as we get to know one another better as teachers and borrow from one another's storehouse of ideas and practises, we will become more cohesive as faculties and better able to work together to improve our schools." (Murphy 1992 p. 72) Teachers began to question their practice and the process of using computers in their classrooms. Rather than forcing computers to fit existing practice they challenged practice in an attempt to invent classroom structures facilitating integration of computers. This was often a frustrating experience but the collaborative support of their peers and the opportunity to experience success

while attempting new techniques in a supportive atmosphere helped them persevere. This process is on going and continues over time.

Oak Bluff Community School supports and encourages initiative and risk-taking. It is understood that new teaching strategies sometimes fail. The culture of the school is that the only *wrong* response is to ignore trying to use computers. Frequent meetings to discuss experiences and the knowledge that all staff is a resource promotes a risk-taking attitude. Although there is no computer expert on staff frequent collaborations among staff provide a varied and broad level of support. Community expertise in solving problems provides an additional level of support.

Understanding the Grant Writing Process

In many ways, grant writing generated some of the best professional development sessions related to technology our staff experienced. This surprised me as I found little literature addressing this potential in grant writing. Initially the focus was on the financial award. More experience with grant writing demonstrated its potential in providing a forum for discussion of technology integration related to teaching and learning. The staff shared energy and discussion generated through proposal writing. The writing process provided a focus for discussion of technology and translated into efforts to integrate computer use in the classroom. A few staff seemed to remain on the periphery of the excitement and active involvement. Several possible reasons for this include; lack of confidence in personal technological skill, disinterest in the additional workload, lack of time due to personal or professional duties and commitments

elsewhere or a sense of being neglected by not being asked to participate on a grant writing team.

Success in grants can be measured beyond receiving the award. "The excitement of bringing people together to create coalitions, identifying needs, and developing solutions – steps you take when creating a grant proposal – can certainly be more important than getting the money." (November 1993 p. 1) After the initial Nortel submission, all the grants focused on what we were trying to achieve with technology, forcing us to articulate current understandings. Becoming more specific on the computer's role in teaching and learning caused us to develop applications related directly to the students, the curriculum and the classroom. The writing process created a forum for staff discussion and in most cases an atmosphere of collaboration among staff as they worked to accomplish a specific task. CommuniQuest, the Pan-am and the Multi-media project forced staff to implement the grant objectives. The requirement for follow-up reports caused implementation teams to discuss what was happening in the projects, evaluating progress and making adjustments accordingly.

Teacher developed projects are most successful. The staff takes ownership for the program, reflecting on how technology is used and accepting responsibility for its implementation.

> "Technology has a large role to play in the reinvention of schools, but the implementation of computers, instructional video, and telecommunication links will be meaningless unless they are designed into

a curriculum and are chosen to support pedagogical models designed to insure the maximum learning opportunities for all students. Technology, alone cannot drive reform. If technology is brought into classrooms without revisiting the curricular and pedagogical issues, it risks being used to implement the educational strategies of the past." (Thornberg 1996 p. 2)

The grant writing process focused dialogue on teaching and learning. Consideration of student composition and classroom setting in the development stage helps prevent unanticipated difficulties with implementation. This important benefit occurs when the creators of the project are also the implementers.

Although the multi-media grant had a significant impact in providing hardware and software, Sarah experienced frustration, implementing activities developed by someone else. With the award came an interdisciplinary curriculum developed by the Department of Education and Training. For the most part the program and activities were very good but Sarah lacked the sense of ownership of implementing teaching activities developed by her specifically for her students. "Few technology-related staff development courses address...the challenge of transfer, and they often focus on how to use some piece of software on tasks totally unrelated to the challenge of setting up student learning experiences matched to the teacher's assignment." (McKenzie 1993 p. 7) Once she accepted that it was acceptable to change and modify the activities to suit her classroom and teaching style she became more comfortable with the implementation process.

Writing various grants provided a forum guiding discussion. In our first Nortel grant writing experience, we wrote about acquiring computers for the new school. The justification for these computers was in general terms with documentation from the literature. This paralleled the discussion of our staff meetings at the time. The process of writing this grant involved all staff members and served to force the articulation of an appreciation of the importance of technology. I believe the proposal was unsuccessful in receiving funding because it did not address, in specific terms, how our students would interact with technology in the classroom. The experience of writing the grant pulled the staff together creating a shared commitment to the importance of technology in Oak Bluff School.

Receiving funding to develop a Community Access Site was an important step in achieving a level of technology in our school. The purpose of the grant did not relate to teaching and learning with computers so the writing process did little to develop an understanding of technology as it related to the classroom. The recognition received through the successful application was important in providing credibility to our technology initiative. Staff invested considerable time and energy discussing technology related both to building design and pedagogy. Receiving external support and recognition validated our efforts both among the staff and with community and business partners.

The writing process for the "Partners in Education" grant did not significantly impact teacher dialogue on integrating technology in the classroom. I believe this occurred for two reasons. First the writing process developed around acquiring a specific piece of

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hardware rather than identifying a learning activity and then determining the technology supports to implement it. Focusing on the virtual newspaper rather than allowing staff discussion to evolve and develop generating their own activity restrained the staff limiting ownership for the project. Furthermore, with three other technology projects in implementation during the spring of 1997 the virtual newspaper project received little attention.

Participation by staff members in the grant writing process provided a means of developing an emerging understanding of how technology fit with our educational practice. "It is becoming increasingly clear that technology in and of itself, does not directly change teaching or learning. Rather, the critical element is how technology is incorporated into instruction." (US Congress, Office of Technology Assessment 1995 p. 57) Throughout the discussions while developing grant worthy projects teachers formed a mental image of how their classrooms would look with technology. As the process developed over an extended period of time teachers were able to look beyond the technology to issues of pedagogy and curriculum that fit their individual teaching styles. This change in mindset developed over time lessening the sense of panic and resistance that might have occurred if the implementations were imposed and mandated.

Understanding Professional Development

The distinction between professional development and training was not intentional while I was encouraging the use of computers and attempting to provide support, causing teachers to implement computers in their classrooms. I describe professional development experiences with teachers as ones that challenge assumptions about

knowledge and the teaching practice that supports student learning. Training provides experience with hardware and software use and applications allowing teachers to develop confidence to use technology in their classrooms. Reflecting on providing technology support to staff causes me to categorise some of our experiences as professional development and others as training.

"Research indicates that new learners go through three cognitive stages in learning to use technology. Initially they must find comfort within their own personal cognitive framework by identifying how the technology can benefit them personally. Examples of such usage might include keyboarding and word processing for personal correspondence.

Only when learners have internalised new practices into a personal conceptual framework of understanding, can they move forward to the second stage. It is here that users begin to integrate their personal understanding of technology into their professional practices. Initially, this may involve the use of technology for personal professional applications such as mark management, test generation, &/or the development of assignments.

It is only at this critical point, when users have been provided with an appropriate level and focus of training, as well as an ample period of time to use and apply the technology at both the personal and personal professional levels, as well as the opportunity to reflect upon this usage,

that they will be able to successfully integrate technology into the curriculum in meaningful and appropriate ways." (Jukes and Holmes 1996 p. 2)

The literature suggests a high percentage of money allocated to a technology plan be used for professional development. "The critical issue to be addressed, if teachers are to confront the challenge of computers in schools is professional development; specifically, the methods of teacher training, the length of that training, and its content. (Gilmore 1995 p. 1) The importance of professional development was recognised in our initiative. Rather than attaching a dollar or time quantifier to an adequate level of professional development and training we achieved professional development and training opportunities utilising the resources available to the school. In instances where we did not have an adequate knowledge base in the school resource people were invited in. This provided training opportunities on familiar ground with as little disruption to the teacher's schedule as possible.

This often involved creating our own training opportunities as new software and hardware was added to the schools technology equation. Training based on a need to know criteria rather that driven by an external schedule ensures that sessions more appropriately meet individual teachers needs. "Truly meaningful education and enthusiasm are not generated until staff members are actually using computer technology with some degree of competence." (Haubrich 1996 p. 20) Participating in sessions with their teaching colleagues provides peer support groups after the sessions have ended. Staff freely gave of their time to learn new resources. This attitude may be the result of

teaching with limited resources in a small school for several years. All of the staff except for one spent a number of years teaching in schools with less than seventy students. In this atmosphere there are limited human and material resources to draw on to support teaching. As the school budget and number of teachers increased staff were appreciative of the additional resources.

Frequent opportunities for training and professional development provide on-going support for staff as they improve their technical skills and develop strategies implementing integrated applications of technology. Most sessions occurred in school while teachers were using computers with their classes facilitating comprehensive knowledge transfer. While learning various technical skills is important the discussion of how technology effects teaching and learning in the classroom and the articulation and development of specific projects using technology creates change in the classroom. Training helps teachers understand how to use computers to support current practice. Professional development causes teachers to challenge existing practice and create new ways of structuring learning.

Our school's experience with professional development over the years leads me to a number of assumptions. The most effective professional development is based on immediacy and necessity to know a particular skill or application. For staff to use technology effectively in their classrooms support and a reasonable comfort level with technology must be developed. Research and experience suggest that single purpose professional development sessions are not effective in creating change in teaching and learning.

"Fixation on skill development usually leads to training agendas which are overloaded as the instructor tried to 'cover' several dozen functions, tricks or features per half hour. Far better to cover fewer functions so as to leave at least half the time for extensive practice and the translation of new learning into classroom practice. Far better to provide time for participants to ask and consider the questions such as: 'So what? What does this mean for my classroom? For my students? What's good? What needs to be altered? How would I make It work?' " (McKenzie 1993 p. 14)

The need to use new strategies and technologies makes learning more effective encouraging transfer to the classroom. The learning must be on going, continual and supported by others. "Even when professional development is widely available, the tendency is often to offer it at times and in ways that create unintentional stress for teachers." (Hargreaves 1997 p. 95) Creating a learning community among staff provides an expectation and environment encouraging risk-taking trying and adapting to new technologies in the classroom.

The experience with using computers to write report cards is an example of training staff in the use of computers to accomplish a task related to their jobs. Although the change to computer generated reports was discussed as a staff once the decision was made individual staff members did not have a choice to not participate. Computer generated reports became a school wide expectation that each teacher had to participate in. I characterise the experience as training rather than professional development because

support for teachers was provided while they were working with the computers on a task that had to be complete within a time frame. As technical problems were encountered peers or parents provided answers. Working to a deadline meant that both problems and solutions were immediate. Although there was evidence of transfer of skills to other teacher tasks the report card experience did not directly impact on changes in assessment, student expectations or classroom structure that should be evident in professional development experiences.

The experience with reports developed skills among the staff. The report card deadline imposed a sense of urgency forcing staff to learn new skills. These skills transferred to classroom applications as teachers used skills they learned in word processing and databases in other classroom applications. The support base broadened through this experience developing collaboration among staff as they learned from one another while accomplishing a task.

Learning web authoring and HTML followed a similar pattern. Presented with a specific purpose and deadline staff focused more intensely and developed skills more effectively. External resource people are helpful but staff learns more from one another through trial and error once the application is introduced. Support for questions while struggling with a specific problem makes the learning more immediate internalising these skills for future applications. Arriving at sessions without an understanding of how the program may be used in the classroom creates a lack of focus for the professional development activity. Arriving at sessions with an idea of how the application may be applied to the classroom serves to focus questions and create deeper understanding.

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The in-services on Hyperstudio illustrate this. Teachers with previous experience and understanding of how the program supports learning in the classroom expressed more focused questions than those unfamiliar with the program. These teachers used the day to explore and learn how to use specific features of the program. Teachers just learning the program focused their attention on the program and only later began to make connections of how they might use the program in their classrooms.

In the Logo sessions the focus differed. Instead of learning the operation of the program we worked through activities relating to concepts teachers were using in their classrooms. As we discovered steps necessary to perform specific functions they were introduced within the context of solving a teaching and learning based problem. By concentrating on the learning activity first and the software application second, new skills were learned in the context of developing the application. This process may be slower to transfer to the classroom but I believe that it will be integrated more thoroughly with classroom teaching and learning.

The experiences with HTML, home page design and Hyperstudio are other examples of training. The sessions demonstrate the importance of clearly identifying classroom connections of how software applications support learning. They also show how new software applications need to be introduced and then incubate while teachers create projects integrating their use in the classroom. I believe the initial disinterest with web editing was caused by a number of other demands being placed on the staff at the time and the fact that web editing was a new skill without obvious applications to the classroom. The early learning about HTML was important in creating an understanding

of the principles of web design. It was much later when the staff began to see direct connections to web design and their own teaching that it was accepted as a skill with implications for teaching and learning.

The differences in the early and middle years' reactions to the 1997 sessions on Front Page provide evidence of the importance of making classroom connections in training and professional development sessions. Without a sense of how web design could be used in their classrooms the middle years teachers explored the program randomly. The early year's teachers came to the session with a specific task in mind and focused in the session on how they could use Front Page to present student work on the Pan-Am project. The idea of presenting student work developed in the earlier Hyperstudio sessions. With this focus in mind they learned more specific features of the program and reinforced that learning by applying it in their classrooms directly after the session. Use of Front Page by the middle years teachers is more sporadic and will only transfer to the classroom when a specific project utilising web design presentation capability is developed. The introduction to its capabilities creates awareness allowing them to develop specific applications for their classrooms when the need arises.

An effective means of understanding a new skill is to teach it. This applies to the experience of preparing for the divisional in-service. Teachers developed both confidence and competence through the experience of planning and preparing their sessions. There was apprehension among staff as they spent the weekend preparing to present to their peers. This created motivation for thorough preparation resulting in reflection of how they used technology in their classrooms. Presenting their experiences and thinking to

other teachers inspired confidence to begin using computers more frequently in their classrooms.

The single most important step in implementing our technology initiative was developing a means to provide notebook computers to the majority of staff. Although five of the six participating teachers, myself included, had computers at home none of us had computers equipped with the same operating system and programs used at school. The notebooks provided a similar platform with the same programs utilised at school. This meant that staff could explore programs on their own time in a non-threatening environment. "Access to equipment at home...fosters use of the computer for a wide range of teacher preparation and planning, because it fits in with normal teacher patterns of marking, planning, and creating tests or handouts at home during evenings and weekends." (Haubrich 1996 p. 21) The fact that all staff commented on the amount of time they spent with their computers outside of school hours causes me to conclude they played a significant role in learning new technologies. Staff members with notebooks produced more technology-based classroom learning activities than those without and demonstrated more comfort and use of the schools computers and programs.

Understanding Corporate and Community Participation

I believe our project is unique in the level of corporate and community support it developed and received. The fund-raising committee has set a goal of $250,000.00 over three years. The technology committee is actively involved in hardware and network purchasing decisions. The program and training committee operates numerous adult computer courses and is in the process of developing an adult technology continuum.

Each sub-committee of the technology board involves numerous non-elected community and business members working collaboratively to achieve their goals and mandates.

We received some criticism for attracting corporate partners to participate in our technology initiative. We define partnership as an arrangement between business and the school that is mutually beneficial to both partners. Current partnerships provide needed capital to purchase and maintain a significant level of technology in the school. The participating corporate partners have access to the computers for training. Open dialogue with business creates understanding in the school of current and future employability needs allowing us to be responsive with the learning experiences we offer. Our partnerships achieve the principles stated in the Ethical Guidelines for Business-Education Partnerships. "Ethical partnerships safeguard learners' interests, build trust and mutual respect, regulate themselves, and make informed decisions that benefit everyone involved." (Conference Board of Canada 1996 p. 100) Corporate partners have a presence in our school but not one of blatant commercialism. They deserve and receive recognition for their contribution to education. One of our corporate partners' recognition signs expresses the ideal of partnership to improve teaching and learning especially well. "It's hard to know where genius is hidden. Thank-you Oak Bluff Community School Technology Centre for developing Canada's future geniuses." (Royal Bank gym sign) I believe our learners' interests have been enhanced not compromised through effective partnering.

Some people suggest that Oak Bluff experienced success attracting partners due to a relatively high SES. Business leaders continually tell me that they receive numerous

requests for donations. Two features attract them to form partnerships with our project. One is the win-win notion of partnership we present. In return for their financial commitment they have the opportunity to use the resources of the school to host training sessions for their employees. This offer holds value for them, as our resources are equal or better than other facilities they could rent. Secondly, providing a plan and concrete evidence of how technology is used in the school to support teaching and learning demonstrates that the school will use the resources wisely. Providing our continuum and examples of student research and presentations assures them that their commitment will effect student learning.

> "To prosper, organisations must be actively plugged into their environments responding to and contributing to the issues of the day. But most fundamentally, learning organisations know that expectations and tensions in the environment contain the seeds of future development. There are far more ideas 'out there' than 'in here'." (Fullan 1993 p. 5)

Over the past four years parents were invited to participate in important decisions related to the education of their children. They were involved in a number of 'education meetings' to discuss what they valued in the education experience of their children. These discussions led to the development of a school mission statement and were followed by meetings including parental input on the age/grade structure and school programs best suited to achieve the schools mission. The climate created through these meetings laid the groundwork for extensive involvement with the technology initiative. "Building a community begins when a leader who is committed to human development

recognises that the school provides a context that brings people together to build an organisation that is mutually supportive and focuses on achieving community-generated goals." (Calabrese 1994 p. 2)

Developing the support of parents and the broader community was an important prerequisite to gaining involvement and partnerships with the corporate and small business sector. As parents saw concrete evidence of their children's accomplishments with technology during student led conferences, by visiting the school and through student produced assignments they developed an appreciation of technology. "Good schools sensitively reflect their communities—both the students and teachers within the school building, and the wider neighbourhood it serves." (Sizer 1989 p. 1) Parents often commented that they turned to their children for support when they experienced a computer-related problem at home. Recognising that their children were developing technological literacy at the school created a sense of support for the direction the school was taking. Evident from the interest expressed at the community meeting, support for the technology centre spread from students and parents to the community at large.

Countless volunteer hours were invested by community members in the operation of the technology board and steps towards achieving a high level of technology in the school. The motivation for this commitment may be found in the broad scope of the initiative. Beyond simply purchasing computers for the school it became accepted and recognised that the technology centre provides a resource for the community and business sector beyond the student population. On-going adult computer training courses held at the school are an example of this service. During our grand opening I asked Alan, the chair

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of the technology board why he so willingly volunteered his time. He remarked that he had been involved in many community activities from coaching hockey to serving on a variety of boards. He stated that this project excited him by its scope and potential to serve a wide cross section of the community. I believe his comments reflect the general attitude of supporters of the centre who are initially attracted by the potential benefits to their children but soon see the broader community implications.

The on-going support and expertise provided by the community and specifically the technology board is largely responsible for the level of technology acquired by the school so far. As a teaching principal it would be impossible for me to achieve the same degree of success working with the staff alone. The board opens avenues of communication with business and has successfully raised over $80,000.00 to date towards the fundraising goal. This initial capital and the co-operation of the school board enabled the school to purchase over $140,000.00 of hardware and software to be repaid at prime over the next three years. The partnership with the board and the teachers allowing the purchase of staff notebook computers is a significant example of achievements made possible only through the support and involvement of the technology board. This allows the immediate implementation of the student and adult technology program and opportunities to continue to upgrade and remain current with the rapidly changing area of technology.

Beyond the financial commitment of the technology board their support in sharing the workload of developing and promoting the technology initiative is significant. They provide expertise and their time and skill in handling many of the important non-

teaching related functions and responsibilities of the centre. This helps ensure that the teachers and I have the time to devote to our primary responsibilities of teaching and learning in the classroom. The board supports our efforts and provides advice and assistance when requested but has done nothing to interfere with the teacher's role in the classroom.

The school's mission statement expresses the importance of life-long learning. As students see their parents and other adults expressing an interest in education a powerful message of the importance of education is delivered to students. It is common for students to work on projects alongside other adults using the computers. They recognise the value of learning when they see other adults taking advantage of the resources the school offers. The opportunity to share technical advice with adults working on the computers raises student esteem and validates their learning.

Understanding Computer use in classrooms

The time invested in developing an appreciation and a mental picture of how computers could be used in the classroom paid dividends once teachers began the implementation process. The discussion, while writing the technology continuum helped develop the understanding among staff that computers needed to be integrated in meaningful ways rather than becoming an add on or a vertical worksheet.

"Another challenge of our time that pervades all these issues and problems
is that we are asking school personnel, in many cases for the first time, to
be thinking contributors who can generate solutions to emergent

problems and obstacles. This is something new. Teachers have seldom been brought together—regularly—to be asked for their suggestion, to develop real solutions to the most pressing concerns students face."
(Hargreaves 1997 p. 143)

The fact that all staff were involved in the discussions related to technology created broad acceptance of the direction we were headed. "While some technology-specific staff development is required, in general all technology-based instruction should be viewed in the larger context of the educational vision of the site." (Thornberg 1996 p. 7) Although there was variance in the degree to which computers were used and integrated all staff participated in the agreement of the direction the school was heading and therefore had a commitment to support one another in their efforts. "Our investigation suggests that innovations, such as high-access-to-technology classrooms, tended to drive teachers to engage in more collegial interaction and instructional sharing in order to prepare for their classes and update their curriculum." (Sandholtz 1995 p. 3) This promoted collaboration as teachers shared experiences, successes and frustrations with technology in the classroom. Evidence of this is related in the sharing between Sarah and Kate in the middle years and Kathy and Debbie in the early years.

The decision to place computers in the classrooms was deliberate. "Today, we look beyond this traditional template of learning to a more interactive, collaborative, and inquisitive student-centred approach to learning. However, while pedagogical changes are taking place within the classroom, the design of new school buildings often perpetuates the "eggcrate" school model. " (Stuebing et al. 1996 p. 1) Planning the new

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school (Appendix B floor plan) the staff considered many different configurations for computer placement. Readings, research and discussions during technology meetings led us to place the computers in the classroom, closest to the point of direct instruction and learning. Current funding provides three computers for most classrooms with the wiring infrastructure in place to allow six once additional funds are raised. Recognising that there are times when a larger group of students needs to gather together to use computers the library media centre currently holds six computers with the ability to expand to twelve. "Although technology offers a variety of learning opportunities, the physical flexibility necessary to support this learning is often difficult to obtain. The networked, computer-integrated classroom was observed to be a static setting that did not readily adapt to changing teaching modes or student projects." (Stuebing *et al.* 1996 p. 1) Our experience of ready availability of computers closest to the point of direct instruction facilitated use and integration.

Computers in the classroom allow students to use them while in the room without having to move to, or book a computer lab. This makes it easier for teachers to integrate computers with learning activities. "The introduction of computers into the classroom changes the teachers' role, as well, leading to decreases in teacher-directed activities and a shift from didactic approaches to a constructivist approach" (Stuebing *et al.* p. 1) As the teacher and other students are in the classroom, support is readily available if the students using the computers require it. Often two students worked together at a computer supporting and helping each other.

"Analysis of the results indicated that the exchanges between students were frequent and substantial, that when problems arose, a student turned first to his or her partner rather than to the teacher, and that the student who worked more often with the computer spoke more often to give answers or explanations while the other student asked more questions. Overall, the students focused on the work to be done and were distracted very little, even by their partner. This study therefore reveals that having two students work on one computer can prove very positive; it contributes in particular to developing the ability for social interaction, itself deemed indispensable for mastering certain intellectual skills and performing certain tasks." (Grégoire *et al.* 1996 p. 18)

When additional computers are required teachers check with neighbouring classrooms or visit the library media centre to use other computers. Sharing of resources in this way promotes collaboration between classes.

The primary frustration and difficulty with integrating computers in the classroom relates to managing time to maximise the use of a limited number of computers in each classroom. Although the staff demonstrated interest, adaptability and willingness to challenge existing teaching practices to change how technology is used in their classrooms many different strategies were tried with varying degrees of success. The demands of organising, preparing and utilising a variety of learning activities to facilitate computer use in the classroom are considerable.

"Teachers also became more proficient at using available time. They learned how to interact with each other and how to prioritise and accomplish tasks during their planning time. Some of the most important tasks were setting goals and blocking out lessons so both team members understood what needed to be done. Having the time to plan reduced stress and eased tensions about not knowing what direction we were going." (Sandholtz 1995 p. 14)

Teachers enjoyed success and noticed improved time for individual and small group work with students when activities were running smoothly. They experienced frustration and difficulties with managing a variety of activities when students were unable or unwilling to accept more responsibility for their own learning. This seemed to occur when students were uninterested in planned activities or unable to participate due to a lack of prerequisite knowledge or skills.

"Another important aspect of a constructivist environment is the emphasis on the quality of understanding as opposed to the quantity. Learners are actively engaged in constructing their own knowledge and understanding rather than passively memorising facts. In such an environment, learners are given time to reflect on what they are learning, rather than racing ahead in an effort to memorise even more information." (Ringstaff and Yocam 1996 p.15)

The past eight months provide evidence of improvement as students acquire more skill using technology and become more adept at choosing activities supporting their learning.

As teachers and students learned to adapt to new hardware and software a broader base of support developed. The past practice of teachers helping one another continues. As teachers learned new applications concurrently with students, some students became more independent solving computer related problems themselves and with encouragement shared the new knowledge with staff and peers. "The technology-rich environment for learning is an active and social one. Students work together and assist one another with technical problems. Teachers and students often share "coaching" responsibilities." (Stuebing *et al.* 1996 p. 15) This creates a broader learning community. As the familiarity with software and hardware increases students and staff begin to discover new applications of its use supporting learning.

An example of this occurred during one of Sarah's classes recently. "In constructivist learning environments, learning is more collaborative and less didactic. Students are actively engaged in constructing their own knowledge, rather than passively memorising facts. (Ringstaff *et al.* 1996 p. 3) She was introducing an activity she had planned for the students using paper and text resources. After the instructions one of the students asked if they couldn't do this just as well using the computer. The students explained how they could find appropriate pictures on the Internet, copy them to the word-processor and type the descriptions printing the final project. Sarah agreed and the students went to work.

Another frustration experienced by all of the staff while using computers is the increased amount of time it takes, initially, to complete computer generated assignments. In the early years this is sometimes due to unfamiliarity with the keyboard and mouse.

Although the younger students express little apprehension with the computer they need to develop a set of skills allowing them to interact with various programs. I initially saw little value in edutainment and paint programs. On closer analysis and with monitored use I later recognised their importance in developing early years skills with computer interaction skills.

The literature stresses the value of word-processing in improving writing, editing and revision skills. "Schools widely use word processing programs to develop students' composition, editing, and revision skills, and it appears that students with a high degree of access to the programs do write more and better." (Hancock and Betts 1994 p. 4) Although this seems apparent with many students, care must be taken to prevent students from being caught up in 'font-it-is'. Some students spend inordinate amounts of time playing with fonts and other formatting features without enough attention given to the style and content of their writing. Recognising this and redirecting the students attention to activities that improve their writing is an important responsibility of the teacher. Assuming that students will automatically make use of word-processing features such as; cut, copy, paste and move or make appropriate use of the grammar checker and thesaurus is a mistake. "It is teachers' beliefs about writing and writing with computers, rather than the technology itself, that makes a difference in how instruction proceeds." (Degroff 1990 p. 570) Although students seem to naturally understand and use spell check, they need to be taught and provided with examples to take advantage of other word-processing features. Time spent introducing and modelling writing with a word-processor improves student work in the long run.

In most cases students were captivated using presentation software; PowerPoint, Hyperstudio and Front Page to create projects demonstrating their understanding. The increased time to familiarise them with this new genre must be recognised in planning. Although the students appreciate being in control of their presentations the learning curve and unexpected software and hardware glitches require more time to be allotted to complete assignments than was necessary using traditional means. By carefully monitoring student activity with the computer teachers can ensure that quality of style and content are not compromised with bells and whistles in the presentation software. "Research on presentation software use indicates that it significantly increases retention rates, provided that the materials are well organised and colour is used appropriately. (Hancock and Betts 1994 p. 3) Providing an activity of student choice to learn the software application, as was the case in the grade seven and eight class with both PowerPoint and Front Page, seemed to be an effective way of allowing the students to learn the program features through experimentation. Patience and flexibility are virtues when using technology. Some student's Renaissance biography projects, completed several months ago are still not posted on the schools home page due to problems with disk space and the server.

Time was an issue in responding to student work electronically rather than commenting on paper drafts. In developing the idea I identified the potential benefits. Although students react to highlighted blocks and teacher insertions more consistently because the final draft cannot be printed without making the changes there is a premium paid in the time it takes to respond this way. Just as it takes time for the students to become

accustomed to a different way of preparing their assignments I anticipate that teachers will develop strategies to become more efficient responding to student work electronically. Very few students have accessed the student writing file on the server to read and respond to their peers' writing. On the other hand they frequently visit the projects attached to the school's home page. Although this provides a wider audience for the students work the opportunity to receive comments is limited.

Endnote: Understanding the Process

The past four years have been challenging, frustrating, invigorating, intense and satisfying. The process of designing and creating a new school in both the figurative and literal sense was an on-going learning process. It began before the construction of a new school received approval. Developing a school that uses technology in significant ways to support learning for the entire community involved a number of stakeholders. The support of family, staff, students and the community allowed us to achieve our current level. The process continues and although mistakes were made throughout the experience our story serves as one model for other educators to consider.

With both teachers and students a supportive school climate allowing the use of technological innovation in a non-threatening environment is important. Although we have experienced some problems and frustrations with attempts to implement and integrate technology the atmosphere is never one of criticism. When either students or staff encounter problems the situation is discussed, solutions are sought and the activity is reworked. This is an important response to encourage risk taking among those learning

to use technology. By continuing to learn and adapt to new technologies a cycle of continuous improvement is created in Oak Bluff Community School.

Appendices
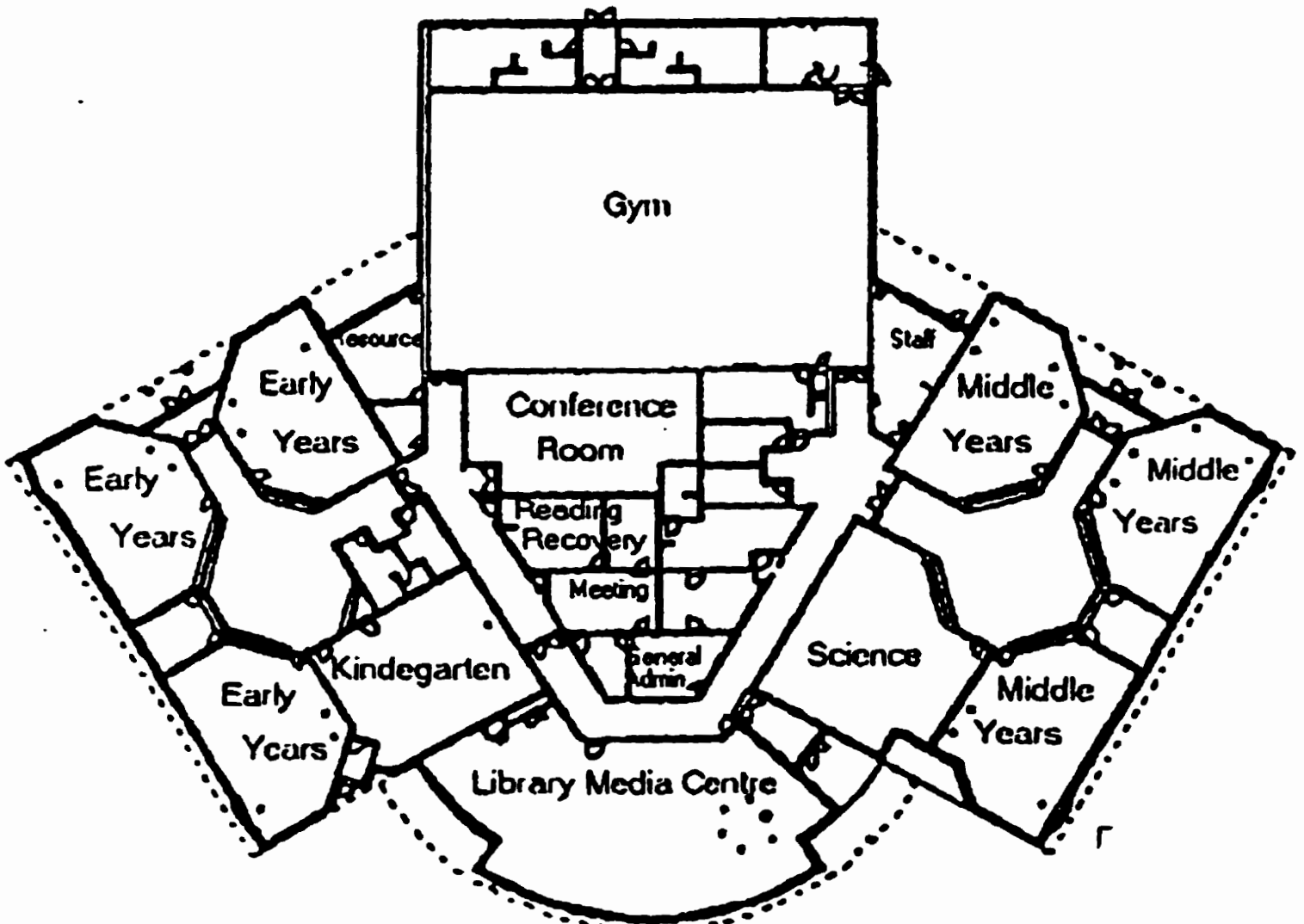
Appendix A

Questionnaire

Appendix A

Questionnaire For Study Participants
Thanks for agreeing to participate in my Masters study focusing on integrating technology in the classroom. I cannot believe where the time has gone but I know I have to get busy with writing. With that in mind I asking that you reflect on the following questions and identify a time, at your convenience, when you could spend ½ to an hour with me discussing technology and your experiences with it in the classroom.

1. What do you know about computers/technology, now that you did not know a year ago?

2. How did you learn it?

3. How have you been able to use it to enhance your teaching and learning for students?

4. What frustrations are you feeling with technology?

5. What experiences do you find most useful to help you integrate technology?

6. What gets in your way in learning about/using technology in the classroom?

7. Describe successful uses of technology in your classroom. What made them successful? What factors contributed to their success?

8. Describe your worst classroom experiences with technology? What caused them to not work?

Please let me know when it is possible for you to meet to discuss these points. Please feel free to address other issues you feel are significant that these questions do not address.

Appendix B

Schematic Floor Plan: New School

Oak Bluff Community School

Appendix C

Technology Continuum

OAK BLUFF COMMUNITY SCHOOL

http://www.mbnet.mb.ca/~oakbluff

TECHNOLOGY CONTINUUM

KINDERGARTEN TO GRADE EIGHT

NOVEMBER 1995

The following continuum provides a framework for students, staff and parents to develop an integrated technology program for Oak Bluff School. The continuum recognizes growth and development of skills by providing for natural carry over from grade to grade in a multi-age school. Skills and activities suggested in the continuum reflect a starting point for the implementation of technology. As technological literacy is dynamic and changing this continuum will evolve to reflect change and growth in skills and applications.

Organization of the continuum is in four main areas. These include; skills and experiences, areas in integration, professional development and suggested resources. Identified areas of professional development relate to current levels of staff expertise and need. Throughout the development of the continuum several categories and processes were considered. These included; care and use of technology, literacy, numeracy, predicting, sorting and accessing information, organizing information, presenting understanding and problem solving. As many of these areas are inter-related they form a basis for skills and experiences to be considered through integrated technological literacy.

KINDERGARTEN AND GRADE ONE

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Log on and off of computer applications Accessing the "C" drive and the CD ROM Exiting Windows and turning the computer off Care of the computer environment Care and use of CD's Use of ALT F4 and exit drop downs of program Use of the mouse; click and double click familiarity with the keyboard Develop a computer vocabulary i.e. logon, logoff, boot, screen, monitor, CPU, cursor	Interactive CD's and story books Computer generated drawings to illustrate student work Preparing cards and notices Word/text relationships sound symbol associations directionality enhancing experiences with alphabet and flip books Writing simple stories and flip books Moving from concrete to symbolic math activities Sharing technological expertise with other children and adults Dinosaur explorations Computer story books Writing computer cards and posters	Evaluation sessions of potential software Sharing sessions with early years staff on integrating literacy computer applications with classroom applications Developing action research projects to understand technological integration	Paint brush and drawing programs CD ROM books, e.g. Broderbund, Diskus books Kid Keys Printshop Deluxe Dinosaur adventure Kid Pix Kid Works 2

GRADE ONE AND TWO

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Care of Disks Accessing "A" Drive, Correctly caring and using a personal disk Saving and Opening Files Keyboarding: Caps Lock and shift keys, understanding of delete and backspace keys, Mouse use as it relates to cursor placement in documents, and placement in different cells Composing, Editing (correcting simple errors) and Printing Finding information on CD Encyclopedias Simple search techniques	Creating weekly and monthly calendars Creating stories and relating experience using Word Processing programs Create graphics to include in word processed documents Writing "notes" to classmates and having them respond and save their answer under different filenames Editing "daily messages" on the computer Researching and sharing new knowledge and discoveries from CD searches Patterning activities using graphics programs	Mini sessions to create familiarity with applications Sharing sessions to develop strategies to allow multiple student interaction with the computer Time to explore CD Information as it relates to themes and investigations in Early years classrooms Developing action research projects to understand technological integration	Paint brush CD ROM books Kid Keys Early Years Encyclopedia Knowledge Adventure series Print Shop Deluxe Student Writing Center Dino Park

GRADE TWO AND THREE

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Format a disk Understanding of the role and location of "A" "C" and "D" drives Saving and Opening Files with a variety of programs Printing work with a variety of programs Keyboarding: awareness of the HOME ROW Mouse use as it relates to cursor placement in documents, and deleting blocks of text Composing, Editing, (using fonts and point size appropriately) Introduction to simple spell checking Introduction to Logo Understanding "repeat" commands in Logo Finding information on CD specialty programs or Encyclopedia Use HOT KEYS to search related information Use graphics from the same program to include in documents	Preparing reports on topics/themes of investigation Produce a video tape to demonstrate understanding of an area of investigation Collaborative writing through accessing and adding to peer work Using Logo to investigate measurement Using Logo to create designs, manages and patterns Produce graphics to include in documents Using information discovered from CD ROM applications in oral discussions and presentations	Time to explore Logo applications as they relate to the curriculum Investigation of appropriate software to match Science and Social Studies concepts Collaborative staff development of word processing activities to compliment skill development Developing action research projects to understand technological integration	Student Writing Center Printshop Deluxe Kid Keys Kid Works Kid Pix Knowledge Adventure Series Logo CD Applications Electronic Encyclopedias

GRADE: THREE AND FOUR

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Keyboarding with correct finger placement using home row 10 wpm Two spaces after periods, one after comma Inserting "Enter" to create new paragraphs Tab to indent Format text to double space, center, bold and underline Alt Tab to switch between applications Introduction to E-mail Importing and Editing text from CD ROM applications Understanding copyright Use an expanded technology vocabulary Editing using move, cut, copy and paste Importing graphics from other program applications Writing and Editing simple Logo Procedures	Preparing and presenting published writing pieces including graphics Use spell check and thesaurus Demonstrating the writing process through a series of computer compositions Utilizing research understandings in projects and presentations Using Logo to write and execute procedures Using Logo to demonstrate patterning and sequencing Produce a multiple scene video presentation Develop collaborative reports sharing work and resources via disk Communicate with peers and partners through local e-mail Prepare and submit assignments electronically. Receive support and feedback from teachers electronically Simple community mapping	Experiences with the Network and E-mail Experience with increased CD resources to match curriculum and student investigations Understanding of Logo procedures and editing functions Time to collaboratively develop interactive e-mail investigations Time to share technology experiences Developing action research projects to understand technological integration	Student Writing Center Microsoft Works and Word Microsoft office Eudora Kid Pix Netscape or Mosaic Logo Printshop Deluxe Mavis Beacon CD ROM's and Encyclopedias

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Keyboarding with correct finger placement	Developing reports of investigations including a variety of resources, formats, table of contents, title pages and references	Mini sessions on File Management Skills	Microsoft Works and Word
Working towards keyboarding without using home row 15 wpm		Skill development sharing sessions on more advanced word processing/ desk top publishing features	Microsoft office
Watching keys	Creating tables and graphs to support Science, Social Studies and Math		Power Point
Checking available space on disk		Inservices on Logo language and applications	Eudora
Creating back-ups of personal files	Using Logo to investigate and demonstrate investigations		Netscape or Mosaic
Moving files from A to C or C to A	mathematical and geometry understandings	Inservices and inservices on Lego availability	Logo
Respecting copyright and individual work		Dacta, robotic sessions	Lego Dacta
Running programs from DOS	Compare Genre and point of view in a variety of articles on a related topic	Investigation of partnerships with Computer/robotics fields and industry	Printshop Deluxe
Composing at the keyboard	Establish partnerships with schools in a variety of geographic locations to compare and contrast questions and lifestyles	Increased opportunity for Internet and e-mail experiences	Mavis Beacon
Searches through CD Rom and Electronic journals			CD and electronic journals and encyclopedias
Establishment of an E-mail partnership and regular correspondence with key pals	Search and use the WEB to support an area of study	Introductory and ongoing sessions with multi-media and presentation software	Tessel Mania
Introduction to Internet WEB sites and Internet searches	Use presentation software and multi-media to share understandings	Developing action research projects to understand technological integration	
Understanding and demonstrating appropriate use of the Internet	Produce and edit a video presentation		
Creation of multiple scene presentations			
Creating tables			
Using existing style sheets			
Using columns in text			
Creating and including graphs in text			
Planning and developing a series of procedures into a superprocedure in Logo			
Introduction of variables in Logo			
Introduction to Lego Dacta robotic			

GRADE FIVE AND SIX

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Keyboarding with correct finger placement using home row 20 wpm Evidence of typing by watching manuscript rather than keyboard understanding file extensions and directories Adding programs to Windows Creating Directories Copying files to a temporary directory Composing, Editing and Revising at the keyboard Finding and reading electronic media Performing mathematical operations within programs Using a database to find information Perform Web Searches and use results in areas of study Search through a variety of electronic resources. Reference results correctly and demonstrate use of information from different sources Creating a simple unstructured database Writing and creating reports including formatted text, graphics, graphs and tables Creating an edited video presentation of an area of investigation explore the use of sound in presentations Use of variables in Logo	Using the computer in the writing process Collaborative writing Development of technology vocabulary Using the computer to perform mathematical operations within programs Estimating to understand accuracy of computer generated answers Searching database Web search information and graphics incorporated in reports information in research of investigations and reports Science and Social Studies applications requiring collection and organization of information Report and essay writing in Content areas and Language arts Script writing and filming including dubbed in special effects and editing Written reports including authors sound buttons and dubbed related sound clips Logo procedures enhancing geometry concepts in math Robotics constructions demonstrating understanding of science concepts	Mini-sessions on computer usage, DOS, Windows, and program applications Collaborative writing opportunities with other educators on action research projects Sessions on computer math and equation functions Sessions on database organization and searches Sessions on the construction and use of databases Time to explore the Web Sessions on narrowing searches and organizing tracking information discovered Sessions on incorporating sound and video techniques Advanced sessions on Logo and variables Developing action research projects to understand technological integration	Microsoft Works and Word Microsoft office Power Point Eudora Netscape Logo Logo Dacta Printshop Deluxe Mavis Beacon CD and electronic journals and encyclopedia Tessel Mania

GRADE SIX AND SEVEN

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Keyboarding with correct finger placement using the home row without looking at the keyboard 25 wpm understanding file extensions and directories Simple troubleshooting of Windows Downloading files and programs Using PKzip and UNzip Creating and importing graphs from a spreadsheet into a word processed report Use the scanner to incorporate images in published documents Write an HTML document including links to other related information Prepare a multi-media presentation including slides, buttons, sound and video clip Use of variables in Logo with controls Develop a series of subprocedures that can be controlled interactively within a superprocedure Create animation's Create Lego Dacta robotic constructions including presentation pages with buttons and graphs	Participation in collaborative writing of research with partners in a different geographical location Essay writing using correct reference format Researching and preparing projects including a variety of resources Preparing multi-media presentations to be shared in school and beyond Using simulations to investigate problem solving and design simulations i.e. "sim" series Preparing biographical sketches for composition into class room home pages Creating computer graphic art to be incorporated into presentations	Sessions to provide skill development in program applications Sharing sessions among staff and beyond to develop and assess integrated technology applications Time to explore WWW to identify appropriate integrated learning links Collaborative writing opportunities to develop and explore staff action research projects Meeting to agree on commonly accepted writing and reference procedures	Microsoft Works and Word Microsoft office Power Point Eudora Netscape HTML editors Logo Lego Dacta Printshop Deluxe Mavis Beacon CD and electronic journals and encyclopedias Tessel Mania

GRADE SEVEN AND EIGHT

SKILLS & EXPERIENCE	AREAS OF INTEGRATION	PROFESSIONAL DEVELOPMENT	SUGGESTED RESOURCES
Keyboarding with correct finger and eye placement 30 wpm Composing, Editing and Revising at the keyboard Finding and reading electronic media related to a topic of study and research Performing mathematical operations within programs Create, edit and troubleshoot spreadsheets with formulas in both rows and columns Create a report using a database Use scanned images in published documents Write an HTML document including hypertlinks, graphics and buttons Prepare a multi-media presentation including slides, buttons, sound and video clip Create animation's Create Lego Dacta robotics constructions including presentation pages with buttons and graphs	Initiate and participate in long-term ongoing collaborative writing projects Prepare and present project understandings in a variety of formats Research and write HTML pages on local community and business interests Teach technological understandings to other members of the community Create interactive stories with robotics constructions Use simulations to investigate and demonstrate understanding of research topics	Sessions on the variety of applications software used Cooperative sessions with student mentors helping them understand how to share and teach other members of the community Time to search Internet sources for relevant and appropriate student links Opportunity to develop collaborative action research projects on inquiries related to technology integration	Microsoft Works and Word Microsoft office Power Point Eudora Netscape HTML Editors Logo Lego Dacta Printshop Deluxe Mavis Beacon Sim series and other simulation software CD and electronic journals and encyclopedias Tessel Mania

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