CONSTRUCTING LEARNING COMMUNITIES IN YUKON SCHOOLS: A PEDAGOGICAL APPROACH FOR TECHNOLOGY INTEGRATION

by

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ABSTRACT

The importance of integrating technology across the curriculum has been prominent in educational literature for the past decade. Numerous obstacles have been identified and documented surrounding the successful integration of technology in public schools. Access to hardware, appropriate software, professional training for educators, technical and financial support to sustain meaningful uses of technology in schools are the primary areas to be addressed when designing a comprehensive information technology implementation strategy for educational environments. The obstacles are clear, but many educational leaders have failed to develop a model which successfully addresses the challenge of integrating the use of technology as a tool for teaching and learning and as a means of constructing new knowledge for and by students.

This paper will explore how technology facilitates learning through inquiry and how inquiry supports a constructivist/constructionist approach to teaching and learning for students and professional staff. This will lead to an examination of how inquiry and constructivism advance the integration of technology in education and how it provides a venue for developing communities of inquiry in schools.

A framework for two initiatives developed for Yukon schools will be presented which address many of the challenges common to the successful integration of technology in public schools today. Both initiatives, the Computer Resource Teacher Model (CRTM) and Technology Learning Communities (TLC), promote integrative and constructive uses of technology through an inquiry-based approach to teaching and learning with computers.

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Chapter 1

Technology and Education

The emergence of powerful new information technologies over the past five years has impacted how we work, how we conduct business and how we communicate. Pressures of our global market will require a workforce where every potential employee can be both a producer as well as a consumer of information. An educated person in our knowledge-based society will be someone who has learned how to learn and will continue to do so throughout his or her lifetime. Citizens of tomorrow must possess the skills to continue to learn, grow and respond to the dynamic patterns of learning and employment emerging this century.

Scores of educational institutions refer to 'life-long learning' in their mission statements and policy documents. Improving technology education is frequently earmarked as a primary goal in school accreditation reports. School districts, colleges and universities are making their programs of study accessible to students, world-wide, through the development of distributed learning networks. It is obvious that information technology literacy will be the gateway to life-long learning in the twenty-first century.

Information technology, one of the most powerful tools available for students and teachers to transform our teaching and learning environment in public schools, has largely remained an untapped resource in promoting life-long learning among our students and educators. Many schools have yet to implement the use of technology beyond a very basic level, even though technology education is perceived to be a core subject of the curriculum of tomorrow (Richie, 1996; Starkweather 1996).

The importance of integrating technology across the curriculum has been prominent in educational literature for the past decade. Numerous obstacles have been identified and documented surrounding the successful integration of technology in public schools. Access to hardware, appropriate software, professional training for educators,

technical and financial support to sustain meaningful uses of technology in schools are the primary areas to be addressed when designing a comprehensive information technology implementation strategy for educational environments. The obstacles are clear, but many educational leaders have failed to develop a model which successfully addresses the challenge of integrating the use of technology as a tool for teaching and learning and as a means of constructing new knowledge for and by students.

Although a good start, furnishing schools with the most up-to-date hardware and software, building state-of-the-art infrastructures to support telecommunications and writing and mandating scores of information technology learning outcomes, does little to produce a 'computer literate' student population equipped with the skills to thrive in the twenty-first century. If educational technology is to be integrated as a tool for instruction across the curriculum, teachers will have to make it happen! Intelligent use of technology occurs only when teachers understand and experience the benefits it can bring to the classroom. The potential of these powerful learning tools will be unleashed when educators modify their teaching practices and integrate the use of technology as a means to build, enhance and extend constructive learning environments for students (Becker, 1992).

Purpose of Paper: Developing Technology Learning Communities in Schools

This paper will present two initiatives developed for Yukon schools which address many of the challenges common to the successful integration of technology in public schools today. Both initiatives, the Computer Resource Teacher Model (CRTM) and Technology Learning Communities (TLC), promote integrative and constructive uses of technology through an inquiry-based approach to teaching and learning with computers.

Before exploring these initiatives, I will examine how technology facilitates learning through inquiry and how inquiry may support a constructivist approach to teaching and learning for students and professional staff. This will lead to an examination

of how inquiry and constructivism advance the integration of technology in education and how it provides a venue for developing communities of inquiry in schools.

I will present the Computer Resource Teacher Model (CRTM) and will relate my experiences and observations as a computer resource teacher for three years at Riverdale Junior Secondary School in Whitehorse, Yukon. Following this, I will present a framework for building and sustaining Technology Learning Communities (TLC) among professionals in schools. This discussion will examine how technology is well situated as an overarching common goal for developing professional communities of inquiry in schools and how TLCs may counter many of the obstacles facing the successful integration of technology across the curriculum. The compositional and operational requirements for the proposed model will be presented, as well as how technology may expand the boundaries of the school's learning community to include regional, national and international members as resource and/or community members.

To understand why technology has not been effectively integrated in our schools' learning environments, it is necessary to examine some of the historical influences of educational computing which have prevented this adoption from occurring. In doing so, I will also describe recent experiences and observations I have had working with teachers and students as information technology consultant for Yukon public schools over the past three years. I will relate these experiences to my theory that the potential for these powerful tools to transform traditional learning cultures will not be realized until educators re-evaluate and restructure their approach to using technology with students,.

Historical Influences on Educational Computing in Public Schools

When microcomputers were introduced into classrooms in the early 1980's, they were received with great expectations by some and with trepidation by others. Except for a few exemplary uses of technology in education, such as MIT's Hennigan Project (Harel & Papert, 1991), the computer was viewed as a means of delivering instruction to students, much like the overhead projector, filmstrip or VCR. The role of technology assumed was to teach students

through drill and practice or tutorial applications. Many educators projected it would aid students in learning more content, in a shorter period of time.

In the early days of educational computing, software programs selected for educational purposes often limited the usefulness of computers. Students, often in a lab setting, were taught the mechanics of using software with 'impenetrable' user interfaces. Computer-assisted instruction (CAI) placed the learner in a passive role in this learning environment. These tutorial-based programs delivered hierarchical activities which included student feedback or evaluation components. CAI lacked the complexity which would make it relevant or compatible to the creation of constructivist classrooms on a substantial scale (Becker, 1998). As a result, computers were often used as teaching machines, and in some instances, took over part of the teaching responsibilities of the classroom teacher (Niederhauser, 1996).

Computer aided instruction (CAI) was very consistent with traditional behaviorist teaching practices, did not cause a shift in pedagogy and did not alter the nature of the learning process for students. (Harel & Papert, 1991). This made it very easy for teachers to incorporate the programs into the curricula without adjusting their teaching practices from the teacher-centered, didactic learning environment prevalent in schools at this time. While this method of using computers did help some students through remediation, it was not the most effective way to use technology with students (Jonassen, 1998).

As early as the 1980's, there were educational reformers who were researching the impact of using production-oriented software with students in the educational setting. Researchers at the Massachusetts Institute of Technology (MIT) were involved in a large, multi-dimensional study at Hennigan School, called Project Headlights. Using LEGO/logo, a software application developed by MIT's Seymour Papert, students constructed machines using LEGO building blocks, gears and motors and wrote the Logo

programming necessary to control and operate their machines (Harel & Papert, 1991). Such innovative uses of computers with students at this time were rare.

The introduction of computers to schools did not lead to any fundamental shift in how teachers were teaching or how their students were learning. Educational computing was not, for the most part, focusing students' attention and effort on intellectual challenges and questions (Becker, 1992). Intelligent use of computers facilitate learning environments where students are challenged to utilize high-level thinking and problem solving skills. They are the skills which prepare students to continue to learn, grow and respond to the dynamic patterns of change in our global society.

During the early years of computing, educational leaders, administrators and schools districts invested millions of dollars on equipment, but teachers were provided with little direction or support to construct meaningful learning environments for their students using this technology. In time, many teachers and principals began to view computers as electronic notebooks or workbooks. They began to question the investment associated with the acquisition of these tools. Skepticism among supporters grew and serious questions were raised as the value of technology in our schools (Willis, 1997). This may have caused many educators and administrators to become reluctant to invest scarce capital dollars on a medium that did not appear to be making a huge impact on student learning.

This situation is compounded by some educational theorists, such as Neil Postman, who believe that technology and our so called 'information age' is a hindrance, not only to education but possibly to humankind. In a presentation Postman delivered entitled *Informing Ourselves to Death*, he describes the impact he believes technologies have on our culture.

> "Through the computer, the heralds say, we will make education better, religion better, politics better, our minds better – best of all, ourselves better. This is, or course, nonsense, and only the young or the ignorant or the foolish could believe it....The message is that through more and more

> information, more conveniently packaged, more swiftly delivered, we will find solutions to our problems. And so all the brilliant young men and women, believing this, create ingenious things for the computer to do, hoping that in this way, we will become wiser and more decent and more noble" (Postman, 1990).

Postman believes the talent used to develop technologies for the assimilation of information is a monumental and dangerous waste of talent and time. He asserts that if the energy and talent used in advancing the use of information technology was directed towards philosophy, the arts, literature or education, society would possibly learn and understand why there are wars, hunger, homelessness, mental illness or anger (Postman, 1991).

Public critics have also surfaced to question the value of educational computing and its contribution to a student's education. Vocal parents often view technology as an infringement on 'the arts' programs in public schools, which were being cut as cost saving measures. It is not surprising that numerous articles have appeared in the press recently questioning the value technology is playing in the education of our students and the increasing financial cost for educational institutes to stay current with the emerging technologies.

Virginia Galt, education reporter for the Globe and Mail, reported on the results of a recent Angus Reid poll which headlined, "Too Much Time Spent on Computers in Schools, Canadians Say." The article went on to conclude that the majority of Canadians believe that too much emphasis is being placed on computers at the expense of teaching the basics (Galt, 1999). This is a most interesting summation and potentially very damaging given that most educational institutes are struggling to acquire the hardware and resources needed to provide students with opportunities to use technology in schools. It

also reveals another issue worth investigating: What is the public's perception as to the role of technology in education today?

In their book, *The Child and the Machine*, Allison Armstrong and Charles Casement not only question the effectiveness of computers in educating our children, but go so far as to question whether we should be exposing children to technology at all in their formative years (Armstrong & Casement, 1998). The authors focus their arguments on the link between computers and improved academic performance and they leave the reader with the underlying impression that computers are being used in the school system to 'teach' children. "We cannot rely on a single technology tool to do the job of educating our children", wrote the authors in the concluding chapter of their book (Armstrong & Casemont, 1998).

Clearly, educational leaders have to make an effort communicate and educate the public about the role information technology plays in the education of our students today. It is essential the critics of using technology in education understand computers are one of many tools used to enhance and extend learning across the curriculum and that their use in the educational arena is not at the expense of traditional curriculum content.

Four key areas can be identified in educational computing which I believe are the underlying reasons why schools have not been successful in implementing and integrating the use of technology with students. Twenty years later many of these issues continue to be challenges for educators who are attempting incorporate and integrate its use across the curriculum. They are:

1. Lack of implementation strategy
2. Lack of teacher training

3. Lack of shift in pedagogy

4. Lack of a relevant curriculum

1. Lack of Implementation Strategy

The relatively short history of technology planning by schools has demonstrated that dropping computers on desktops and periodically dipping teachers into technology workshops does not result in teachers and students using technology effectively (Hoffman, 1996). This was the extent of most technology plans during the early introduction of microcomputers to schools in the 1980s. In retrospect, it appears that there was a belief that the need for technology in schools would sell itself and the innovation would be accepted and adopted due to its obvious benefits. This symbiotic adoption did not occur.

Innovations such as the introduction of a new technology diffuse at a very slow rate in organizations (Rogers, 1983). This is evidenced by the fact that two decades after the introduction of computers to public schools, many educational leaders are still struggling to have teachers use technology in a meaningful, constructive manner with their students (Johnson, 1997; Willis, 1997).

Given the complexity of issues surrounding implementation of information technology (IT), it is understandable that a comprehensive, curriculum implementation strategy is needed as part of a larger information technology plan for a school district. Curriculum should be the driving force behind such a plan and should incorporate the hardware, software and support resources needed to achieve the learning outcomes of the curriculum (Hoffman, 1996). Specifically, an effective information technology plan should include the following:

1. Dynamic curriculum – integrated across the curriculum
2. Implementation plan for the curriculum – updated yearly (3 – 5 year plan)
3. Teacher training - operational and pedagogical
4. Hardware standards/network specifications for schools
5. Software which supports curriculum objectives
6. Technical support/network support for the classroom teacher and school
7. Adequate resource funding for the life of the plan

8. Classroom support for teachers – technology or school computer coordinator Schools seldom had implementation strategies to guide them during the early introduction of computers in public schools.

Detailed planning is essential for the successful integration of IT in schools (Uebbing, 1995). This is particularly true in the educational arena where reforms are slow to be adopted, employees are known to be resistant to change and where individuals and units often work in isolation of each other (Bossart, 1996).

When implementing a significant change in an educational system, a top-down, bottom-up strategy has been found to be successful (Fullen, 1994). Research has demonstrated when top-down (district offices) and bottom-up (teachers) strategies mesh, change is likely to occur and be successful. Mandating change from the school district level will not be successful; what is most important when implementing change at the school level is the classroom teacher. (Fullen, 1994). Schools are not known for initiating change, so a bottom-up approach is likely not to work without some direction from a central authority.

Due to the complexity surrounding the adoption of technological innovations in educational institutions, there is a need to involve all stakeholders (top-down, bottom-up strategy) in the planning and implementation efforts of the curriculum (Johnson, 1997). The range of stakeholders involved in an information technology plan is far reaching and must be representative of all who will be directly involved in the implementation process and support of the curriculum. Unfortunately, many of the important stakeholders remain invisible in the planning process and this may account for the seemingly dismal results of school districts to successfully implement technological change at the school level (Bossert, 1996).

Teachers, parents, students, business community members, administrators, technology coordinators, curriculum consultants, network specialists and technicians should be involved in the plan's development (Uebbing, 1995). Only through a

comprehensive, coordinated effort by all stakeholders will there be an understanding of the complexity of issues surrounding the implementation of the IT curriculum and the technology infrastructure needed to support it in public schools.

An underlying element encompassing all facets of a successful technology plan is adequate financial support to sustain the human, hardware and software resources needed to support the curriculum. When human resources (teacher training and technical support) are under-funded, it will affect the delivery of the curriculum. When a school does not have hardware, software and a network infrastructure in place, curriculum objectives may not be met. There exists an interdependency among all levels of support for information technology. Parallel financial support for human and hardware support should be sustained throughout the life of the plan.

2. Lack of Teacher Training

It is well documented in literature that one of the biggest hurdles to overcome for implementation of information technology in schools today is the need to address the 'technology skills gap' that exists in the teaching profession (Hope, 1997; Niederhauser, 1996; Maddux, 1997; Ritchie, 1996; Willis: 1997). Although there has been some progress in improving technology expertise among teachers over the past few years, there has also been a very rapid growth in sophistication of hardware, software and network infrastructures over the same period of time. As a result, the gap between teacher skills and their ability to use today's hardware and software is growing. It is important to theorize and if possible, understand why teachers have lagged behind industry in acquiring and maintaining an adequate level of computer literacy. Understanding this phenomenon, why and how it occurred, is an important issue to consider when developing IT plans for school districts.

The primary human resource issue surrounding technology implementation in schools is the need to provide the resources to train teachers (Hope, 1997; Willis, 1997). Although it is possible to cite scores of literature on the need for technology training

among teachers, none so poignantly describes the underlying problem surrounding this phenomena than Johnson's (1997) findings comparing private industry and public education's training of employees. She found that in one year business spent well over $2 billion on training their employees on the use of technology, but 90% of teachers in America report that they were 100% self taught (Johnson, 1997). Private industry does not operate on the pretense that they can just sit an employee in front of a new piece of technology and hope that he/she will learn how to use it efficiently and effectively. Industry knows that this would be ineffective, inefficient and counter-productive to do so.

Educational leaders appear to expect teachers to attain their technology skills by osmosis; furnish them with the technology and they will learn to use it effectively with students. The past twenty years have proven this will not happen. Administrators and curriculum leaders must acknowledge that training opportunities and resources must be allocated for professional development if they hope for present teaching practices in technology to change (Meltzer & Sherman, 1997).

3. Lack of Shift in Pedagogy

New computer applications and sophisticated hardware and network infrastructures have left many teachers unfamiliar and fearful of technology. Teacher training can no longer be limited to learning how to operate the hardware and software. A far more critical issue for IT integration in schools is the need for a shift in teaching practices, from teacher directed learning, to student-centered learning (Niederhauser, 1996).

It is time for teachers, as a profession, to critically examine their pedagogy. The traditional role of the classroom teachers as the 'expert' transmitting information, knowledge and facts to the 'empty learner' does little to support the global educational vision of life-long learning (Goldman Segall, 1998; Richie, 1997; Wilberg, 1997). Our traditional foundation and approach to learning assumes that students will learn on demand and in doing so, it places the learner in a passive role in his or her own education.

It assumes the student will embrace the scope and sequence of the course of study. Students' success or failure is determined through formal and informal assessment instruments. In this environment students learn the same concepts at the same time, but each student takes away his or her own unique meaning and understanding through their own unique cognitive processes. Didactic learning environments and formal assessment do not assess or appreciate the different life experiences students bring to the classroom or how students perceptions or suppositions of their world have been challenged, modified or newly constructed during the course of study.

In her book, *Points of Viewing Children's Thinking,* Ricki Goldman-Segall (1998) explores the discourse facing teachers in our current educational climate. Educators today are struggling to find a balance between: instruction and construction, routine and spontaneous learning, work and play (Goldman-Segal, 1998, p. 68). A significant number of cognitive scientists now view learning as a process of constructing one's cognition, or thinking/understanding. Theorists suggest that learning occurs not by recording information, but by interpreting it. In an information age where the knowledge base is growing exponentially, it is logical that teaching practices must shift to adopt a more student-centered learning environment.

Educational reformers are encouraging teachers to modify their teaching practices, teaching styles, along with their underlying beliefs as to what constitutes 'good teaching'. Most reformers are encouraging teachers to adopt teaching practices that are more consistent with a constructivist model of learning (Becker, 1998). Constructivist teachers recognize that students all have unique experiences which they bring to each classroom activity and they connect lessons to student experiences. Curriculum serves as a foundation for what to teach; a constructivist approach to teaching addresses how students learn and how to make the learning relevant and meaningful to the student (Brooks & Brooks, 1999).

Many integrated technology programs in schools support a constructivist approach to student learning where the emphasis is placed on using the computer as a tool in a student's knowledge constructions (MacInnes & Kissoon-Singh 1996; Feng, 1996; Papert, 1980, Willis, 1997). Citizens of tomorrow require the skills to collect, examine, evaluate, critique, defend and to construct new knowledge. Production-oriented software applications such as spreadsheets, databases, word processors and multimedia tools, coupled with telecommunications, all aid in facilitating students' constructions of knowledge. Information technologies possess enormous potential to support constructivist learning environments.

Technology is also playing a new role in resource-based learning in our schools. The Internet provides students with rich data through electronic journal and research articles and through collaboration with experts willing to share their expertise with students on the net. Students are no longer limited to participating in intercollegiate projects within the confines of their schools or city. Technology has redefined the wall-less classroom and has made it is possible for students to participate in national and international collaborative projects from a desktop-computer terminal. Goldman-Segall asserts this globalization of the learning environment further challenges the traditional role of the classroom teacher as the bearer of all knowledge. She believes that the days of teachers being the gatekeepers of knowledge are gone and that teachers can no longer confine learning within the walls of their classroom (Goldman-Segall, 1998, p.81).

> "What I suggest is that teachers give up trying to keep the barn doors closed. I suggest they take a look at what's on the outside of the barn first. Then they need to find ways to explore, with those children with whom they live throughout the day. They need to navigate new territories, learning how to construct larger groupings of human experience from the plethora of possibilities and points of viewing" (Goldman-Segall, 1998, p. 81).

It is no longer merely desirable to learn for life; it is a necessity if one wants to be a productive, participating member of society. This is true for both student and teacher.

4. Lack of a Dynamic Curriculum

When introducing a new curriculum, it is vital that professional expectations for teachers and the learning outcomes for students are clearly articulated and supported with relevant resources. Computers will be underutilized unless there is a strong curriculum tied to well designed teaching strategies (Wilberg, 1997).

The first educational computing curriculum for British Columbia and Yukon, *Computers into the Classroom,* was introduced in 1984 (B.C. Ministry of Education, 1984). It was issued to schools as a resource and was not a mandated curriculum. Insufficient or inadequate hardware and software resources, along with staff lacking technology skills, provided an avenue for schools to ignore the curriculum and they were able to do so without repercussions or much attention from curriculum leaders.

The level to which technology education was ignored in British Columbia is evidenced by the fact that a new information technology (IT) curriculum was not introduced until September 1997; a full thirteen years after the last computer resource document. By this time, the original computer curriculum was not only dated, but irrelevant. Several generations of new technologies had evolved during this time and schools had little direction or mandate to upgrade their hardware and networking infrastructures. The gap in relevant IT curricula furthered the perception that the teaching of information technology was of little importance in schools.

In response to the need to formalize and standardize the teaching of information technology in British Columbia's schools, the Ministry of Education produced the Information Technology Integrated Resource Packages (IRPs) targeting students from kindergarten to grade ten. The aim of this curriculum is to integrate the use and teaching of technology skills across the curriculum, by classroom teachers (B.C. Ministry of Education, 1995). For most teachers the implementation of IT in schools is markedly different from other innovations they may have experienced in their teaching careers. Many teachers are struggling to learn the skills needed to effectively utilize this medium

with their students and most have yet to recognize implement the use of technology be an effective tool in promoting inquiry learning in their classrooms.

Examining and understanding the obstacles underlying the successful integration of technology in public schools is the basis for exploring the role professional communities of inquiry can play in addressing the 'technology skills gap' that exists among educators. It will also serve a venue for them to experience inquiry learning as a member of a community of inquiry. School and technology-based communities of inquiry provide a means to address and counter many of the challenges facing districts which lack global IT plans and/or funding for adequate operational and pedagogical professional development for staff.

Before examining what constitutes inquiry learning, a community of inquiry and how these communities promote a constructivist approach to teaching and learning, I will share my observations and experience an information technology consultant who has worked closely with educators and departmental officials in their attempt to build technology learning environments for students and teachers. In doing so I will present arguments and evidence as to why I believe fundamental changes must occur at the school level before we can hope to realize our goal of integrating the use of technology in a meaningful way with students.

The Missing Link – Technology Integration

My three years as Information Technology Consultant for the Yukon Department of Education have provided me the opportunity to be intimately involved in the long-term planning for resourcing and integrating the use of technology across the curriculum. During this time, we have invested in the human and financial resources to build school infrastructures, acquire hardware and software tools and have provided professional development opportunities for educators. The groundwork had been well established to promote and facilitate the successful integration of information technology among students and staff. Seemingly, everything was in place for schools for educators to

embrace technology resources and integrate their use to enhance and extend student's learning experiences.

As I traveled throughout the territory, my observations proved otherwise. With very few exceptions, no fundamental change had occurred in how teachers used technology with their students. Classes are still scheduled into the computer lab for a predetermined number of minutes per week, teachers are still seeking subject-oriented software, most of which holds little educational value for the students and participation in collaborative and online projects is rare in schools.

At the outset, I was perplexed as to why teachers were continuing to use technology as they had decades ago. The elements which were lacking in the days of early educational computing had certainly been addressed. We had a new curriculum which specified the role technology should play in a student's learning. Teachers had been furnished with the hardware and the 'production oriented software' to promote and complement a constructivist learning environment. Inservicing highlighted the need to integrate the use of technology into the curriculum, not onto existing programming. As I explored this issue further I found it was not an isolated to one or two schools -- it was a system-wide phenomena. What had we missed?

What we overlooked was the most critical element when implementing an innovation of this magnitude -- the classroom teacher. We were not only requesting teachers to change how they used technology with students, but most importantly, we were asking them to change **how** they taught. And we did so without considering the structural changes which would have to occur at both the school level and in teacher education programs to implement such a shift in practice. In theory, it was a rational approach; in practice, it was impossible to implement. It was a classic 'top-down' strategy which failed because the plan did not include all the stakeholders needed to implement such an innovative pedagogical approach to teaching and learning with technology.

Traditionally schools have scheduled the use of their computer labs in much the same fashion as libraries did before adopting an open scheduling model to facilitate resource based learning. Classes are scheduled into the computer lab for a particular block of time to 'use' the computers. I knew this to be the case in most schools, but what I emphasized with teachers on my regular visits to their schools, was to refocus how they used the technology with students. To promote a more integrated approach to using computers with students I asked teachers to guide their use of it by asking the questions: "How are my students using technology to enrich their learning environment and how is it tied to what we are studying in the classroom?" While these might have been guiding principles on the approach to using technology tools, it did little to facilitate integration.

Once all the classes have been 'booked' into the computer lab there is seldom any remaining time for flexible scheduling for student use. This does not facilitate a teacher's need to block additional time in the lab when planning for long-term projects. When a student's access to technology or online resources is limited to thirty minutes, Tuesday mornings and Friday afternoons, it does little to facilitate spontaneous access to technology that often arise in learning environments. For that matter, 'computer labs' do little to promote true integration of technology in student learning.

Four critical areas have to be addressed at the school level to facilitate the integrative use of technology with students.

1. Inservicing of principals on the aim of technology integration in schools
2. Re-evaluate 'timetabling' and distribution of computer hardware
3. Professional development for teachers on the pedagogical approach for technology integration with students.
4. Parents and the community involvement/advisement on educational reforms

Inservicing principals on the aim of technology's role in education will provide administrators with an understanding of the changes needed at the school level to support technology integration. Administrative support is important, if not essential, if changes at

the school level are to be successfully adopted (Conyers, Kappel & Rooney, 1999; Hoffman, 1996; Richie, 1996). In conjunction with the staff, administrators should play a significant role in reviewing and restructuring student access to computer technology by adopting an open-ended timetabling schedule for the lab. This, along with moving toward a more distributed network of computers throughout the school, will facilitate integration. Pods of computers in individual classrooms promotes 'just in time' learning with technology and augments an integrated approach to their use. (McCraw, Meyer & Tompkins, 1995).

Like principals, teachers would benefit from further inservicing on the aim of technology integration across the curriculum. It is an innovative approach to using computers and requires educators to re-think their basic pedagogical teaching approach, adjust their craft and to re-conceptualize their goals for students. (Becker, 1997). The above issues could be addressed through traditional inservicing of professional staff, but for it to be meaningful and successful at the school level, the discussion and implementation must come from within (Booth & Wells, 1993). School based communities of inquiry provide a venue for educators to explore, examine and implement the fundamental structural and pedagogical changes necessary at the school level for technology integration.

Historically, educational reforms are slow to be adopted in educational systems and are often met with resistance by traditionalists who are reluctant to adjust steadfast practices and procedures (Harel & Papert, 1991; Fullen, 1994). The public is often the last to learn of transformations in the educational system and understandably, are not always supportive of newly adopted practices with which they have had little input. Inviting parents and the public to be active participants in the reconceptualization of technology's role in education provides an avenue to involve and inform these stakeholders about the important role computers are now assuming in a student's learning environment.

It is easy to see why the early introduction of microcomputers was not universally adopted by the educational system. This innovation lacked an implementation plan, mandated curriculum, trained teachers, (technically and pedagogically) and relevant software and hardware resources to be widely adopted and accepted as a valuable teaching tool.

Today, many of the elements necessary for the successful integration of technology in education are in place for educators to embrace. Sophisticated hardware and software, new applications for the Internet and development of distributed learning networks are continuing to evolve. The challenge remaining for educators is to adopt the teaching practices which capitalize on the potential for technology to transform how we teach and learn in the next century.

Chapter 2

What is inquiry learning?

It is without question that the most important 'resource' in our educational system is the classroom teacher, but the role of this primary resource in 'educating' the citizen of tomorrow is in a dramatic state of transition. Historically, the model within which educators have worked has been one of isolation. Teachers learned the content of their area of 'expertise' and then were charged with the duty of transmitting the information, content and skills to their students, evaluating them for proficiency and moving them along to the next teacher, to do the same. Schools are structured in such a way that they afford little time for interaction, collaboration or professional growth among their experts. Preparing the knowledge constructors for our new economy will require a model in education which promotes inquiry and provides an environment where inquiry learning can be learned and practiced by both students and teachers.

The old schools' model of a teacher's role as an educator requires change, along with the perception of what will constitute an 'educated' person in the next century. Educators are caught between the well-entrenched traditional model of teachers as the transmitters and the authority of knowledge and the demands of our new economy where citizens must be able to respond to complex issues by working collaboratively with others in the construction of new knowledge. If follows, epistemologically, that educational reformers will be subjected to review and redefine what will constitute knowledge in our new economy. In a world that is becoming increasingly complex and sophisticated, educational constructs, such as learning communities, may serve as an appropriate venue to facilitate our newly constructed theories of knowledge. As such, the educational system should accept, respond and adopt teaching and learning practices which move away from the belief that any one individual can possess the expertise, knowledge and understanding needed to respond to the complexity of issues in a society where the exponential growth of knowledge is easily shared from a desktop computer.

Fluid learning communities are schools where teachers are students, students are teachers and teachers and students are comfortable co-learning a topic of inquiry. If we hope to cause an effective shift in the paradigm of what an educated person must be in our world community, we have no choice but to think differently about what we teach, how we teach and the new role educators must adopt in our schools to achieve these goals.

The concept of communities of inquiry is based on the premise that we learn differently and more effectively thorough inquiry. Traditional learning communities rely heavily on dialogic interchange between teacher and student. Inquiry learning, on the other hand, relies on the communal acquisition of knowledge (Collins, 1997). 'Learning how to learn' is the fundamental core of inquiry learning and is at the heart of many of the curricular and pedagogical reforms in education today.

Inquiry learning can be traced back to the writings of Dewey nearly one-hundred years ago (Lipman, 1997). It is a pedagogy that has not been universally embraced nor completely understood by most professional educators who were 'trained' in a more conservative, behaviorist manner. What has changed is the urgency with which it now assumes as we enter a new century (Sampson, 1998).

Matthew Lipman (1991) describes inquiry learning as an environment where learners listen to one another with respect, build on one another's ideas, challenge one another to supply reasons for an otherwise unsupported opinion, assist each other in drawing inferences from what has been said and seek to identify one another's assumptions. The inquiry approach to learning promotes problem solving in authentic settings, collaboration among students, classrooms, teachers, scientists and community. Robust learning and genuine understanding are achieved through these communities only when students are active and thoughtful participants in their learning.

There is no question that creating 'communities of inquiry' in schools is about change. It promotes an environment in the school where teaching, and learning about

teaching, becomes seamless (Wells, 1994). It will require participants to acquire a new set of mind skills and 'habits of learning' that become embedded in the day-to-day practices of the learner. Teachers who are members of learning communities will experience, first hand, a learning environment that is based on conceptual understanding and the ability to apply this knowledge in a variety of contexts.

In an inquiry based learning environment students do not sit and simply absorb information. They are engaged in activities that help them building understanding. Children pose questions, seek answers to questions they care about, develop, discuss and defend theories and share ideas with others. When inquiry is encouraged in the classroom, students may start asking questions teachers may not be able to answer. This may be very threatening to educators who are accustomed to being the expert and central figure of authority in the classroom. Teachers facilitating inquiry learning respond to students' queries by guiding them to the resources or tools which may help them find an answer to their question. As a co-investigator, the teacher models and practices the role of inquirer and life-long learner for his/her students.

Teachers cannot be expected to create an environment in their classrooms for students to develop, experience and practice inquiry dispositions if they themselves do not have similar formative experiences (Booth & Wells, 1993). Most teacher educators joined preservice programs before inquiry was adopted as an approach to learning with students or before advanced technologies were available for use in schools. As a result, they likely have not experienced how technology can enhance student learning or how to incorporate it effectively in an inquiry learning environment (McLaughlin, 1998). Becoming a member of a professional community of inquiry may provide veteran teachers with an opportunity to experience inquiry learning and to incorporate inquiry practices in their classrooms. Unfortunately, many of our newly graduated teachers have not had inquiry learning modeled for them; nor have they experienced inquiry learning during their recently completed programs. Current teaching methodologies must be

incorporated and modeled in pre-service training of new teachers. If teachers are expected to practice and promote inquiry in their classrooms, then they should have it demonstrated and practiced for them by their teacher educators. If they are expected to use technology with their classes, then teacher educators should model integrated uses of technology in their methodology and content courses (Hancock, 1997; Willis, 1997). Preparing teachers for the 'computer cultures' of this century must include more than having them learn content and follow curriculum guidelines (Goldman Segall, 1998).

Adequate pre-service training of teachers using technology was addressed in the *Report to the President on the Use of Technology to Strengthen K-12 Education in the United States (1997).* The report recommended that US schools of education incorporate the use of technology into their pre-service curricula so the next generation of teachers are capable of making effective use of it with their students (President's Committee of Advisors on Science and Technology, 1997). Until these issues are addressed in Canadian preservice programs, the public school system will have to assume the responsibility of inservicing new teachers and existing professional staff, on current and relevant teaching methodologies for using technology with students in public schools.

Inquiry learning results in new learning opportunities teachers and for their students. It is a learning environment where they can experience and learn the skills, knowledge and understanding needed to be productive, responsible citizens in our increasingly complex, global economy (Booth & Wells, 1993).

Constructivism/Constructionism's role in inquiry learning.

Constructivism is a learning theory describing the process of knowledge construction. Constructivism is central to inquiry learning. It is the application of what are often referred to as 'constructivist practices' in the classroom and elsewhere, which provide support to the knowledge construction process (Zemelman, Daniels & Hyde, 1993).

Constructionism is not a better form of instruction; it is a different kind of knowledge where students are involved in constructing things, rather than banking knowledge (Harel & Papert, 1991). In this environment the learner works collaboratively with peers, teachers, community members or online specialists by engaging in problem solving, critical thinking and inquiry as the central focus to their learning.

Seymour Papert (1991) extends Piaget's interpretation of constructivism to constructionism, where the emphasis is placed on the particular constructions or artifacts created and shared by the learner.

> Constructionism – the N word as opposed to the V word – shares constructivism's connotation of learning as 'building knowledge structure' irrespective of the learning circumstances of the learning. It then adds that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe (Harel & Papert, 1991, p. 1).

Papert believes that our traditional curriculum centered, teacher driven forms of instruction do little to contribute to the intellectual growth of students. In curriculum centered forms of instruction he sees teachers as technicians charged with delivering prescriptions of curriculum to passive students who are afforded little opportunity to participate or experience the verbally-expressed, formal knowledge transmitted to them.

Since the early 1980's educational reformers have been exploring approaches to make learning more meaningful for students. They have sought to provide an environment where students can construct their own understandings of knowledge and make the connection between 'schoolwork' and the world beyond the classroom (Frye, 1999). Papert contends that moving to a constructionist approach of learning challenges our long held, deeply rooted ways of thinking about education and knowledge. It requires a restructuring of our education system, its learning environment and a reshaping of the structure of knowledge itself (Harel & Papert, 1991).

Applications of constructionist practices in the classroom present additional challenges and benefits to the classroom teachers and the student. The challenge is for the

teacher to provide a framework where the student can construct knowledge and understanding. Constructionist-based classroom environments require longer interdisciplinary content models. This permits in-depth exploration of a topic for the student, making the intellectual issues meaningful and substantively more engaging for the student (Becker, 1998). The focus in a constructionist classroom is on process rather than product, along with the adoption of open-ended questioning techniques which require contemplation and assimilation of information (Brooks & Brooks, 1993). Students in this learning environment engage in different activities, take initiative for their learning, and work more independently.

It is important that teachers understand the conditions under which a constructionist pedagogy arises. Becker (1998) outlines the three types of resources as essential elements to enable teachers to institute these practices:

1. Information resources for teachers:
2. Social support resources
3. Educational resources for students

Information resources for teachers constitute the opinions, arguments and knowledge that enable teachers to absorb and internalize a rationale for why these changes are necessary to facilitate this mode of learning. They also provide a means to reflect and resolve issues surrounding competing pedagogical goals and objectives in the educational system.

Social support resources refer to the school's environment and its ability to provide a structure and climate that will promote a constructionist approach to learning. Becker encourages teachers to form professional networks among themselves as a means of engaging themselves as learners. (See chapter 4) He emphasizes the need for teachers to model teaching practices for each other and to share experiences and advice on how to accomplish the changes needed to facilitate this pedagogy so it becomes a normal day-to-day practice in the classroom.

Educational resources for students include an array of materials, equipment and information and communication resources (both hardware and human) that students need in order to engage in this learning environment. Becker believes that successful implementation of constructionist instructional reforms requires the presence of all three types of resources (Becker, 1998).

Evaluation in this type of learning environment must be re-conceptualized to compensate for the expanded knowledge base the student is developing in a particular subject area (Goldman-Segall, 1999). Testing solely for the presence or absence of 'chunks' of information the student may be able to recall is irrelevant in this type of learning environment. Teachers must adopt alternate means of assessing where they can determine whether students have organized, structured and used information in context to solve the complex problems which they are studying and/or the knowledge construction which resulted through the process (Herman, Aschbacher & Winters, 1992).

Educational institutes are driven by a behaviorist teaching model where 'recall, memorization and multiple choice testing' procedures remain in place (Jonassen, 1993). By clinging to traditional evaluation (testing) methods, students very quickly 'get it,' and they realize the constructionist process that is being emphasized in the classroom is really unimportant and what has been learned 'in the process' of producing the product, will not count. Students respond quickly by assuming their well-enshrined behaviorist model of learning. What will be presented to be evaluated will be a product they believe the teacher wants to see; not a creation from their 'mind's eye.'

The fact remains that quantitative measures for evaluation are still required in our system. Acceptable methods of evaluation must produce marks which are justifiable and understandable to students and parents and they must incorporate methods that meet the 'evaluation criteria' of the school and educational administration. There has to be a balance between the weight assigned to the process and weight assigned to the product, based on the criteria developed for evaluating a student's product.

When working in a constructionist classroom environment, *the process*, or how a student arrives at his/her end-product, should be considered in evaluation. If we are promoting independent thinkers, problem solvers and critical thinkers, then we should evaluate these criteria. If we hope to make the student's learning situations more realistic and meaningful, real-world experiences through constructionist teaching environments, then we should adjust our evaluation process to reflect the goals of the learning experience. The method of evaluating student's work should be based on the overall objectives of the project, the product and the processes involved to achieve end-product.

Evaluation Methods in a Constructionist Learning Environment

The ideal evaluation method should include a combination of methods, which facilitate 'ongoing evaluation' throughout the duration of the project. There are any number of alternative evaluation processes which can be adapted or adopted for inquiry based learning environments. I have outlined five methods below.

1. Portfolio. All students should be required to maintain a portfolio of their work throughout the school year. Included in this portfolio should be a copy of their skills inventory, which they can update as new skills, tools and technologies are learned through the completion of specific pieces of work. The portfolio should also include a copy of the student's 'goals' for the semester, along with project goals for specific pieces of work they may be presently engaged in studying. This provides a means for students to keep an inventory of the goals they have achieved and it provides a visual representation as to how well they are proceeding along 'their' skills continuum.

2. Journal The journal as a method of evaluation can be a very effective evaluative tool for both the teacher and the student. It is particularly useful when students are engaged in long-term projects as it provides a medium for them to reflect on how well they are progressing through their project. It also serves as a record of their troubleshooting methods, and their critical thinking processes. Teachers can use the journal to monitor

student progress and to respond to specific problems students may be encountering with a particular aspect of the exercise.

3. Self-Evaluation All students should be provided an opportunity to reflect on their learning through a method of self-evaluation. We cannot 'get into the heads of others;' this method of evaluation offers insight into exactly what the student gleaned from the process of completing the product submitted for evaluation. It is very effective in causing the student to reflect on what they have accomplished, what they might strive to improve in later projects and what they could have done differently during the learning process they recently experienced.

4. Teaching/Exhibits In my experience one of the most powerful, yet underutilized, evaluative tools is the 'student as teacher' model. Students who present and share the knowledge they have learned and the process involved to collect and present the knowledge, is a powerful learning and evaluative process.

5. Peer Evaluation When students are involved in a similar learning experience and have an appreciation for the process that results in the end product, then peer evaluation is useful. When using peer evaluation to reflect on other student's work, the evaluators must have a clear understanding of the criteria and goal of the product presented for them to evaluate. If criteria are not clearly communicated, there is danger that the peer evaluation process may lead to the students evaluating the product exclusively.

Establishing Criteria for Evaluation in Constructionist Learning

The criteria for the evaluation should be negotiated between the student and the teacher so both have a very clear understanding as to the goal of the exercise or project. The criteria for any given product should incorporate as many, but should not be limited to, the items outlined below. Students are often very clever and insightful in identifying criteria for evaluation. They should be encouraged to develop and negotiate their own criteria as part of the evaluation process.

1. **Effective Communication**. Did the student effectively communicate her message using her chosen medium? Was the medium an appropriate choice for the topic, story or information to be communicated? Was the story told? Were new or novel methods used to communicate their knowledge?

2. **Originality/Creativity**. Did the student 'construct' knowledge in the process of completing the task? Is it presented in a creative, original format? Did the student seek conventional and non-conventional sources of information to support their research?

3. **Movement Along Their Skills Continuum**. Did the student achieve one or more of their goals outlined in their growth plan? Did the student achieve and identify unexpected learning outcomes as a result of the project? Did the student keep an accurate record of outcomes in his/her portfolio?

4. **Collaboration/Peer Tutoring.** Did the student work well with his/her classmates and contribute to a 'team building' effort in their learning environment? Did he/she seek out help from others and was he/she willing to share knowledge and skills with others?

5. **Reflection.** Is the student able to identify situations where he/she used problem solving or trouble shooting techniques during their learning process? Was the student able to work independently to solve problems? What were the student's overall impressions of this process?

This is far from an exhaustive list of criteria for evaluating in a constructivist learning environment. The most important goal of establishing criteria for evaluation is that it must be put in context with the intended goals of the process/product identified by the student.

Role of Technology in Inquiry Learning

Technology can be an enabler of inquiry. Current technologies support the constructivist movement by encouraging exploration and inquiry and supporting information management skills in all subject areas. Teachers and students learn to be learners by combining inquiry practices and technology to develop the skills the future

economy demands. Technology provides the means by which students can research, record, observe, synthesize, present, argue and defend their knowledge constructions.

In a constructivist learning environment, technology functions less like books, journals and films, and more like workshops, laboratories or studios, where students can immerse themselves within contexts that challenge and extend their understandings (Barab, Hay, & Duffy, 1998). In this environment, learning is not a product delivered to the student, but a situated activity or process that is easily supported by the use of technology tools.

Providing teachers with technology, software and training will not necessarily lead them to use technology in a 'constructive' manner. There exists two fundamental gaps between theory (constructivism) and practice (classrooms of inquiry), which must be addressed if educators are to adopt a constructivist approach to teaching and learning with technology.

First, teachers must be motivated to incorporate a constructionist teaching methodology as an integral component of their teaching practice. This represents a major shift in pedagogy for most teachers. They must experience a constructionist learning environment or have it modeled for them if they are to appreciate the powerful impact it can have on student learning. Many educational reformers believe that technology may provide the impetus and means for educators to move from their technical role of transmitters of information to one where they are facilitators and co-constructors of new knowledge.

Second, inquiry and critical thinking are fundamental to a constructionist approach to teaching and learning. Teachers must become 'inquirers' themselves to experience and appreciate an inquiry method of learning and the critical thinking skills that are inherent to the process. Only then will they understand this learning process and in doing so, model the importance of being a life-long learner for their students. I will describe a classroom

experience I had with students that exemplifies the above situations; a classroom of inquiry where both the teacher and the students became co-learners and inquirers.

Inquiry Learning – A Classroom Experience

The situation I am about to describe was a transformational experience for me as a teacher. It was not anticipated or planned. It resulted from the activities of a several classes of students who were eager, excited and motivated to learn more about a particular topic then I had set as parameters for the unit of study. The classroom became a 'community of inquiry,' where the students and teacher became co-inquirers and co-learners.

After returning from a hypertext mark up language (HTML) workshop, I developed an activity for my grade seven classes where they were to use basic tags to simulate the creation of web pages. My instructions to the students were limited to a description of the language, how HTML was read and interpreted by the web browsers, the parts of an HTML document and basic scripting of text and graphics. Students were then asked the students to incorporate several specific tags to create their own web pages.

In following days I witnessed students who were excited and actively engaged in their learning. They displayed a level of cooperation and collaboration that I had seldom witnessed in my classroom. Only ten of the computers in the class were connected to the Internet, so students had to share the stations to download pictures and to view their pages on a color monitor. They were not only excited to see their product, but displayed an equal level of pride and enthusiasm in viewing each other's creations.

Soon, I noticed that students were adding their own features to their pages. Through their own inquiry, students discovered and incorporated the scripting needed to add background color, links to other web sites, sound, text color and email links for their web pages. What I found most intriguing was their willingness to share and teach each other, (including me) the discoveries they made while exploring the source code of web pages on the Internet.

I adapted the classroom procedures to incorporate an information sharing session. At the beginning of each class, I allotted time for students to share their new creations with classmates. We compiled their discoveries and I watched, in amazement, as these resourceful students initiated and extended their own learning.

Lunch hours became a time to 'debug' pages and evolved into an informal extension of the class's learning environment. Three to four students would clamor around a station helping each other to edit HTML scripting when a tag did not work. A two-week unit extended to last for over five weeks and would have continued, had it not been the end of the school year. The results were web pages which were far more elaborate and sophisticated than I had ever anticipated the students were capable of creating. The confirming evidence as to the power of this community of inquiry was that every student submitted a product – one hundred and forty students had created their own web pages.

The enthusiastic, productive, cooperative and meaningful co-learning that took place in these classes was transformational for me as an instructor and caused a shift in my strongly held pedagogical beliefs. My willingness to expose my 'vulnerability,' as not being the bearer of all knowledge, was emancipating and positively accepted by the students as we became co-learners in a very engaging learning environment. We had, by happen chance, created our own 'community of inquiry.' Whether this experience would have the same impact on other educators is unknown, but I suspect most would be deeply affected by such an experience. The question remains, "Can we simulate or create these experiences for other teachers?"

All teachers are now faced with developing a level of technology literacy that will enable them to implement the information technology curriculum. It is evident that offering one or two day inservices to teachers is not affecting any dramatic change in who is using technology in their classroom, or how they are using it. An alternate model, one that promotes continued exploration and growth of teachers is needed. Developing

'Technology Learning Communities' (TLC) in schools may provide an avenue to introduce teachers to an environment where they can experience a community of inquiry and as participants, learn the technology skills needed to successfully integrate the use of technology in a meaningful way with their students.

Chapter 3

What is a community of inquiry?

A common thread among the literature written on building communities or communities of learners is that the participants must have a common interest or a common goal (Nicholson, 1991; Sergiovanni; 1993; Thomas, 1990; Wells, 1997). The curriculum has mandated that all teachers must acquire a level of technology literacy, but this common need or goal will not insure participation by teachers in a community of inquiry. There must be desire on the part of the teachers to want to learn the skills needed to operate the technology tools and to use it in a meaningful manner with their students.

Central to the development of any healthy community or community of inquiry, is trust. Trust is the foundational element if the community is to move forward in a productive manner. Members must feel secure in joining the community and must feel safe in expressing their reservations about professional skills and abilities. It must provide an opportunity for educators to investigate together and to contribute to one another's inquiries though open discussion and dialogue.

Characteristics of a Community of Inquiry

A community of inquiry differs from other communities which are bound together through common tradition or practice. An intrinsic characteristic of a community of inquiry is self-critical practice, which is exploratory and inquisitive by nature (Lipman, 1997). In his article, *Thinking in Community*, Lipman (1997) argues that a community of inquiry unites both the communal and social nature of a community, with self-critical practice. He specifies characteristics which distinguish them from other communities in our society as:

1. Having a distinct goal
2. Having a sense of direction,
3. Being rational and critical by nature

I will examine the compositional elements of a community of inquiry and relate them to the 'Technology Learning Communities,' model I am proposing for Yukon schools.

1. A Distinct Goal

A community of inquiry works through a process toward a set goal. This common interest or goal may produce a product or lead to a settlement or judgement. (Lipman, 1997). My initiative to build 'Technology Learning Communities' (TLCs) in schools will promote two fundamental goals but they should not be limited to these primary objectives. First, TLCs will provide an venue for teachers to engage in 'dialogue' about using technology in the classroom and integrating it across the curriculum.

Lipman (1997) differentiates between conversation and dialogue when describing communities of learning. He describes conversation as an exchange of feelings, thoughts, information or understanding, which aims at establishing equilibrium. Dialogue, on the other hand, is collaborative inquiry which explores or investigates an idea, concept, problem or issue and is foundational to a community of inquiry (Lipman, 1997). The aim of communities of inquiry is disequilibrium, where each argument evokes a counter-argument that moves it forward and pushes the other beyond itself. Through dialogue, teachers will inquire, explore, investigate, and examine issues surrounding the use of technology in the classroom and with their students.

It is my position that communities of inquiry must engage in both conversation and dialogue. The differentiation of the two concepts is an interesting one, but the social and communal nature of communities of inquiry are such that I think it is impossible to limit discourse to Lipman's definition of dialogue. Conversation may lead to dialogue on an issue and dialogue may lapse to conversation; both contribute to inquiry.

Second, the TLCs will provide an avenue for teachers to explore and to learn new and emerging technologies. Teachers will have an opportunity to share their expertise, knowledge and understanding of the medium with others. These communities will provide an arena where educators can openly acknowledge and discuss their struggles to learn and

integrate the use of technology with their classes. It will provide a security to those who are reluctant to expose their 'vulnerabilities' as educators faced with a curriculum with which they may be ill prepared to deliver.

2. Sense of Direction

A community of inquiry has a sense of direction and permits arguments to lead this sense of direction. As new needs or discussions unravel, the community of inquiry follows the direction of that argument providing it leads the participants toward their common goal. The TLC must maintain a sense of direction, and be open to take on a new direction, as needs dictate. New technologies, new software or a new member of the community may redirect the focus of the community for a period-of-time, but should do so within the context of the common objectives of the community.

3. Promotes rational, critical and creative thinking.

Immersion into a discipline studied in a community of inquiry should promote rational, critical thinking among its members. The TLC will provide educators an opportunity to critically examine their practices and the need to practice and adjust their approach to using technology with students. Instead of thinking about how we can use the computer in the classroom, we should be examining how the computer can be used as an extension of the existing curricula.

In the early 1980s, educators felt it was important that students learn 'about' computers or they used them as 'teaching machines' as they took over part of the teaching responsibilities of the classroom. The shift in emphasis from computer aided instruction, to students using computers to create knowledge, has led to a shift in the software applications promoted by the new curriculum. This software, which I will refer to as 'global software,' are applications such databases, spreadsheets, multimedia, hypermedia, computer programming and conferencing software that can be used across disciplines and grade levels. The universality of the software, and the fact that teachers from all grade levels will eventually have to learn the applications, makes a community of

inquiry a perfect venue for teachers to co-learn these new applications and to investigate how technology can facilitate and foster the development of communities of inquiry in their classrooms.

The new information technology curriculum promotes a constructivist approach to teaching technology where the emphasis is placed on using the computer as a tool in student's knowledge constructions (Feng, 1996, MacInnes & Kissoon-Sing, Papert, 1980, 1996, Willis, 1997). A technology community of inquiry will provide an avenue for teachers to explore this pedagogy. It may be modeled by teachers within their communities of inquiry, or by those who practice this approach as a teaching with their students.

Yukon Technology Learning Communities

One of the many challenges when implementing any innovation in Yukon schools is addressing the various multi-grade configurations found in our schools. Yukon has a student population of approximately 5200 students and 700 professional and par-professions, spread among 28 rural and urban schools throughout the territory. Individual school populations vary from less than ten students to over 900, in schools with K – three, K – six, K – seven, K – nine, K – 12 and eight – 12 grade configurations. Few teaching 'specialists' have the opportunity to lead classes exclusively in their area of expertise. Many must, simultaneously, assume multi-grade and/or multi-subject teaching assignments. In smaller rural schools, demands are placed on teachers to assume leadership roles within the community, along with a multitude of extra-curricular responsibilities. There is a higher turnover rate of rural teachers, which further challenges the ability to sustain a sense of community among these professionals. This differs dramatically from the urban teaching population where staff turnover is low. Urban teachers also do not experience the level of professional isolation of their rural counterparts and they tend to have more homogeneous teaching assignments.

I will present two initiatives which may be considered for developing communities of inquiry in Yukon Schools. The first, the Computer Resource Teacher initiative, is better situated for larger schools where economies of scale permit flexibility in staffing assignments. The second, Technology Learning Communities (TLC), are a more formal model which could be adopted by a school of any size where the staff has identified a desire to explore the integration of technology and/or a need to develop technology skills among staff members.

The Computer Resource Teacher Model – A School-Wide Community of Inquiry

In September, 1993 the junior high school where I was teaching (Riverdale Junior Secondary School) was assigned a new principal. Chris Gonnet had come to us from a technologically innovative school and he was keen to implement some of their successful practices at our school. He wanted to move away from teaching about computers and move toward a more inclusive model where all teachers would be given the opportunity to use technology with their classes in a supportive environment. To do so he believed we need to create an environment where staff members felt safe, supported and encouraged to integrate the use of technology within their subject areas.

His vision included the creation of a position in the school for a computer resource teacher. This person would serve as a facilitator in the computer lab for teachers and students involved in technology based projects. It was made at the outset of this project that the position would only exist for a period of two to three years. Over this period of time it was understood and expected that the teaching staff would develop their skills to a level where they could work independently using technology with their classes.

Staff support for this initiative was imperative if it was to unfold as planned. Creating the position required a restructuring of teaching assignments to facilitate freeing-up a staff member to assume the computer resource position for the school.

A less formal community of inquiry evolved as a result of the creation of a computer resource person for our school. It proved to be very successful in promoting

the integration of technology across the curriculum, and in the process, it supported teachers in the development of their technology skills. The model worked much like that of a teacher-librarian, where through a collaborative effort, the classroom and the computer resource teacher co-planned a unit of study incorporating the use of technology. Teachers were required to join their students when they visited the lab and in the process, co-learn with their students if they were unfamiliar with the application of technology at hand.

In the beginning teachers were slow to approach me, which left me with time to explore and learn about the Internet, a resource I began to see as a powerful tool for education. At this time (1994) Yukon did not have an point of presence for Internet access. Through participation in a pilot program led by Community Learning Network (CLN) in Victoria, BC, the school was provided with a telnet account for dial-in access to a hub in Fort St. John, BC. I inquired about the possibility of accessing the Internet via the World Wide Web (WWW), but was led to believe that it was not available in Yukon. I persevered and learned enough Unix code to access files on the net and navigate through the tedious menu lists associated with this interface. Although I was excited about this medium, I could not help but wonder whether teachers, many of who were struggling with basic computer literacy, would share my enthusiasm. Nevertheless, I continued to introduce the medium to teachers and students. Both groups appreciated the potential of this resource but were somewhat mesmerized by the skills that appeared to be needed to interface with the net.

One teaching experience with a grade 8 humanities class proved to be the catalyst for showcasing the power of this medium in transforming, extending and enhancing learning environments for students and teachers. This particularly high-energy group of students was studying the novel, *Waiting for the Rain*, by Sheila Gordon. The story traced the lives of two boys from South Africa, one black and the other white, who grew up together on the same farm. The students were moved by the story, but appalled at

the treatment of black South Africans in their country during Apartheid. At the time the students were studying the novel, Nelson Mandella had been released from prison and his presidential inauguration was only weeks away.

The teacher approached me to give the class a demonstration of the Internet and what ensued during and after that initial meeting was a powerful entity. Since they were studying human rights and South Africa, I thought it might be interesting to see if we could find some resources on the internet which might be interesting to the group. Students watched on an overhead screen as **we** navigated through menu lists until we arrived at the University of South Africa server.

As an extension of their unit of studies the students had been studying about constitutional rights and were most anxious to learn what changes South Africa's new constitution would mean for their people. One student asked if it was possible to locate a copy of their old constitution to see how it differed from Canada's act. We looked and looked, but could not find a site that offered this data. I proposed to the class that we could possibly find a person at university who may be able to point us in the right direction. We found a faculty search engine and I took a risk and typed in my last name, Davidson. Amazingly, there was someone at the university with that name and she happened to be a librarian at the institute. That discovery brought a round of applause from the students!

As a class, we constructed an email to Ms Davidson and explained our quest to locate a copy of the SA constitution. That afternoon and the next morning, students periodically popped into my room see if we had received a response.

Early the next afternoon I not only received a response from Ms Davidson, but also received the location of the document on the net. The class was able to join me an hour later and we located the document, downloaded it, printed and copied it for the students to review. They clamored around in groups analyzing its contents. They were quick to identify and read sections of the act that clearly were oppressive to black South

Africans and at the end of the class packed the document with them to study further in class.

As an observer, watching this drama unfold in my classroom was a moving experience. The novelty of using the Internet to retrieve this information quickly fell to the background as the students critically 'studied' and compared the constitutional 'rights' of citizens of South Africa, all the while commenting and comparing them to the freedoms they enjoy and take for granted living in Canada. It was a powerful learning experience for all involved but the inquiry into the topic did not end there.

Less than two weeks later Mandella had been sworn into power and simultaneously, a new constitution was enacted. The students asked their teacher if it would be possible to obtain a copy of the new constitution to see just how it was going to impact the lives of black South Africans. We sent yet another email to Ms. Davidson and she responded immediately, not only with the document but with a complete copy of Mandella's inauguration speech which had been delivered the day before. Once again, we downloaded both documents. In collaboration with the class, we decided to do a comparative analysis of the two constitutions. Over the next two days the students pulled the fundamental issues they found to be most oppressive in the old constitution and countered them with the sections of the new act which they felt addressed the issues.

As educators, it was easy to appreciate the powerful learning experience which transpired among the students as a result of this activity. Equally interesting was how the students reacted to their 'discoveries'. They were obviously motivated and enthused by this new learning environment and shared their experiences with other students and teachers. More teachers inquired about learning about this medium. Word spread to the school council and to department of education officials and they requested more information. For the first time this medium was receiving the support needed to adopt it as a means to extend students learning beyond the conventional resources available to them in the school and community. Skeptics who had previously viewed the Internet as a

passing fad became less vocal and in some cases, more supportive, of adopting this innovation as a tool for research and communication in and among our schools.

It did not take long for other teachers to begin approaching me to learn more about this medium. A chance visit to my classroom by a computer consultant visiting Whitehorse from Vancouver moved our use of this medium ahead by quantum leaps. He casually asked why I was not using the WWW as it was a more user-friendly interface to conduct research and to connect with other classes around the world. At his suggestion I made one phone-call to CLN and requested that they change our account from a telnet to a slip connection. The rest is history – we had a browser interface which the most novice user could easily learn and navigate. We also had a new enthusiasm among staff members to become 'surfers' of the information highway.

Our school began to participate in collaborative online projects. The interest in using and integrating the use of technology into mainstream courses grew by leaps and bounds. Teachers were excited to explore this new medium themselves and with their students. The requests for workshops increased, not only from our staff members, but from colleagues and administrators in other schools and the demand for inservcing was not limited to the use of the Internet. Teachers explored the use of spreadsheets, databases, drawing tools and desktop publishing applications of how they could use computers with their students. The computer resource centre became a hub of activity and it was not uncommon for the lab to be fully booked for three to four consecutive weeks by teachers wanting to integrate the use of technology with their students. In time art classes, outdoor education, science, math, French, humanities and industrial arts classes were incorporating the use of technology with their classes.

The interest generated by this one initial activity blossomed into a school-wide level of inquiry and interest for using technology with students. Teachers became very proactive in the desire to become more skilled in using computers. Our staff became infinitely more proficient when using the lab and were becoming skillful in

troubleshooting technical problems that arose with their classes. Their confidence to do so countered one of the major inhibitors educators often cite as a drawback to using technology in schools – technical glitches.

Teachers began integrating the use of computers with their classes with less assistance from me. Our collaborative time together became less of "how I thought' we could use computers with the students to the teachers telling me "how they wanted' the use of computers to unfold in their students learning environment. Teachers began using computers more frequently for administrative purposes and were becoming increasingly more familiar with the tools and software applications they could use with their students.

After two years as the computer resource teacher I accepted a new position and was not replaced at the school. Whenever I visited my former school I would examine the computer lab 'sign-up' schedule to see whether the facility was being used to the level it was when teachers had a full-time resource person. It was clear that by the level of participation and the scope of projects undertaken by the staff that they no longer had a need for a computer resource person. They tapped into the various skills they had developed over the past two years and used them to further the professional development of the staff.

The year after I left, one staff member who was one year from retirement, took on an enormous project with seventy-six students from her three grade eight humanities classes. The classes were studying the renaissance and she developed a project required the students research, write, design and script a web resource on renaissance personalities. At the launch of the site the class staged a short skit for community members and parents who were invited to catch a sneak-preview of their work. Some students took on the role of the renaissance personalities (in period costumes) who observed and commented in the background on what they thought about how they were being portrayed by 1990's students. Others played themselves and their conversations focused on working through the process of deciding what content and graphics they were going present for renaissance

personality and the scripting and 'debugging' of the HTML code for the website. It was a wonderfully creative way to share the hard work, collaborative planning and the critical thinking strategies which were employed to produce the final product with their invited guests. Three years later this teacher continues to receive email messages from around the world congratulating her and her classes on the comprehensive resource they created. Five years later I still use this project as an example of an innovative way to integrate the use of technology across the curriculum.

(http://www.yesnet.yk.ca/schools/projects/renaissance.html)

Although the Computer Resource Teacher model is not a formal community of inquiry as we might envision them developing in a school, the impact in promoting inquiry among staff members was evident. This experience highlights the need for administrative understanding and support if technology in schools if real change and support for innovation is to occur (Brunner, 1992; Meltzer & Sherman, 1997). Riverdale Junior Secondary School became the lead school for technological innovations in Yukon schools and still serves as a model for other schools to explore when technology integration is targeted as a primary goal of their school's growth plan.

Technology Learning Communities (TLCs)

While it is impossible to prescribe a stead-fast model for developing technology learning communities for schools in such a diverse environment, it is necessary to provide a conceptual framework from which a professional community of inquiry can develop their learning environments to meet the specific needs of their professional staff. The individual school communities will determine how the model unfolds, but as a starting point, the framework outlined below will provide a foundation for the initiating professionals to come together as inquirers.

1. **Overview to school administrators and invitation to join pilot program.**

Administrative support for introducing an innovation in a school is essential (Meltzer & Sherman, 1997; Uebbing, 1995). Schools administrators who are well

informed as to the overall objectives and expected outcomes of an inovation are more apt to support and promote it in their schools. Introducing the concept of building a Technology Learning Communities (TLC) in schools also provides a venue to explore and discuss the aim of technology integration in schools and the structural reforms which may have to be considered to support an constructivist approach to using technology with students and staff.

2. **Presentation to schools expressing interest.**

Once an administrator expresses an interest in forming a TLC in his/her school, arrangements are made to present the initiative to the staff. Staff members will be introduced to the model, the rationale behind exploring forming this learning community and how constructive teaching practices facilitate technology integration in schools. Highlighting the collaborative and supportive nature of the TLC may encourage reluctant staff members to become involved in this innovation.

The operational framework for building a learning community in their schools will also be included in this presentation. Emphasis on the element of trust must be highlighted and the operational procedures for promoting a community based on trust must be earmarked as the foundational element of the community if it is to move forward in a positive and productive manner. It is necessary that staff members understand that involvement in the TLC is voluntary and any staff member can join the community regardless of their skill level. It should be stipulated that new members can join the community at anytime.

3. **Skills inventory – Identification of community leaders**

To aid in providing the community with a sense of direction, the first task of the TLC should be to survey its members to identify the needs and areas of competence among its members. This should not be limited to the technical abilities of the staff, but also their understanding of the pedagogical approach to inquiry learning. Rubrics may provide a means by which members of the community can evaluate their technology skills

and their approach to teaching and learning with computers (Appendix A). Rubrics may also help teachers to identify and inventory their strengths and weaknesses when using technology with students. Compiling the results of rubrics on a spreadsheet and charting them on a bar graph provides community members with a very visual snapshot of the areas of growth which may exist among its members and aid in targeting common goals of the community members (Appendix B). Similar rubrics could be developed to examine community member's perceptions and practices in other skill areas and pedagogical practices. As part of the skills inventory of the staff, the TLC should identify who will lead various areas of inquiry and/or identify community members or colleagues be willing to lead a topic of inquiry.

4. **Identification of primary and secondary goals of the TLC**

The first task of the community of inquiry must be to establish short and long-term goals for its members. While the primary goal of the TLC will be to create an inquiry learning environment and improve technology skills among its members, identifying the secondary goals to achieve this primary objective must be undertaken at the outset of the formation of the community. The members must identify the areas they would like to see addressed over the short term (three to five months). It is important that all are reasonable and achievable.

Secondary goals of the community may change in time as a result of their experiences in the community and new goals may be identified as they explore various topics of inquiry, but the fundamental impetus for coming together must remain intact.

5. **Assessment of Resources**

One of the most beneficial elements of this community will be to explore and identify the hardware, software and human resources available to the staff and students. Many educators do not have a clear enough understanding of technology to set reasonable goals for their community or their classes. Taking the time to investigate and learn about the capabilities and limitations of the tools they have at hand will aid them in planning

how to make the most productive use of the computers and infrastructure and will aid in planning for future acquisitions.

A TLC provides a wonderful opportunity for teachers to share their experiences, both successes and frustrations, with other staff members. It is a perfect forum to tap into the rich experiential base educators bring to their schools.

6. **Building of school technology plan.**

As a follow-up to the previous item, school communities of inquiry should build a technology plan for their school by identifying both the pedagogical skills and resources needed to integrate the use of technology across the curriculum. Given the dynamic nature of technology, it is doubtful that anything over a two-year plan would be viable when planning for hardware/software resources. Over time community members will learn to appreciate how one technology innovation may alter the acquisitions identified in the plan and/or the short term goals of the TLC.

This is a perfect venue to examine which model of distributing and accessing computers in the schools will be most beneficial to attaining their long-term goals.

7. **Examine tools to facilitate onsite and online collaboration to meet goals**

An underused and potentially very powerful tool which educators can use for collaboration is the Internet. Educators should become well versed to the many online resources which may be tapped into for their own personal development and as resources they can use in their classrooms. Overtime, all members of the community should become fluent in using email, web browsers and other online collaborative and communicative tools which facilitate inquiry among educators and students. Doing so opens opportunities for other professionals to contribute to the community, facilitates communication among educators who may be geographically isolated and opens opportunities for regional, national or international collaborative projects among classes.

8. **Evaluation.**

Evaluation of the TLC must be ongoing. To sustain a community of inquiry members must feel they are benefiting from the time invested. Do the members feel they are achieving their goals? Have the members of the community been able to apply what they have learned in their community of inquiry in the classroom? Have they begun to more a more constructivist approach to learning with their students? Are they using a more integrated approach to teaching and learning with technology? Frequent and regular evaluation of the community's practices will help it remain focused and will aid in identifying new goals for the community as it evolves. The rubrics which were completed early in the development of the community could be re-issued and compared to earlier results to assess whether members are benefiting from participation in the TLC or if the community is achieving its goals.

Chapter 4

Implications of Developing Technology Learning Communities

The positive implications of the introducing technology communities of inquiry in schools are numerous. TLCs will provide an arena for cross discipline and grade interaction among teachers. This promotes collaborative learning among staff members, strengthens the school community and lessens the professional isolation teachers often experience in their own schools.

Forming TLCs in schools, using technology as the common goal, may provide the impetus for teachers to critically examine their teaching practices and to explore alternate, more effective methods of engaging their students in meaningful learning environments. It provides an opportunity for educators to develop a professional trust among themselves, provides 'on going' professional development for those participating in the TLC and provides a model for students of teachers as being life-long learners.

TLCs should promote open communication with staff, administration and students about issues concerning technology in the school. Members of the community should make it a practice of reporting the work they are doing in their community with staff members. Monthly staff meetings or newsletters could aid in their effort of encouraging others to join their TLC. As technology leaders in the school, the TLC participants could also be used as an avenue for communicating technology information, goals or successes with parents, colleagues, department or education officials.

TLCs could serve as a reliable, informed school resource for teachers using technology in schools. Because each Yukon school has a slightly different computer hardware and network configuration, TLCs are well situated to research the parameters of the technology capabilities of the school and should report their findings to the staff. Teachers could be kept well informed of new technologies in the school and how they could be incorporated into the curriculum.

Showcasing technology successes to other staff members provides further exposure to the teachers 'constructive' uses of technology with students. As successes are celebrated, it is likely the enthusiasm will 'influence' other staff members and draw more people into the community. Examples of 'good practices' could be submitted to the Yukon Education Student Network (YESNet) web server and via email to share with TLCs in other schools. The webserver could be used to establish an online technology discussion group among teachers in all schools.

Equally valuable to showcasing successful practices is the importance of discussing the challenges technology presents in the educational environment when 'things do not go as planned'. There is a security in knowing that if something goes astray, as it often does in this medium, that you are not alone in experiencing these challenges. Sharing troubleshooting methods which have worked for other staff members provides additional security to educators who may be less comfortable with computers. Through their participation in TLC they will certainly learn who to turn for support should they run into a 'glitch' with their class.

As teachers become more comfortable exploring technology and becoming inquirers themselves, they are likely to become more comfortable promoting communities of inquiry within their own classrooms (Becker, 1998). Teachers and students should be encouraged to co-learn, and students should be encouraged to assume the role of the teacher when their experiences and skills will benefit those in their learning community.

Future Implications of Technology in Education

Over the past ten years we have learned much about the challenges involved in successfully integrating technology in our schools. It has proven to be one of the most complex, system-wide innovations education has experienced this past century. Many of the challenges could not have been predicted. Some of the problems were a result of poor planning, resourcing and training of professional staff. As new technologies

emerged, the role of technology evolved from a subject area to be taught, to a tool for learning and it is this transition with which we are now struggling to understand.

We must continue to explore the role technology will play in the education of our citizens today, with a close eye on tomorrow, as schools and districts embark on developing distributed distance learning networks as a method of delivering instruction and enabling construction for students and staff. There is no doubt distance learning will present a new set of challenges for schools. Hopefully, we have learned valuable lessons from past experiences and will be better prepared to understand and address the complexities of introducing technological innovations to our school systems in the future.

Appendices

Appendix A

Self-Evaluation Rubrics for Teacher Computer Use

Check the level which best describes your current level of skill in each area.

Level 1: Pre-awareness **Level 2: Awareness**
Level 3: Mastery **Level 4: Advanced**

I. Basic computer operation

- ___**Level 1** I do not use a computer.
- ___**Level 2** I can use the computer to run a few specific preloaded programs. It has little effect on either my work or home life. I am somewhat anxious I might damage the machine or its programs.
- ___**Level 3** I can set-up my computer and peripheral devices, load software, print, and use most of the operating system tools like the scrapbook, stationary, clock, note pad, find command, and trash can. I can format a data disk.
- ___**Level 4** I can run two programs simultaneously, and have several windows open at the same time. I can customize the look and sounds of my computer. I use techniques like shift-clicking to work with multiple files. I look for programs and techniques to maximize my operating system. I feel confident enough to teach others some basic operations.

II. File management

- ___**Level 1** I do not save any documents I create using the computer.
- ___**Level 2** I save documents I've created but I cannot choose where they are saved. I do not back-up my files.
- ___**Level 3** I have a filing system for organizing my files, and can locate files quickly and reliably. I back-up my files to floppy disk or other storage device on a regular basis.
- ___**Level 4** I regularly run a disk-optimizer on my hard drive, and use a back-up program to make copies of my files on a weekly basis. I have a system for archiving files which I do not need on a regular basis to conserve my computer's hard drive space.

III. Word processing

- ___**Level 1** I do not use a word processor, nor can I identify any uses or features it might have which would benefit the way I work.
- ___**Level 2** I occasionally use the word processor for simple documents, which I know I will modify and use again. I generally find it easier to hand write or type most written work I do.
- ___**Level 3** I use the word processor for nearly all my written professional work: memos, tests, worksheets, and home communication. I can edit, spell check, and change the format, of a document. I can paginate, preview and print my work. I feel my work looks professional.
- ___**Level 4** I use the word processor not only for my work, but have used it with students to help them improve their own communication skills.

IV. Spreadsheet use

- ___**Level 1** I do not use a spreadsheet, nor can I identify any uses or features it might have which would benefit the way I work.
- ___**Level 2** I understand the use of a spreadsheet and can navigate within one. I can create a simple spreadsheet, which adds a column of numbers.
- ___**Level 3** I use a spreadsheet for several applications. These spreadsheets use labels, formulas and cell references. I can change the format of the spreadsheets by changing column widths and text style. I can use the spreadsheet to make a simple graph or chart.
- ___**Level 4** I use the spreadsheet not only for my work, but have used it with students to help them improve their own data keeping and analysis skills.

V. Database use

- ___**Level 1** I do not use a database, nor can I identify any uses or features it might have which would benefit the way I work.
- ___**Level 2** I understand the use of a database and can locate information within one, that has been pre-made. I can add or delete data in a database.
- ___**Level 3** I use databases for personal applications. I can create an original database - defining fields and creating layouts. I can find, sort and print information in layouts which are clear and useful to me.
- ___**Level 4** I can use formulas with my database to create summaries of numerical data. I can use database information to mail merge in a word processing document. I use the database not only for my work, but have used it with students to help them improve their own data keeping and analysis skills.

VI. Graphics use

- ___**Level 1** I do not use graphics in my word processing or presentations, nor can I identify any uses or features they might have which would benefit the way I work.
- ___**Level 2** I can open and create simple pictures with the painting and drawing programs. I can use programs like KidPix or MacPaint.
- ___**Level 3** I use both pre-made clip art and simple original graphics in my word processer documents and presentation. I can edit clip art, change its size, and place it on a page. I can purposefully use most of the drawing tools, and can group and un-group objects. I can use the clipboard to take graphics from one application for use in another. The use of graphics in my work helps clarify or amplify my message.
- ___**Level 4** I use graphics not only for my work, but have used it with students to help them improve their own communications. I can use graphics and the word processor to create a professional looking newsletter.

VII. Hypermedia use

- ___**Level 1** I do not use hypermedia (HyperStudio), nor can I identify any uses or features it might have which would benefit the way I work.
- ___**Level 2** I can navigate through a pre-made hypermedia program.
- ___**Level 3** I can create my own hypermedia stacks for information presentation. These stacks use navigation buttons, sounds, dissolves, graphics, and text fields. I can use an LCD projection device to display the presentation to a class.
- ___**Level 4** I use hypermedia with students who are making their own stacks for information keeping and presentation.

VIII. Internet basics

- ___**Level 1** I do not understand how networks work, nor can I identify any personal or professional uses for networks, including the Internet. I do not have an account on any network nor would I know how to get one.
- ___**Level 2** I can identify some personal or professional uses for networks, and understand they have a value to my students and me. I've read some articles about the Internet in the popular press. I can directly use network access to a library catalog or CD-ROM.
- ___**Level 3** I can describe what a computer network does and how it can be useful personally and professionally. I can distinguish between a local area network, a wide area network, and the Internet and can describe educational uses for each. I can describe the history of the Internet, recognize its international character, and know to a degree the extent of its resources. I have personal access to the Internet that allows me to receive and send email, download files, and access the World Wide Web. I know that I must protect my password, and should restrict access by others to my account
- ___**Level 4** I use networks on a daily basis to access and communicate information. I can serve as an active participant in a school or organizational planning group, giving advice and providing information about networks. I can recommend several ways of obtaining Internet access to others.

IX. Student Assessment

- ___**Level 1** I do not use the computer for student assessment.
- ___**Level 2** I understand that there are ways I can keep track of student progress using the computer. I keep some student produced materials on the computer, and write evaluations of student work and notes to parents with the word processor.
- ___**Level 3** I effectively use an electronic grade book to keep track of student data and/or I keep portfolios of student produced materials on the computer. I use the electronic data during parent/teacher conferences.
- ___**Level 4** I rely on the computer to keep track of outcomes and objectives individual students have mastered. I use that information in determining assignments, teaching strategies, and groupings.

X. Ethical use understanding

- ___**Level 1** I am not aware of any ethical issues surrounding computer use.
- ___**Level 2** I know that some copyright restrictions apply to computer software.
- ___**Level 3** I clearly understand the difference between freeware, shareware, and commercial software and the fees involved in the use of each. I know the programs for which the district or my building holds a site license. I understand the policy on the use of copyrighted materials. I demonstrate ethical usage of all software and let my students know my personal stand on legal and moral issues involving technology. I know and enforce the school's technology policies and guidelines, including its Internet Acceptable Use Policy. I have a personal philosophy I can articulate regarding the use of technology in education.
- ___**Level 4** I am aware of other controversial aspects of technology use including data privacy, equitable access, and free speech issues. I can speak to a variety of technology issues at my professional association meetings, to parent groups, and to the general community.

XI. Professional growth and communication

- ___**Level 1** I do not use electronic resources for professional growth or communication.
- ___**Level 2** I can find lesson plans and some research in on-line data-bases. I correspond with parents and other teachers using e-mail.
- ___**Level 3** I use the Internet and other on-line resources to obtain research findings, teaching materials and information related to the content of my classes. I read electronic newsletters and journals to keep current on educational practices. I participate in electronic discussion groups and chat rooms, which are related to my area of education, and both contribute to and use the best practices discussed there. I use a computerized presentation program when giving workshops or speaking at conferences. I use technology to take part in distance learning opportunities for my own professional development.
- ___**Level 4** I organize professional growth opportunities for other teachers and feel comfortable teaching other staff members about the use of technology.

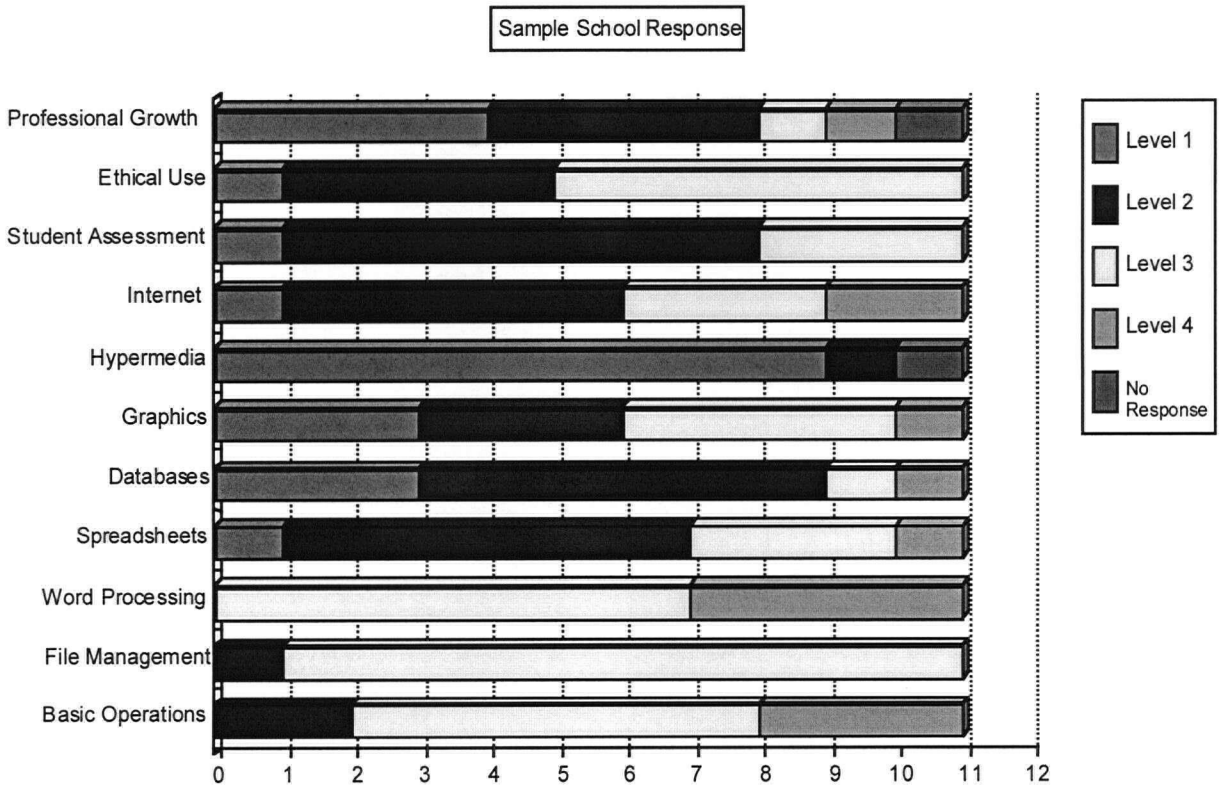
Appendices

Appendix B

Sample Data Collection Results (Rubrics for Teacher Computer Use)

Check the level which best describes your current level of skill in each area.

Level 1: Pre-awareness
Level 2: Awareness
Level 3: Mastery
Level 4: Advanced



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