THE CURRENT STATE OF TECHNOLOGY COMPETENCIES OF TEACHERS IN NEWFOUNDLAND AND LABRADOR SCHOOLS

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The Current State of Technology Competencies of Teachers in Newfoundland and Labrador Schools.

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Abstract

This study was designed to assess the current level of teachers' computer and information technology competencies, assess the attitude of teachers toward computer and information technologies, and relate the level of teacher competencies and attitudes toward computers to age, gender, school type and geographic location.

A thorough review of the literature revealed two suitable instruments, the Technology Needs Assessment Instrument (Alliance of Connecticut Regional Education Service Center, 1997) and the Teacher Attitude Toward Technology Survey (Christensen and Knezek, 1996); which when combined, adequately addressed the research questions. Over 380 of the 540 employees (teachers) in 31 schools in School District #3 in Western Newfoundland returned the surveys. The respondents were inservice teachers ranging in age from 20 to over 50 years, with 2 to over 25 years of teaching experience, from a variety of school types, and were fairly evenly represented by gender and urban and rural location.

The findings suggest that teachers in Newfoundland and Labrador require a significant amount of training to meet the International Society for Technology in Education foundation standards for all educators; there are significant differences in the view of males and females with regard to their technology competency; younger teachers tend to view themselves as more competent in the use of technology than older teachers; and elementary teachers appear to view themselves as having less technology competence than other teachers while high school teachers tend to view themselves as having more technology competence than other teachers. The attitude of Newfoundland and Labrador teachers toward computer technology is generally positive (with some attitudinal differences between males and females, younger and older teachers, and urban and rural teachers). A strong positive correlation was found between positive attitudes toward computers and teacher competency levels in computer and information technology. Overall, it was recommended that training and support of teacher technology use in the classroom should become a priority at all levels. This should include the allocation of a greater portion of budgets to teacher training and support, development of technology plans that specify which standards should be used for student learning, teacher education and inservice, technology resources, and technical support.

Centers for teacher training should be developed in each region of the province which support, encourage and assist teachers in the integration of technology in the classroom. Stakeholders must work together to explore ways to provide cost effective, easily accessable distance education programs in computer and information technology to teachers in their schools and homes.

Stakeholders should identify and implement methods in their technology plans which build on the positive attitudes of teachers and provide and improve training opportunities which take advantages of and reinforce these attitudes. Technology is an ever-changing field and, for teachers to keep up, life long learning and a commitment to self training is required.

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CHAPTER ONE

INTRODUCTION

Technology is a distinctly human endeavor that modifies and is modified by human activity. Since the invention of stone tools, technological applications have provided, and will continue to provide, humans with the ability to modify their environment. At present, the most ubiquitous of these technologies are computers, computer networks and related peripherals. Because advances in computer and information technology have the potential to affect all areas of human existence, it is vital that students understand the interrelationships of this technology with other technologies, the environment, and human activity.

Computer and information technology encompass tools and strategies for solving problems, using information, increasing productivity and enhancing personal growth. Knowledge and skills that were unheard of a decade ago are critical for technological literacy today. Examples include: a knowledge of how to access and produce information stored electronically; the ability to access information on the Internet; local databases of material in public libraries; and communication through global networks.

The concept of basic literacy, the minimum necessary skills for a person's economic survival, has changed with time. In the early part of this century to be literate meant to be able to write one's name. Later, literacy came to mean the ability to read and write; and today it implies the ability to read, write and compute.

To effectively function in society there is a need to understand the language and terminology of the society and be able to make effective decisions about technology. In this new kind of society fewer jobs will be open to the undereducated, and skills that are considered higher level, such as problem solving, analysis, synthesis, critical thinking, and communications will be essential for many workers (Hunt, 1983; Jones, Valdez, Nowakoski, & Rasmussen, 1995a).

Technology and global developments have created a fiercely competitive marketplace. Today, as never before, economic and social well-being depends on the capacity to make the most effective use of human resources and to maintain workforce skills. The growing complexity of jobs in Canadian and international workplaces increases the demands being placed on workers. For many, the literacy skills that earlier enabled us to do our jobs effectively are no longer sufficient (Conference Board of Canada, 1998). Business and industry seek employees who are technologically literate and able to participate in a highly skilled, technologically rich work force that adapts readily to constantly changing technology. Employees must have skills, strategies and tools for finding, retrieving and analyzing this information, and dealing with technological change in the workplace. Business requires personnel who are able to think critically and be adaptable to change. The worker of today must possess a diverse skill set and be engaged in life-long learning.

It is critical that schools seek ways to enhance the learning and teaching environment in order that all students will have the required skills to succeed in adult life. Schools must prepare individuals to create, gather, retrieve, store, analyze, synthesize and present information to solve problems. Graduates lacking these technological capabilities will be isolated from information that drives the world of work and they will be unable to participate fully in a democratic society (State of Arizona, 1997).

Throughout history, technological change has influenced the teaching and learning process. Teachers will continue to be challenged by new and emerging technologies. The current challenge for schools is to determine how we educate students to utilize computer and information technology for solving problems and meeting needs and thus facilitate new knowledge integration in all facets of life. To meet the challenge, we must help students gain knowledge about, develop skills in using, and apply and interact with computer and information technology.

In order to do this we must keep in mind that much of the research on transfer of learning strongly supports the position that instruction and educational activities should closely parallel the final desired behavior (Barron & Goldman, 1994). Because society needs people adept at using computer and information technology, we should incorporate computer and information technology as students develop problem-solving skills and strategies in their classrooms and school-to-work environments. The tools, skills and computer technology must be used in context. Understanding that students have different learning styles, we can help them use technology as a means to apply the academics they learn in school within the context of the real-world. Computer and information technology instruction is becoming an integral part of a student's educational experience (Barron & Goldman, 1994; Government of Newfoundland and Labrador, 1996b; Government of Newfoundland and Labrador, 1996c; Province of Alberta, 1998; State of Arizona, 1997).

The pervasive nature of computer and information technology into, for example, elementary, intermediate and secondary schools has led to increased student use and the need for teachers to gain the skills to become competent in their use. The skills required range from those in basic computer and information technology, to how to implement technology across the curriculum, how to assess the appropriate use of technology, and how to measure student achievement for a given learning situation (Department of Education, 1986; Government of Newfoundland and Labrador, 1996c; Province of Alberta, 1998; State of North Carolina, 1996).

Curriculum implementation is strongly influenced by the beliefs and perceptions of classroom teachers and principals. This is supported by Aitkenhead's (1985) findings which further contend that the value system and beliefs of teachers does not allow for new approaches. Many of these computer and information technology tools require patterns of thinking inconsistent with teachers' current beliefs and values. He suggests that only by gaining an understanding of the system of thought that teachers bring to their work will curriculum specialists understand the key factors for change and implementation of innovations.

In a number of Newfoundland and Labrador schools, teachers and students are actively engaged in using computer and information technology tools as a part of daily life and a natural part of learning activities. These are the technology users, the "have" teachers and students. Others, the "have not" teachers and students are not able to share in the use of technology mainly because of a lack of knowledge, skills and/or resources. For many teachers, the time, the resources, or a long-term inservice plan to expand their technological capacity has been lacking. The provision of a quality, multifaceted long-term inservice plan which accounts for careful attention to adult learning theory and current professional development models is required. The solution also requires the development of innovative ways to acquire the necessary inservice time and appropriate resources: human, physical and financial.

Two major areas to be considered in designing an effective teacher inservice plan for technology integration are teacher attitudes toward, and competency levels with respect to, computer and information technologies. Current teacher competencies will determine the subject and depth of treatment; and, teacher attitude will determine the approach the inservice will take in addressing the inservice need.

Stern & Keislar (1977) did an extensive review of teachers' attitudes and attitude change in teachers. They discovered that teachers' attitudes do make a difference in the teaching process and that the attitude of teachers can be altered. To effect change in attitude, an adequate orientation period is required for teachers to explore and understand the innovation. A positive attitude towards an innovation is enhanced through familiarity. With knowledge, familiarity, and competence any established negative feelings tend to disappear or become more positive (Beasley & Sutton, 1993; Lillard, 1985; Loyd & Gressard, 1996; Stern & Keislar, 1977). Koohang (1989) suggested that where a negative or ambivalent attitude toward computers exists it can be a deterrent to using computers in the classroom. Positive teacher attitudes toward computers are recognized as a condition for their effective use (Woodrow, 1992).

Ely (1995) states that "decisions can be made from the 'top' but unless the classroom teacher is convinced that (a) change is important and (b) has the knowledge and skills to make it happen, innovations will languish even as equipment gathers dust" (p. 2). In order to integrate computer and information technology into school curriculum, teachers need to be competent in the use and application of these technologies. The degree of benefit to students will depend on the skill and competencies teachers have with respect to these new tools (Panel on Educational Technology, 1997). Successful implementations are associated with trained and knowledgeable teachers in the classroom (Bracewell & Laferriere, 1996). Since the introduction of microcomputers in classrooms, the education community has recognized that the redesign of teacher education and training is essential to successful integration of technology in classroom instruction. "While much has changed over the years, the need for teacher support and training has not, as the importance of training teachers and administrator is the key to successful implementation of technology in the classroom" (Banks, Searcy, & Omoregie, 1997, p. 6).

Fabry & Higgs (1997) state that "one place to impact change is with a technology plan that begins with a needs assessment of all educators dealing with technology integration in schools" (p.396). They go on to state that "if schools are to move forward, it is essential that they know where they are and what their vision of the future holds" (p. 396). One of the main problems with determination of the need for inservice in Newfoundland and Labrador schools is that there has been little or no comprehensive skill competency assessment or attitude evaluation/testing done to assess the level of proficiency or need and confirm the seriousness of the inservice problem with respect to technology.

Statement of the Problem

The purpose of this study was to determine which computer and information technology skills teachers have along with their level of readiness to integrate computer and information technology into the classrooms of Newfoundland and Labrador schools. Overall, the study assessed the current level of competencies and attitudes of teachers toward computer and information technologies.

The problems to be addressed in this study were to: 1) assess the level of technological competencies of Newfoundland and Labrador's teachers with respect to International Society for Technology Education (ISTE, 1997) foundation standards for educators; 2) determine how Newfoundland and Labrador teachers vary with respect to the level of computer and information technology competencies by analyzing selected demographic information and other characteristics; 3) assess the attitude of Newfoundland and Labrador's teachers toward computer and information technology; 4) determine how Newfoundland and Labrador teachers vary with respect to attitude toward computer and information technology by analyzing selected demographic information and other characteristics and; 5) determine the relationship between the level of related technological competencies and the attitude toward computer and information technology of Newfoundland and Labrador teachers.

Background and Rationale for the Study

The development of the document, A Framework for Computer and Information Technology Integration, including prescribed general curriculum outcomes, key stage outcomes and specific learning outcomes will be completed in the Spring of 1999 (Government of Newfoundland and Labrador, 1998). This Department of Education document, currently in draft form, outlines the outcomes and skills students will be required to learn or acquire at each key stage. By stating these outcomes for students, it also frames the skill sets that teachers must have to assist students. In order to achieve the latter, teachers must become competent through development of their own skills.

The Technology Education Center, Corner Brook, Newfoundland, is a partnership between the College of the North Atlantic, School District #3 - Corner

Brook - Deer Lake - St. Barbe and Sir Wilfed Grenfell College, Memorial University of Newfoundland. A major part of its mandate is to develop programs for teacher inservice, consult with schools to develop school-based inservice, and support individual teachers in skills acquisition and development of strategies to integrate computer and information technology into the learning environment. To plan effective professional development and make the best use of the scarce teacher inservice time, it is critical to have an up-to-date needs assessment of teacher competencies related to computer and information technologies. This will enable more effective planning for inservice to address the most critical needs for School District #3 - Corner Brook - Deer Lake - St. Barbe as well as the development of a 3-5 year professional development plan for the district and each school in the district.

A review of the literature revealed that there are few studies of teacher technology competencies, with no published studies referring to Newfoundland and Labrador, or even Canadian teachers. More studies were found relating to the attitudes of teachers towards technology; but, few were found which specifically addressed Newfoundland and Labrador teachers. This lack of literature further adds to the need for this exploratory study.

Significance of the Study

Considerable resources have been expended to place computers in schools. In the past decade, millions of dollars have been spent by the federal and provincial governments, school boards, schools, parent teacher associations, school councils, and school partners on developing a capacity for computer and information technology in many locations, including Newfoundland and Labrador schools. Many educators and parents are recognizing the effects of this influx of technology and associated resources on teaching and learning (Government of Newfoundland and Labrador, 1996a; Government of Newfoundland and Labrador, 1996c; Province of Alberta, 1998; State of North Carolina, 1996; State of Vermont Department of Education, 1996).

The implementation of the program articulated in A Framework for Cross-Curricular Computer Integration (Government of Newfoundland and Labrador, 1998) will influence the direction of professional development programs in Newfoundland and Labrador. As preparations are made for the increased use of technology and the specific training of teachers to implement programs to realize these computer and information technology outcomes, it is important for policy makers, educators, and researchers to understand how teachers relate to this technology (Martin, Heller, & Mahmound, 1992). Understanding the variables of personal motivation is valuable to those involved in staff development or instructional design for teachers' computer use. They need to be sensitive to the characteristics of their audience and for the design or delivery of instruction for adopting innovative behavior and computer integration in particular (Marcinkiewicz, 1994).

The first step in any well-developed professional development plan is an accurate assessment of the need for inservice and the delimitation of factors affecting the perceived need. The best assessment of the current state of teacher competencies in computer and information technologies is to use a self-assessment instrument to measure these competencies (see Appendix A). Combined with an attitude toward computers scale and a collection of appropriate demographic information, this assessment, it was anticipated, would allow an analysis of the scope of the task of moving teachers to the appropriate levels of the many technological competencies required to effectively implement programs and thus address the identified student outcomes related to technology. It should also facilitate the development of short-term inservice plans and an effective 3-5 year plan for teacher professional development.

Research Questions

This study was guided by the following research questions:

1. What is the level of computer and information technologies competencies of Newfoundland and Labrador teachers with respect to the International Society for Technology in Education standards?
2. How do Newfoundland and Labrador teachers vary with respect to their level of computer and information technology competencies when analyzed by selected demographic information and other characteristics (gender, age, school type, and geographic location)?
3. What is the current attitude of Newfoundland and Labrador teachers toward computer and information technologies as measured on scales related to

enthusiasm/enjoyment, anxiety, avoidance, attitude toward email, negative impact on society, and productivity?

4. How do Newfoundland and Labrador teachers vary with respect to their attitude toward computer and information technologies when analyzed by selected demographic information and other characteristics (gender, age, school type, and geographic location)?

5. What is the relationship between teachers attitude toward computers and their levels of computer and information technology competencies?

Limitations of the Study

The instruments reviewed and used in this study were developed for teachers in the United Stated, and as such, they may contain a regional bias, although none were detected by the author or the experts who reviewed the instrument. Also, this study focused on the teachers in School District # 3 - Corner Brook - Deer Lake -St. Barbe schools. The results may, therefore, not readily be generalizable to teachers in other school districts or in other provinces. By and large the teachers in this province receive training in education from the same teacher training program and are required to teach a common curriculum therefore, the findings may be generalizable to districts with a similar makeup of teacher population in the province of Newfoundland and Labrador.

Definition of Key Terms

For the purpose of this study a number of terms were defined:

Curriculum integration:

A knowledge, view and curriculum approach that consciously applies methodology and language from more that one discipline to examine a central theme, issue, problem, topic, or experience.

Computer Integration:

A knowledge, view and curriculum approach that consciously applies computer and information technologies and skills as an integral part of other disciplines.

Computer Anxiety:

The psychological, physical, or sociological discomfort or fear associated with using a computer (Speier, Morris, & Briggs, 1995) along with an affective response of apprehension or fear of computer technology accompanied by possible feelings of nervousness, intimidation, and hostility (McInerney, McInerney, & Sinclair, 1994).

Information Technology (IT):

The use of computers, communication networks (including the World Wide Web), and audio-visual equipment to help transform the technology of instruction. IT encompasses or represents a combination of all of these technologies when used to link teaching with learning (Rosener, 1997).

Technological Literacy:

A concept used to characterize the extent to which an individual understands, and is capable of using, technology (Dyrenfurth, 1991) and can make decisions about technological issues (APEF, 1995; ITEA, 1997)

Professional Development:

Any activity or process intended to improve skills, attitudes, understandings, or performance in present or future roles (Loucks-Horsley & Roody, 1991).

Urban:

A school located in a community or serving a collection of communities where the population base is greater than 5000 people.

Rural:

A school located in a community or serving a collection of communities where the population base is fewer than 5000 people.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews the recent literature related to developments in technological literacy, competency, as well as the attitudes toward computer and information technologies. It also examines technology and teacher development, the relationships between gender and technology, age and technology, the impact of technology on learning, and professional development issues related to technology.

Technological Literacy and Competency

We live in a time in which change is constant, and educational institutions must manage that change. This generation must be educated to comprehend, cope with, and direct the new technology. The average citizen, regardless of occupation, must cope with the growth of technology on a daily basis (Lauda, 1994). Changes in the nature of work brought about by technological change requires ever increasing levels of technological competency by workers and citizens (Government of Newfoundland and Labrador, 1999).

In order to discuss the various aspects of technology it is necessary to elucidate the concepts related to technology and the application of technology to educational settings. Technology has been defined by Dugger (1997) as human innovation in action. It is the use of a body of knowledge and the systematic application of resources to produce outcomes in response to human needs and wants. It involves problem-solving related to organizing people, information, time, energy, materials, equipment, and capital to enhance human endeavors (Michigan Department of Education, 1998). Technology "draws its domain along the dynamic continuum that starts with wants and needs and ends in the satisfaction of those wants and needs" (Satchwell & Dugger, 1996). Technology according to Zilbert & Mercer (1992) is a body of knowledge, a field of study, a substantive curriculum, and a pervasive force relevant to all aspects of human endeavor. Technology competence implies far more than learning with or about computers or the ability to use any device, machine or tool. Technology is perhaps best summarized as a process whereby knowledge, tools and skills are applied to solve practical problems and extend human capabilities.

The vernacular use of the word technology often means computer and information technologies. Technology is actually a very broad concept. It is the way humans meet their needs and wants. Technology has 3 important elements - knowledge, process, and product.

Technological knowledge has three main forms; tacit, prescriptive and descriptive. Tacit knowledge is acquired by doing, through skill, practice and experience. Prescriptive knowledge is based on assessment of process and strategies. It results from intellectual processing of observations and experiment, often producing rules or procedures. Descriptive knowledge is based on fact, such as material properties, which often have a mathematical or scientific basis. Individuals may have differing levels of comprehension for each form of technological knowledge. The nature of technological knowledge has important implications for the development of technological literacy and capability (APEF, 1999).

Technological processes are the how and why of technology. These are characterized by the decision making processes that start at the recognition of a problem and continue all the way to a technical solution. Many of these problem solutions are arrived at through the design process, in which a generalized and a specific set of actions are employed to develop solutions. The iterative nature of the process allows for a wide range of solution possibilities (Government of Newfoundland and Labrador, 1999; APEF, 1999).

Technology as a tool or product encompasses all those human-made objects from the dawn of time to the present. They are the consequence of technological activity, of employing technological processes and knowledge combined with resources to solve problems and meet needs. These products have cultural, social, economic and environmental significance associated with them (Government of Newfoundland and Labrador, 1999; APEF, 1999). The very ages we use to refer to human progress and development are technology based: stone, bronze, iron, industrial, atomic, and information (Manitoba, 1998). Some say we are in the early stages of a biotechnology era.

Technological literacy is a concept which has several interpretations and points of view in the literature. Dyrenfurth (1991) characterized technological literacy as the extent to which an individual understands, and is capable of using, technology. Dyrenfurth and Kozak (1991) defined technological literacy as "...a multi-dimensional term that necessarily includes the ability to use technology, the ability to understand the issues raised by our use of technology, and the appreciation for the significance of technology" (p.7). The Michigan Department of Education (1998) stated that technological literacy refers to being "educated" about technology. Technological literacy, according to them, can be characterized as a multi-dimensional term that includes the ability to use technology (practical dimension), the ability to understand the issues raised by the use of technology (civic dimension), and the appreciation for the significance of technology (cultural dimension). The Saskatchewan Department of Education defined technological literacy as "the intellectual processes, abilities and dispositions needed for students to understand the link between technology, themselves and society in general" (1999, p.4). One of the most succinct definitions of information and technology literacy is that used by the State of Wisconsin (1998):

> Information and technology literacy is the ability of an individual, working independently or with others, to use tools, resources, processes, and systems responsibly to access and evaluate information in any medium, and to use that information to solve problems, communicate clearly, make informed decisions, and construct knowledge, products, or systems (p. 1).

Banks, Searcy, & Omoregie (1997) suggested that the definition of literacy by Gadsden (1995) and Lee (1995) be combined. Gadsden contended that literacy per se is a life-long ever-changing activity, transformed by life events and is defined and shaped by cultural and community beliefs about the nature of education and the rewards of learning. In this sense literacy becomes a functional activity in which people continue to value previous means of literacy such as books, reading and learning but are also confronted with the reality of making a living. Lee maintained that literacy is a set of pedagogical principles aimed at empowering individuals to create and reflect on their creations and the impact of these on community, family and society. Banks suggested that these definitions can provide insight for new understandings, beliefs and practices which for a new paradigm he dubs "techno-literacy" (p.10). Techno-literacy is broadly defined as "a means of fostering development of the skills in literacy, numeracy, the humanities and technologies that are necessary to negotiate economic self-sufficiency in the new technological age" (p. 10).

Glister in an interview with Pool (1997) uses the term "digital literacy" as a component of technological literacy, which he defined as the ability to understand information and more importantly, to evaluate and integrate information in multiple electronic formats that the computer can deliver. Being able to evaluate and interpret information is critical.

In Newfoundland and Labrador the move towards adding technology literacy to the curriculum started with the 1992 report Change and Challenge: a Strategic Plan for Newfoundland and Labrador (Government of Newfoundland and Labrador, 1992b). A plan of action was introduced to add new programs at the intermediate and secondary school levels which focus on sciences, enterprise, cooperative education, and technology based education. Intentions to expand computer and information based technologies within the school system were expressed.

Both the Building a Foundation for Prosperity (Government of Newfoundland and Labrador, 1992a) and Inventing our Future, the Prosperity Action Plan (Government of Newfoundland and Labrador, 1993) documents indicate that priority within the education system should be given to establishing "Technology Foundation" courses, increasing the understanding of technology, and developing technological literacy. The Department of Education report Adjusting the Course Part II (Government of Newfoundland and Labrador, 1994) emphasized the need to improve science and technology education and clearly indicated both be part of the core curriculum for all students. The Technology In Learning Environments (TILE) report Enabling Tomorrow's Learners, Today (Government of Newfoundland and Labrador, 1996c) stated that the K-12 education system of this province is experiencing transformation. Part of the redesigning process was planning for integration of technology into and across the curriculum. This report stated that "technologies, appropriately used, increase productivity in learning environments" (p.87). They in turn support systematic change and our struggle for excellence. In 1995, the Department of Education report Directions for Change recommended that all students acquire credits in technology education as part of graduation requirements.

Newfoundland and Labrador became part of the Atlantic Provinces Education Foundation (APEF) in 1995. The resulting document, Essential Graduation Learnings, specifically identifies "Technological Competence" and "Problem Solving" as two of the seven major outcomes of schooling. The Technological Competence Essential Graduation Learning states: "Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems" (Atlantic Provinces Education Foundation, 1995, p.11).

During the winter of 1998 a Department of Education of Newfoundland and Labrador Provincial Committee on Cross-Curricular Integration of Computer Technology was established. This committee has developed draft learner outcomes for integrating computer and information technology across the curriculum which are now available for review and feedback. These outcomes clearly indicate all teachers in the K-12 domain of Newfoundland and Labrador's education system will require a defined level of competency in computer and information technologies (see Appendix B).

Technology related curriculum in Newfoundland and Labrador schools is an inclusive label. It encompasses the fields of Educational Technology, Computer Integration and Technology Education (Government of Newfoundland and Labrador, 1999). Instructional technology, or educational technology, is the application of technology to the instructional, curricular, and management demands of a school district. Instructional technology involves using technology to assist in 1) enabling students to complete assignments, access information, integrate knowledge and skills, and become independent learners; 2) providing instruction and instructional management; and, 3) providing staff development. This type of technology tends to fall between technology as a product and technology practiced as a low-level process. Tools are used to support intellectual and pedagogical issues which are centered on the outcomes of the discipline (Government of Newfoundland and Labrador, 1999).

Computer Integration is an endeavor to deal specifically with computer and information technology skills and competencies. It is related to the ubiquitous nature of computers and the need for everyone to have fundamental skills. Typically, computer integration is viewed as outcomes based and designed to complement technology education and be accomplished within other disciplines rather than as a stand alone curriculum (Government of Newfoundland and Labrador, 1999).

Technology Education is "an educational program that helps develop an understanding and competence in designing, producing, and using technology products and systems, and in assessing the appropriateness of technological actions" (Wright, Israel, and Lauda, 1993). Technology Education is a K-12 subject or content area. The purpose of the Technology Education curriculum is to study the relationship of technology to individuals and society through activities that help the students explore, discover, experience, analyze, and apply technology in a hands-on, laboratory setting. Technology Education instruction focuses on studying the concepts and processes of physical technology, information technology, and bio-related technology. Technology education is designed to expose students to the broader issues of technological literacy and has a primary contribution in the area of technology capacity. This is not addressed in any significant way in any other areas of the curriculum (Government of Newfoundland and Labrador, 1999).

Technology Competence is the ability of individuals to apply knowledge, tools and skills to solve practical problems creatively, extend human capabilities, and evaluate the impact of technology on themselves and society (Zilbert & Mercer, 1992). Peck (1998) defined technology standards as "a common set of expectations that define what someone should know about and be able to do with a certain set of technologies" (p. 47). These technology standards refer to the popular context of computer competencies and the knowledge and skill required to acquire and use information.

Technology and Teacher Development

As computer and related technologies become more commonplace in the classroom, there will be a need for teachers to develop a particular degree of technological literacy and a number of competencies to enable them to keep up with, and teach, their students. The actual competencies to be gained would depend upon what is required in each situation based on the curriculum, the needs of the teachers, and the ability of technology to fulfil those needs (Duckett & Wallet, 1994; Government of Newfoundland and Labrador, 1999; Minnesota Task Force on Information Technology, 1995).

In a 1990 report Niess, as quoted in Halpin (1996), identified a set of guidelines for computer assisted instruction that could be applicable to all teachers regardless of grade level or subject matter. These guidelines, he stated, "must fit the computer into the curriculum rather than fit the curriculum into the computer; use the computer as a personal and professional tool; and use the computer in the learning of subject matter" (p. 300).

The Council for Educational Technology (1996) of the Mississippi Department of Education believes that classroom teachers must create learner-centered environments for students while maintaining their identity as teachers. The role of the teacher changes from a "deliver" of information to a facilitator and mentor who guides students through an educational journey. In order to be competent in this task teachers must:

1. navigate information in order to create knowledge using, technology, media, and telecommunications;
2. be effective communicators through a variety of appropriate technologies/media;
3. use technology to foster the critical thinking and analyzing abilities of students;
4. provide technical support;
5. evaluate the uses and applications of technology;
6. create a learning environment with curricula infused with technology and its applications;

7. engage in the planning process for future technologies and their applications (p. 3-5)

The National Council of Teachers of Mathematics included technology in their 1989 Curriculum and Evaluation Standards for School Mathematics. The rationale for doing this was that industrialized countries were experiencing "a shift from an industrial to an information society, a shift that has transformed both the aspects of mathematics that need to be transmitted to students and the concepts and procedures they must master if they are to be self-fulfilled, productive citizens in the next century" (p. 2). These standards were updated to include technology not available in 1989 and are now in Principles and Standards for School Mathematics: Discussion Draft, 1998 for evaluation and feedback.

Duckett & Wallet (1994) stated that, although teaching at different grade levels and/or in different disciplines may require specialized competencies, they believe there are skills and understandings required by all persons entering or currently in the teaching profession. To be literate and competent, teachers need competencies in four areas: technical, educational, ethical and social and specialized development of audio visual or computing resources. Technical knowledge and skills are those which allow for the operation and use of the audio visual and computer equipment, both hardware and software, and library resources. Educational competencies requires the teacher to have a functional level of knowledge for the integration of audio visual and computer hardware/software into the curriculum. Ethical and social competencies require the educator to have knowledge of the various ethical and social issues related to the use of educational technology. The specialized development of audio visual or computing resources are those competencies required by an educator's special position or discipline.

Since 1995 the movement for setting appropriate technology standards for students and teachers in the United States has gained momentum. The National Educational Technology Standards (NETS) project and the Information Power project were established to set the standards to define what students should know about and do with technology. The National Council for Accreditation of Teacher Education (NCATE) is the organization responsible for examining and granting accreditation to teacher preparation programs (Peck, 1998).

In 1995 the National Council for Accreditation of Teacher Education (NCATE) adopted technology requirements for institutions seeking accreditation. In addition to the standards they have set for the entire school of education, NCATE recognizes three sets of technology standards for use in accredited institutions: those of the International Society for Technology in Education; those of the Association for Educational Communications and Technology; and those of the International Technology Education Association (Cooper & Bull, 1997; Peck, 1998).

The most compelling competency recommendations for preservice teacher which apply equally to inservice teachers have been developed by the International Society for Technology in Education (ISTE) (State of Rhode Island, 1996). The ISTE (1998) evolved a set of preservice teacher standards that reflect fundamental concepts and skills for applying computer and information technology in educational settings.

These as published on their current (1999) web site, included:

1. Basic Computer/Technology Operations and Concepts. Candidates will use computer systems to run software; to access, generate and manipulate data; and to publish results. They also will evaluate performance of hardware and software and apply basic troubleshooting strategies as needed.
2. Personal and Professional Use of Technology. Candidates will apply tools for their own professional growth and productivity. They will use technology in communicating, conducting research and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical and legal use of computer/technology resources.
3. Application of Technology in Instruction. Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software, applications and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations (ISTE, 1998).

For a more detailed list of competencies see Appendix C.

While the ISTE foundations for technology competency of teachers is a recognized standard, it should be noted that foundation standards for all teachers and actual technology competencies are not a "one size fits all" scenario (Government of Newfoundland and Labrador, 1999). New roles for a variety of educators serving in different capacities will require competency levels above the foundation standards, for their positions, to be defined and adopted (State of Rhode Island, 1996). While applauding the standards development efforts of these organizations, Peck (1998) called for a second generation of standards to go beyond foundation and define a realistic set based on grade levels and subjects which teachers are called upon to teach. He proposed that professional organizations from each subject work with the ISTE and other organizations to complete this task and provide "a set of on-line learning experiences through which teachers can gain the identified skills and knowledge by using the very technologies we're hoping they'll embrace in their own teaching" (p.53).

Wiebe & Taylor (1997) stated that, since technology through the ISTE foundations has been recognized by such a credible and respected organization as NCATE, it should provide a clear indication of the importance of technology in education. These foundations provide indicators for professional education units at all stages of development. All teachers and children must have access to all the technologies and training that they can get to incorporate into their learning. "The foundations provide a basic plan for building a core of educators who can take us to new levels of learning through technology" (p. 8).

Teacher Attitude Toward Computers

Stern & Keislar (1977) did an extensive review of teacher attitudes and attitude change. They discovered that teachers' attitudes do make a difference in the teaching process and that the attitude of teachers can be altered. To effect change in attitude an adequate orientation period is required for teachers to explore and understand the innovation. These finding are further supported by Zoller & Ben-Chaim (1996) who studied 500 eleventh-grade students and 53 teachers in Israel.

Gabriel & MacDonald (1996) studied 94 students in preservice education programs at an Ontario university. The students were administered a pre-test and post-test survey of computer attitudes using the Computer Attitude Scale (Loyd & Gressard, 1984). The students completed 19.5 hours of instruction in lecture and laboratory with hands-on experience in technologies used in Ontario schools. They were divided into three groups based on computer experience (low, medium, high). No significant difference was shown between groups; however, all groups were more confident and less anxious at the end of the sessions.

A study of 1730 secondary school students by Shashaani (1994) showed that computer attitudes are affected by experience. They found positive correlations between computer experience and attitude, suggesting that more exposure to computers was associated with more positive attitudes. This finding was confirmed by Dambrot, Watkins-Malek, Silling, Marshall, & Garver (1995). Jorde-Bloom & Ford (1988) found computer experience and knowledge as well as experience with innovation are factors positively related to computer use among primary and elementary administrators.

Other studies have confirmed that a positive attitude towards an innovation is enhanced through familiarity. With knowledge, familiarity and competence, any established negative feelings and anxiety toward computers tend to disappear or become more positive (Beasley & Sutton, 1993; Chopra, 1994; Dyck & Smither, 1994; Lillard, 1985; Loyd & Gressard, 1996; McInerney et al., 1994; Sacks, Bellisimo, & Mergendoller, 1994; Stern & Keislar, 1977). Zhang and Espinoza (1997) studied the relationship between computer self-efficacy and attitudes and need for learning computer skills. The results among 296 undergraduate students at a regional state university revealed that computer self-efficacy had a significant effect on students need for learning computer skills. These results also indicated that attitude toward computers and perceived need for computer skills was greater for students enrolled in computer classes than those not enrolled in computer classes. This suggested that those who recognize the usefulness of computer technologies are more aware of the need to obtain necessary computer skills.

These findings were contrary to that of Speier, Morris, & Briggs (1995). They studied 959 students enrolled in computer classes at a large midwestern university. Those who exhibited computer anxiety before the 15 week course exhibited more anxiety after the course. This suggested that training and computer use do not mitigate subject anxiety. These findings corroborated an earlier major study of 500 California State University students by Weil, Rosen & Sears (1989). In a similar study by Mahmood And Medewitz (1987) initial negative attitudes toward computer technology persisted, albeit somewhat diminished, after an extensive computer literacy course.

Katz (1992) suggested that teacher personality attributes remain stable over long periods of time and that teachers who have personality traits associated with positive or negative attitudes towards computers will maintain these attitudes regardless of length or intensity of exposure to computers. Coley, Cradler, & Engel (1997) found that increased experience with computers at home was associated with lower anxiety for both males and females, with higher confidence levels for males, and greater liking for computers by females.

Lillard's 1985 study of teachers in Warren County, Pennsylvania found significant positive relationships between teachers' knowledge of and attitude toward the instructional use of microcomputers, teachers' attitude toward computers and willingness to use computers, and teachers' knowledge of and willingness to use computers. This confirmed other findings of the importance of teachers' attitudes in the successful implementation of an instructional innovation. Koohang (1989) suggested that when negative or ambivalent attitude toward computers exist, it can be a deterrent to using computers in the classroom. Positive teacher attitudes toward computers are recognized as a condition for their effective use (Woodrow, 1992). Kluever, Lam, Hoffman, Green, & Swearingen (1992) collected data from 265 teachers in 125 different schools to study changes in attitude toward computers. The study included a pretest, participation in a nine month Teaching Teachers

Computer Competencies Project, and a post test. The results were gathered over three years of the program. The findings suggested that positive attitude changes occur with exposure to computers and that teacher attitudes toward computers affected their instructional use of computers and the likelihood of profiting from training.

Gender and Computer Technology

In applications of technology, as in many fields in education, one must be cognizant of the issue of possible differences in teaching and learning and attitudes based on gender. The majority of the research in the literature deals with children or students in preservice teacher programs. Much of the literature on gender and computing reveals that there are marked differences between male and female use of, and attitudes toward, computers (Chen, 1986; Coley, Cradler & Engel, 1997; Fetler, 1985; Loyd & Loyd, 1988; Shashaani, 1993; Shashaani, 1994; Siann, Macleod, Glissov, & Durndell, 1990; Zoller & Ben-Chaim, 1996).

Males tended to demonstrate higher participation rates and had more positive attitudes toward computers, especially when programing was involved (Chen, 1986; Shashaani, 1994; Siann, Macleod, Glissov & Durndell, 1990; Zoller & Ben-Chaim, 1996). Females were less interested in working with computers, more negative in their attitude, lacked confidence working with computers, had less self-efficacy with regard to complex tasks and expressed lower expectations of computer use and usefulness (Busch, 1995; Gilliland, 1990; Shashaani, 1993). Where computer use was not associated with programming or math and science, fewer gender differences were found (Chen, 1986; Linn, 1985; Sacks, Bellisimo & Morgendoller, 1994). In another instance no significant gender differences was found at all (Gabriel & MacDonald, 1996).

A 1997 study of grade 7 and 8 students in an elementary school in Ontario, Canada, examined the attitudes of students toward modern technology and, their attitudes toward learning using modern technology in an academic setting. The researchers also attempted to determine whether there was a correlation between the two attitude variables. The investigation looked at the effects of gender and grade level on students' attitudes toward technology and toward learning using these technologies. A highly positive attitude toward use of computers was evident in the study. The results indicated neither gender nor grade level had any effect on students' attitudes toward technology or on their attitudes toward learning using technology in an academic setting (Hurley & Vosburg, 1997).

Kay (1989) conducted a study at the University of Toronto on computer literacy and attitudes toward computer use between males and females. The results indicated that males had significantly higher literacy scores than females and were significantly more inclined to use computers in the classroom.

In a major study by Fetler (1985) 23,395 twelfth-grade students and 293,717 sixth-grade students were surveyed. The twelfth-grade boys outperformed the girls in every major area of computer literacy and the sixth-grade boys outperformed the girls on all but one area. The twelfth-grade boys and girls differed on two attitudinal measures: girls were more likely to agree that computers slow down and complicate business operations, boys were more likely to perceive computers making math more interesting. The sixth-grade boys and girls differed on several attitudinal measures. Girls were more likely to agree that computers slow down and complicate business operations, less likely to agree that knowledge about computers will help get them a better job, that someday most things would be run by computers, and that computers can make math more interesting. Boys were more likely to have a positive attitude toward computers in the workplace.

A study of 3,500 teachers in 55 schools in small rural schools was conducted in southeastern Idaho to determine the best predictors of teacher technology use in the classroom. The results of the survey indicated that gender was a significant factor and that this was the second best predictor of teachers' perception of their ability to use technology. Males tended to perceive themselves as having higher ability in technology use compared with females (Mathews, 1998).

In a number of other studies, male students and teachers tended to use computers more frequently than females (Burke, 1986; Koohang, 1987). By contrast, there were also several studies that showed no significant difference between males and females in their use of computer and information technologies (Lyons and Carlson, 1995; Fary, 1988; Grasty, 1985; Smith, 1985; Sacks, Bellisimo & Mergendoller, 1994). Many of these studies indicated that, when computer experience was controlled, there was no significant difference between the attitude of males and females (Coley, Cradler & Emgel, 1997; Dyck & Smither, 1994). This was confirmed by studies of female professors in higher education settings who started at a disadvantage but eventually caught up with their male counterparts (Faseyitan and Hirschbuhl, 1991; Fuller, 1986; Millet, 1991).

The attitude of both genders was more positive if they had a male sibling as a role model. Attitude was more positive for males if the father was the influence and more positive for females if the mother was the role model (Coley, Cradler & Engel, 1997; Huber & Scaglion, 1995; Shashaani, 1993).

The gender differences found in several of the studies were attributed to gender socialization. This indicated that parents and school educator sex-type views were critical factors influencing student attitudes toward computers. A positive correlation was observed between lack of interest and confidence in female students to use computers, and their socializers' belief of the inappropriateness of computers for females (Coley, Cradler & Engel, 1997; Huber & Scaglion, 1995; Shashaani, 1993). In a study of 36 males and 36 females ranging in age from fifteen to fifty-two Corston & Colman (1996) found that, in the presence of males, females tended to show more anxiety and less confidence and did not perform as well in task tracking of computer skills. When placed in the presence of a person of the same sex, females tended to perform the tasks virtually as well as males.

Fletcher-Flinn & Suddendorf (1996) conducted three studies in New Zealand on computer attitudes, gender and exploratory behavior. According to the first study of preschoolers, the gender role socialization appeared to start early. Forty children and their parents were studied. The results showed that preschoolers had amassed a great deal of knowledge about computers, held positive attitudes toward them, and did hold gender-related beliefs. Short-term exposure to computers did not do much to change the beliefs. It was concluded from two other similar studies conducted on high school students that the students all held positive views but few held gender-stereotypical beliefs. This was attributed to the affirmative action programs promoting gender equity in New Zealand classrooms.

The goal of achieving sex equity in education should, according to the Canadian Teachers' Federation (1998), guide all aspects of the development and implementation of microelectronic technology. In particular, increased participation of female students in technology-oriented classes and greater representation of women teaching these subjects should be concrete school and system goals.

Age and Technology

A very limited number of studies have been done which addressed the relationship between age and computer technology. Shashaani (1993) studied 1754 ninth and twelfth graders in Pennsylvania. The results showed no significant difference in interest in computers between grade levels. However, the grade nine students results included slightly more gender related differences than did the twelfth graders.

In a study of 219 young adults (30 and younger) and 203 older adults (55 and over) in the central Florida area, Dyck & Smither (1994) found that older adults were less anxious, had more positive attitudes, and had more liking for computers than young adults.

Meskill and Melendez (1997) studied the attitudes of 19 older teachers (aged 40 - 57 years) involved in a six week computer training program in Egypt. The researchers used a combination of the Computer Attitude Scale (Loyd & Gressard, 1984) and Computer Attitude Scale (Griswold, 1991). Prior to the course there was no significant difference between age and computer liking, nor between age and computer usefulness. After the course, even though there were positive changes in attitudes and perceptions of computer utility, age was found to correlate negatively with computer liking and computer use.

Impact of Technology on Learning

In order to integrate computer and information technology into school curriculum teachers need to be competent in the use and application of these technologies. The degree of benefit to students will depend on the skill and competencies teacher have with respect to these new tools (Panel on Educational Technology, 1997). Successful implementations are associated with trained and knowledgeable teachers in the classroom (Bracewell & Laferriere, 1996) but we must make it clear that technology is not the ultimate goal; technology is a tool to help achieve the goals of education effectively (Wallinger, 1997).

A content analysis of a wide variety of professional journals, papers, and dissertations was conducted by Plotnick for the period October 1, 1994 through

September 30, 1995 (Plotnick, 1995). The analysis identified eight trends in technology related to education: 1) computers are pervasive in schools and higher education institutions and virtually every student in a formal education setting has some access to a computer; 2) networking is one of the fastest growing applications of technology in education; 3) access to television resources in the school is almost universal; 4) advocacy for the use of educational technology has increased among policy groups; 5) educational technology is increasingly available in homes and community settings; 6) new delivery systems for educational technology applications have grown in geometric proportions; 7) there is a new insistence that teachers must become technologically literate; and 8) educational technology is perceived as a major vehicle in the movement toward education reform.

According to Houston (1998), Executive Director, American Association of School Administrators, a national survey of U.S. educators indicated that the majority attributed a significant increase in student achievement to technology and felt that technology was an important tool in motivating students to learn. They also stated that the two things they need most were professional development and the best possible instructional software. Houston suggested that we are just starting to see how to use powerful technology to help students learn, and in terms of the actual use of this technology, teachers are the ones who have to determine how to use it and what to use.

Hawkridge (1990) specified four rationales for using computer technology in schools: the social rationale, the vocational rationale, the pedagogic rationale, and the catalytic rationale. The social rational is based on the wish by governments, parents and educators to make sure children are aware and unafraid of computers and technology and understand that they need to be prepared to use these technologies and understand their role in society. The vocational rationale is that computer competency is important and learning to control computers may be the foundation for a career. The pedagogical rationale is founded on the belief that computers can teach or students can learn using computers, with potential advantages over traditional methods. The catalytic rational states that schools can be changed by the introduction of computer technologies and that this introduction facilitates and demands change.

The early use of computer technology in schools was for computer assisted instruction (CAI) and other forms of Computer Based Education (CBE) (U.S. Congress Office of Technology Assessment, 1995). Kulik,(1983), used meta-analysis to study 51 previous studies on Computer Based Instruction (CBI). This study determined that CBI can improve student learning, student attitudes toward computers, and to a lesser extent student attitudes toward the subject area and the rating of the teacher.

In 1985 Kulik, Kilik, & Bangert-Downs conducted similar research. They looked at previous studies that had been completed and included them if they matched four criteria: they took place in actual classrooms, they provided quantitative results of the experimental and control group, they were free from methodological flaws, and they were able to obtain the original studies. Thirty-two studies matched the criteria and were included. It was concluded from the meta-analysis that, while not all forms of CBE produce the same effect, CBE has a positive effect on achievement of elementary school children, with CAI having the most positive effects.

Kulik and Kulik (1991) updated the previous studies, including 254 controlled evaluation studies of CBI. Overall they found that CBI increased student examination scores by moderate but statistically significant effects. CBI also produced positive changes in student attitude toward teaching and computers and reduced substantially the amount of time required for instruction.

Technology in schools has been cited for enhancing teaching and learning. Means & Olson (1994) conducted case study research in schools using technology as part of a concentrated program of school reform. They found that technology had a number of positive effects: it allows more complex assignments to be feasible, provides an entry point to content areas and inquiries that might not otherwise be accessible, potentially extends and enhances what students are able to produce, and stimulates problem solving and other thinking skills in the selection and manipulation of appropriate tools.

In a study conducted by CAST (Center for Applied Special Technologies) evidence was gathered to show that online access within the context of what is already happening in the classroom can help students. They can become independent, critical thinkers who are able to find, organize, and evaluate information. They can then effectively express their new ideas in compelling ways (Coley, Cradler & Engel, 1997).

Findings from CAST were supported by a study commissioned by the Software Publishers Association. Two meta-analyses of studies were carried out between 1990 and 1994 and between 1995 and 1997 on the effectiveness of technology in schools. These studies reported that the use of technology as a learning tool can make a measurable difference in student achievement, attitudes, and interaction with teachers and peers. These positive effects, it was found, exist throughout education, for both regular and special needs students, and in all subject areas (Sivin-Kachala & Balbo, 1994; Sivin-Kachala & Bialo, 1997).

The North Carolina Regional Education Laboratory (NCREL) report, Plugged In: Choosing and Using Educational Technology, is a summary of their latest work in seven states regarding the use of educational technologies. It was found that implementation of these tools in education, combined with recent research, the report maintained, will produce successful, engaged learners responsible for their own learning. Such students are self-regulated and able to define their own learning goals and evaluate their own achievement. In order to have engaged learning, tasks need to be challenging, authentic, and multi disciplinary. Such tasks are typically complex and involve sustained amounts of time. They are made authentic in that they correspond with the tasks in the home and workplaces of today and tomorrow. Tasks often require integrated instruction that incorporates problem-based learning and curriculum by project (Jones, Valdez, Nowakoski, & Rasmussen, 1995b).

A 1995 U.S. Congress Office of Technology Assessment report states "not only do technologies allow access to a broader range of instructional resources, but they offer students the opportunity to learn to use electronic tools to access information and develop research skills using the technologies they will face in the future" (p. 59).

The Apple Classrooms of Tomorrow (ACOT) project reported that, in addition to students in ACOT classrooms preforming well on standardized tests, they developed a variety of competencies not usually measured. ACOT students "explored and represented information dynamically and in many forms, became socially aware and more confident, communicated effectively about complex processes, used technology routinely and more appropriately, became independent learners and self-starters, knew their areas of expertise and shared that expertise spontaneously, worked well collaboratively, and developed a positive orientation to the future" (Apple Computer Inc., 1995, p.10).

A study was conducted in two high schools as part of a larger Computer Pilot Program in schools of the New York City Board of Education. The study focused on the difference between teacher and student interactions and the degree of student centered activity in traditional classrooms compared with those involving the use of integrated computer learning systems. The results showed that in traditional classrooms teacher initiated interactions occurred 2.5 times as often as student initiated interactions. In the integrated computer learning system classroom the same number of interactions occurred but the number of teacher initiated interactions were only slightly higher than the number of student initiated interactions. The integrated learning system classrooms were more student centered and more individualized (Swan & Mitrani, 1993).

Technology can even affect the way students perceive teachers. In a 1997 study, Forman found that adding technology such as presentation software and interactive graphing to the teaching situation can significantly improve the students' perception of the teachers' creativity and originality while not harming students' perceptions of the teacher being warm, caring and concerned about them.

Professional Development

Since the introduction of microcomputers, the education community has recognized that redesigned teacher training would be essential to the successful integration of technology in classroom instruction. The increased use of technology in K-12 classrooms has created a massive inservice training need in technology for practicing teachers (Northrup & Little, 1996); and according to Banks, Searcy and Omoregie (1997) training teachers and administrators is the key to successful implementation of technology in the classroom.

Because teachers typically feel uncomfortable about integrating technology into their instructional activities, most who do attempt to do so, continue to use computers for low-level, supplemental tasks such as drill and practice, word processing, educational games, and computer based games (Ely, 1995; U.S. Congress Office of Technology Assessment, 1995). Researchers conclude that teachers are being inadequately prepared to use instructional technology and consequently are unable to effectively integrate technology into the classroom (U.S. Congress Office of Technology Assessment, 1995).

With regard to professional development, Fullan (1992), a recognized authority in school reform, advanced the proposition that "..teacher education is a matter of life-long learning, starting before one enters teacher pre-service (probationary period) and continuing throughout one's career...." (p. 114). With the rapid change in technology, and technology applications to education, this may be even more relevant to the areas of technology education and educational technology than to other curriculum areas.

Joyce & Showers (1980) believe that inservice has a number of levels of impact: awareness, concepts and organized knowledge, principles and skills, and application and problem solving. Only when inservice allows a teacher to reach the fourth level of impact can we expect increased student learning and achievement.

The Province of Alberta recognized that teachers need to be computer literate and confident in the use and application of technology to improve the effectiveness of instruction. It recognized that technology can be an important component of effective teaching, and suggested that technology competencies be included as part of teacher certification, and that teachers should continually improve their technology knowledge and skills (Province of Alberta, 1998)

In a 1995 report to the Minnesota Department of Education the Minnesota Task Force on Information Technology emphasized the need for professional development by stating that: "Staff development is a critical component of an information technologies system" and that schools must "...help staff develop skills to use information technologies to effectively support learning and administration. In addition, staff development will need to be ongoing to keep teachers current with new technology" (p. 10).

Teacher inservice education should be readily available to generalists as well as instructional specialists. Particular emphasis should be placed on multi-disciplinary studies and the integration of microelectronic technology with other print and audiovisual resources (Canadian Teachers' Federation, 1998).

As technology moves from the periphery to the center in K-12 schools, so too must it move from the periphery to the center in teacher preparation (National Center for Accreditation of Teacher Education, 1997). NCATE asserts that moving technology to the center of teacher education can be done through standards for teacher education which include technology. Many institutions enunciate the need for standards not only for teachers, but throughout the education system.

> The power of standards lies in their capacity to change fundamental components of the educational system. This assertion has several key points. First is the capacity to cause or influence changes. To be clear, standards imply change, not an affirmation of the status quo. Second, the changes are in fundamental components of education, by which I mean curriculum content, instructional techniques, assessment strategies, and teacher education and professional development programs. Third, I refer to a larger educational system, as opposed to one component such as assessments. A feature of standards is that they influence the entire educational system by

specifying outcomes, for which the concrete expression is -- What should all students know and be able to do? (Bybee, 1998, p. 3)

In order to meet these new standards on all levels, teachers will require training. Because technology changes rapidly, technology training is an ongoing need--not a short-term fix. Thus, a more productive notion than training is educating teachers and administrators in the use of technology, so that, as new technology comes along, they can train themselves (Caverly, Peterson, & Mandeville, 1997). The fact that teachers are not ready to meet these standards is often not the fault of teachers themselves. As Schofield (1995) points out, computers often do not live up to their promise because no one shows teachers how to integrate their new technology into their instruction or, sadly, into their students' learning processes. Thus, when teachers want to go beyond using technology for data input or for motivating youngsters, they face a huge learning hurdle.

Persky (1990) engaged in case study research at the Educational Development Center, Inc. in Massachusetts. The findings of this study indicated that novice technology users are more likely to begin integration of technology into curriculum when they have knowledgeable persons to turn to for computer advice and emotional support. Also, teachers engaging in reflection about instructional uses of technology are more likely to evaluate classroom practices and redesign instruction to better meet student needs; and administrators need to put structures in place so that teacher development is supported by regular communication between teachers. One of the most meaningful lessons learned from this project is that using technology is not easy and that the usual notion of training is not sufficient to give the kind of knowledge and support teachers require.

The Office of Educational Technology (1995) reports that the United States Department of Education has aligned its professional development programs around a set of principles for effective professional development. They suggest the focus on the teacher is central to school reform, that the emphasis must be on both content and pedagogy which embodies good research and practice. There must be a commitment to professional development as a long-term process which is embedded in the regular routine of school. Sustained intensive professional development will encourage teachers to view technology as a tool to improve all facets of their professional lives. This must be complemented by giving teachers regular access to technologies they are studying with realistic hands-on training. As well, changes in the school organization are required such that the school culture supports and values technology. One of the key elements is that institutions allow teachers the time to engage in professional development, share ideas and practice and experiment with technology.

Curriculum improvement and technology integration can best be described as the alignment of outcomes, process skills, and technology competencies so that students and teachers learn about technology by teaching and learning with technology (State of Rhode Island, 1996). The process by which this can occur is thoughtful, planned, sustained professional development, which includes technology integration tied to the content objectives of the curriculum.

Innovative Professional Development

Educators understand that technology is now a critical component in learning, and that staff development in this area needs to be determined, sustained, varied, calculated, supported and frequently individualized (Clifford, 1998). "Teachers are more effective after receiving extensive training in the integration of technology with the curriculum" (Sivin-Kachala & Balbo, 1994, p. 2). Successful use of technology in schools depends upon the skills of the teachers and other staff in those schools (Glennan & Melmed, 1996). Successful staff development requires sustained effort. Bringing in an expert to present a two or three hour technology workshop is a good beginning, but expecting the faculty to grasp the concept and implement it is unrealistic without quality follow-up. The staff needs a person who can answer questions as they arise; an on-site person who serves in the capacity of technology coordinator (Clifford, 1998).

Inservice training in the form of staff development courses should concentrate on the conceptual/pedagogical aspects of educational technology instead of stopping at brief hardware and software orientation. Teachers should also be provided with time and support for training necessary to become confident and competent in their use of technology (Clouse & Alexander, 1997). "Helping teachers use technology well may be the most important step to helping students" (U.S. Congress Office of Technology Assessment, 1995, p. 95).

In some schools, innovative programs allow teachers to become trained in the use of technology. At Pine Hills Elementary, in Orlando, Florida, students who are selected because of their technology competence work with the technology teacher and help train teachers to produce news letters, download, and operate video equipment (Shames, 1996).

Another innovative professional development initiative called SCOUT Camp was developed as a collaborative effort between University of North Carolina - Chapel Hill, the Chapel Hill-Carrboro City schools, and Nortel as a business partner. The design and development of this initiative was guided by five principals: practice what you preach; create a compelling vision; focus on learners and learning, not technology; plan around a framework for improving learning; and plan for transfer of learning. School based teams, of at least two teachers each, attend the five day summer camp. The participants are immersed in high-quality technology-rich, constructivist learning environments where they focus on enabling active, student-based learning. The camp combines learning by doing with reflective practice. As part of the activity the technology "know how" to complete the project is gained through hands on skill building workshops and learning centers. Transfer of learning is accomplished through teacher and student-friendly reusable materials, teacher developed learning and technology action plans, site based assistance from their own school based technology specialists, and collegial support by reunions of the campers. The results of this camp are very positive. Ongoing evaluation of the campers found that many teachers transferred the activities to their classroom while some did not (DeWert & Cory, 1998).

A Pilot Mini District of the Cincinnati Public Schools was established to develop model programs and research reform initiatives for the larger school district. Over the course of the program the focus was on supporting the teachers using technology on-the-job site. Approaches that worked in their district included shadowing, one-on-one for one, rotating topics, walk-in clinics, and student exchanges. Shadowing involved teachers shadowing other teachers to observe classrooms where technology is used successfully. This helped teachers develop a vision of what they can do with technology in their classrooms and placed staff development in the context of practice. The "One-on-One for One" model has one teacher working with one coach in a session focused on the needs of the individual teacher. These sessions can be accomplished by having several coaches and teachers working at once during a day or by having one or two sessions per day over an extended number of days. The Rotating Topics design had three coaches working with small groups of teachers. Groups would rotate through the three sessions, each with a different coach. These sessions focused on placing technology in meaningful classroom contexts. The Walk-in Clinic model involved setting up an area where a coach is available and teachers flow in and out of the clinic on a voluntary basis throughout the day. The design of the Student Exchange is based on the growing appreciation of the growing skills and abilities of students to teach their peers and teachers. Students who are proficient in a technology or application coach their peers and or teachers. Another form of this is where teachers exchange students: "I'll teach your students this if you teach mine that". Many of these models require the use of substitute time for planning, coaching, or taking in the sessions. In this way the inservice can be done in the school in context and technology adoption is viewed as a process that takes time (Maddin, 1997).

Summary

This literature review, overall, strongly supports the proposed research and indicates that computer and information technology literacy is desired and even demanded by employers, government, parents and educators. For students to become competent in the use of these technologies, teachers must have the competencies to assist student development. The International Society for Technology in Education has developed a standard set of foundation technology standards for teachers. Teachers mastering these foundation skills will have the basic competencies to effectively integrate technology in the classroom and promote literacy in students. From the literature it is clear that few teachers in, or entering the profession, actually have the required competencies. In acquiring these teachers will have to engage in inservice activities. To achieve change in teacher beliefs and practice, the attitude and competence of the teacher must change. The process of change and teacher growth will most certainly take time. The persons responsible for training need to create a short term and long term inservice plan which meets the needs of the teacher. To satisfactorily produce competent teachers the training must address where the teachers are in relation to the required competencies and what attitudes toward the technology the teachers bring with them. A logical place to start would be a needs assessment of teacher competencies and attitudes.

CHAPTER THREE

THEORETICAL FRAMEWORK AND RESEARCH DESIGN

The purpose of this study was to determine which computer and information technology skills teachers report having along with their level of readiness to integrate computer and information technology into the classrooms of Newfoundland and Labrador schools. The study assessed the current level of teachers' computer and information technology competencies, and attitudes, and related these to selected demographic factors (gender, age, school type, and geographic location).

Design of the Study

In order to investigate the levels of competency in technology skills and attitudes toward computer technology a Technology Needs Assessment Instrument was developed consisting of three parts: teacher demographics, technology needs assessment, and teacher attitude toward computers (see Appendix A). This instrument was constructed by evaluating and selecting two instruments through a review of the literature. A technology needs assessment created by the Alliance of Connecticut Regional Education Services Center (1997) was the most complete instrument best matching the required assessment of skills regarded as foundation skills by the International Society for Technology in Education and the Draft Cross-Curricular Computer Integration Outcomes for K-12 education in Newfoundland and Labrador (Government of Newfoundland and Labrador, 1998). The Attitude Towards

Computers Instrument was the most currently available validated instrument used to assess the attitude of teachers toward computers and related technologies (Christensen & Knezek, 1996).

The school district of Corner Brook - Deer Lake - St. Barbe, Newfoundland permitted administration of the instrument in 31 schools. A request was forwarded to the Board of Education in that district for permission to use the data in the survey for the purposes of this research. The survey was sent to schools early in February of 1999 and was administered to teachers in the schools. A letter to the principal and teachers outlined the purpose of the survey and requested that the survey be competed by teachers and returned before the end of April 1999. The letter also ensured the teachers of confidentiality of the information and that no teacher would be individually identified. The completed surveys were returned to the School District office and forwarded to the researcher.

Instrumentation

A single questionnaire was compiled to investigate the levels of competency in technology skills, attitude towards computer technology and the relationship between levels of competency and attitude towards computer technology. The instrument consisted of three parts: teacher demographics, technology needs assessment, and a attitude towards computers assessment.

Part one of this Technology Needs Assessment Instrument gathered data on 10 personal information items which allowed categorization of responses based on age, gender, school type and location (urban/rural). Part two of the instrument was a technology needs assessment which asked teachers to rank their competency on computer and information technology based on three areas: 1. professional productivity - use of technology for professional and personal productivity; 2. integrating technology - integrating technology into the teaching/learning process; and 3. student inquiry - using technology to encourage student inquiry and high level thinking processes. The professional productivity section contained 19 questions and was broken down into three categories that addressed 1. operating computers, related technologies and software applications; 2. evaluate technology materials; and 3. accessing information. The integrating technology section contained 19 questions in three categories that addressed: 1. evaluating, selecting and applying instructional technology; 2. the use of emerging technologies; and 3. ethical use of technology. The student inquiry section consisted of 10 questions in two categories that relate to 1. design, develop and support technology activities; and 2. use of technology in assessing student work.

The original technology needs survey used in this research was developed by the Alliance of Connecticut Regional Educational Service Centers to assess the competency of Connecticut teachers and evaluate the inservice need based on the State of Connecticut teacher competency standards. The survey was used in the spring of 1998 to evaluate the level of technology competency and needs of educators in school districts throughout Connecticut. It was based on the Levels of Technology Proficiency for Connecticut Educators developed using the International

Society for Technology in Education foundation standards (minimum standards for all teachers) for technology literate teachers (Kaplan, 1999).

To obtain measures of teacher computer and information technology competency in this study, teachers were presented with the competency statements and asked to assess their current skill level attainment or practice on a nine -point scale which ranged from 1-Not Yet Ready to 9-Could Teach Others. The scoring of this ordinal scale was based on assigning weights from 1 to 9 for each position on the scale. The computer and information technology competencies were divided into three scales: professional productivity, integration of technology, and student inquiry. These scales are divided into a number of subscales which are listed in Table 3.1.

Table 3.1 Technology Competency Scales and Sub Scales

Scale	Sub-scale
1. Professional Productivity	A. Operate computers, related technologies and software applications A1. Basic A2. Advanced B. Evaluate technology materials C. Access Information
2. Integrating Technology	A. Evaluate, select and apply instructional material to the curriculum B. Use emerging technologies C. Demonstrate ethical use of technology
3. Student Inquiry	A. Design, develop and support technology activities B. Use technology in assessing student work

Part three of the instrument consisted of a Teachers Attitudes Toward Computers (TAC) survey and was designed to assess the attitude of teachers toward computer and related technologies. The TAC is an 80 item questionnaire for measuring teachers' attitudes toward computers on the six subscales of enthusiasm/enjoyment, anxiety, avoidance, attitude toward email, negative impact on society, and productivity. A five point Likert scale was used to solicit responses from the subjects who selected one of the following choices: to S - strongly agree, SA - somewhat agree, U - undecided, SD - somewhat disagree, or D - strongly disagree with the statement presented. This part of the instrument was originally developed by Christensen and Knezek (1996) who statistically selected the strongest indicators from 14 instruments with acceptable measurement properties that were reported in the literature. Their questionnaire was designed so that a number of questions were worded positively while others were negatively worded. This was done to ensure that the responses were not influenced by the wording of the statements. These items were scrambled and numbered on the survey according to Table 3.2.

Table 3.2 Survey Items in each Attitude Scale

Attitude Scale	Survey Items
Enthusiasm/Enjoyment	1, 7,13,19,25,31,37,43,49,55,61,67,71,75,78
Anxiety	2, 8,14,20,26,32,38,44,50,56,62,68,72,76,79
Avoidance	3, 9,15,21,27,33,39,45,51,57,63,69,73
Attitude toward Email	4,10,16,22,28,34,40,46,52,58,64
Negative Impact	5,11,17,23,29,35,41,47,53,59,65
Productivity	6,12,18,24, 30,36,42,48,54,60,66,70,74,77,80

The assembled instrument used in this current study was forwarded to four experts in the field by the author. The nature and purpose of the study was explained and the parts of the instrument were outlined. The experts were asked to identify items which, in their opinion, should be excluded from the instrument. The experts were also asked to determine if any items were missing and should be added to the instrument; and to examine the instrument and make any suggestions to improve the instrument. Based on the comments of the experts the instrument generally remained as presented with a number of minor corrections.

Instrument Validity and Reliability

A review of the literature was undertaken in order to identify valid instruments to be used in this thesis. The technology needs assessment survey part of the questionnaire used was developed by the Alliance of Connecticut Regional Educational Service Centers, an alliance of six Regional Educational Service Centers which serve the needs of Connecticut's school districts. Their instrument was based on the ISTE foundation standards for all educators (International Society for Technology in Education, 1997) and validated by consultation with experts in the State of Connecticut (Kaplan, 1999).

The TAC part of the questionnaire used in this research was developed by Christensen and Knezek by statistically selecting the strongest indicators from fourteen other instruments with acceptable measurement properties that were reported in the literature. Their instrument measures indices in which validity has been well-established in the literature (Christensen & Knezek, 1996). Construct validity and internal consistency reliability analysis were performed on the TAC by surveying 621 educators in Texas, Florida, New York, and California during 1995-1996. A factor analysis of the individual items was performed and resulted in selections of several factor structures as the most meaningful representations of each domain. The seven factor structure internal consistency measures are found in Table 3.3.

Table 3.3 Internal Consistency Reliability for the TAC

Factor	Cronbach's Alpha
Enthusiasm/Enjoyment	0.9800
Computer Anxiety	0.9800
Computer Avoidance	0.9000
Attitude Toward Email	0.9500
Negative Impact on Society	0.8500
Productivity	0.9600
Kay's Semantic	0.9400

Subsequently, Christensen and Knezek collected TAC data from 91 teachers prior to and after their 6-week training sessions in Port Arthur, Texas. The paired data were viewed a number of ways, including the originally published subscales, and through 7-factor, 10-factor, and 16-factor structures. There was strong evidence that a reduction in anxiety about computers occurred in participants over the course of their training sessions and that the trainees came to perceive a more positive role for Email in classroom learning. These findings were viewed as successful confirmation of the discriminant validity of the TAC (Christensen, 1997; Knezek & Christensen, 1997a; Knezek & Christensen, 1997b). To further verify the internal consistency and robustness of both the competency and attitude scales, Cronbach's alpha reliability coefficients were computed using the data collected for the study (see Chapter 4).

Procedure

In order to proceed with the study it was necessary to obtain the support of School District 3 - Corner Brook, Deer Lake, St. Barbe. In the initial stages of the study the board office was contacted and a meeting arranged with the assistant director. After some discussion, it was decided that this needs assessment was a priority for the board and the board would support the study, administer the instrument and use the data for internal planning. A set of criteria for the study was discussed with the board and the Technology Education Center. The instrument was sent from the board office to schools on February 10, 1999. Schools were asked to cooperate with the study and administer the survey to all teachers. Teachers were asked to cooperate with the study by completing the instrument and returning the completed survey to the designated person within the school. Once the surveys were completed, the school principals were requested to return the surveys to the district office by February 19, 1999. The instruments were collected by the district and forwarded to the researcher.

The participants were informed that the questionnaires would be coded only after being received by the researcher and that no individual would be identified, nor, for the purpose of the study, would any school be identified. A covering letter (Appendix D) explained the purpose of the survey and included that the district had given the researcher permission to use some of the data from the survey for a Master of Education study under the direction of the thesis supervisors and the Faculty of Education, Memorial University of Newfoundland. Instructions for completing the instrument were included.

Data Analysis

All data were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows. Analysis was completed on the responses to all questionnaire items. Descriptive statistics were generated from the demographic questions 1 to 9. These were then used to compile a profile of the questionnaire respondents. A number of groups and subgroups were identified and further analyzed.

Descriptive statistics and analysis of variance (ANOVA) procedures were used to address research questions 1 and 2 which sought to identify differences between various groups and subgroups of teachers on levels of technology competence. Items were grouped into scales and subscales that represented needs for inservice related to technology competencies in identified areas. Cronbach's test of alpha reliability was conducted on each scale and subscale. This process was used to eliminate any possible weaker items, thereby improving the overall reliability of this section of the instrument and making the overall reliability of the instrument more meaningful. An analysis of variance was conducted on each scale and subscale to further determine whether significant differences existed among age, gender, school type, and geographic location. Tukey's HSD post hoc multiple comparison tests were used to identify any significant differences between groups.

Analysis of variance (ANOVA) procedures were used to address research questions 3 and 4 which sought to identify differences between various groups and subgroups of teachers on attitudes towards computer technology. Items were grouped into factors that represented attitudes related to identified areas. Cronbach's test of alpha reliability was conducted on each factor. An analysis of variance was conducted on each factor to further determine whether significant differences existed among age, gender, school type, and geographic location. Tukey HSD post hoc multiple comparison tests were used to identify any significant differences between groups. This is the most common analysis type for uneven groups and was considered the most appropriate post hoc analysis method given the exploratory nature of the study.

Pearson's Product Moment correlation analysis was used to determine the relationship between teachers' attitude toward computers and their level of competency.

Description of Respondents

Overall, 381 responses to the questionnaire out of a potential 540 were received. Questions 1 through 9 enabled the author to compile a descriptive profile of the respondents.

School Type of Respondents

Question 1 asked the respondents to indicate the type of school in which they worked. As can be seen in Table 3.4, of the 377 teachers who responded 36.6 % indicated they work in primary/elementary schools, 11.7% work in junior high schools, 20.7 % worked in senior high schools and 19.1 % work in all-grade schools. The other 11.9 % of teachers work in other types of schools, K-6, K-9, 4-12, 7-12 and 9-12.

Table 3.4 School Type of Respondents

Type of School	n	%
(1) Primary/Elementary	138	36.6
(2) Junior High	44	11.7
(3) Senior High	78	20.7
(4) All - Grade (K-12)	72	19.1
(5) Other	45	11.9
Total	377	100

Gender of Respondents

Responses to the second question are shown in Table 3.5. Fifty-three percent of the respondents were female and 45 % male. Five respondents did not report their gender.

Table 3.5 Gender of Respondents

	n	%
Female	201	53.3
Male	171	45.4
Missing	5	1.3
Total	377	100

Age of Respondents

Question three ascertained the age of respondents. The results are shown in Table 3.6. It is clear that the majority (over 60%) of the respondents were over 40 years of age and few, 7 % of teachers, were under 30 years of age.

Table 3.6 Age Categories of Respondents

Age Ranges (years)	n	%
(1) 20-30	23	6.1
(2) 31-40	108	28.6
(3) 41-50	202	53.6
(4) 50+	33	8.8
Missing	11	2.9
Total	377	100

Teaching Experience of Respondents

Table 3.7 shows the responses from question 4 on teaching experience. Almost half of the teachers responding had 21 years or more teaching experience. A very small number (6.1%) were relatively new teachers.

Table 3.7 Years of Teaching Experience

Teaching Experience (years)	n	%
(1) 1-5	23	6.1
(2) 6-10	48	12.7
(3) 11-15	63	16.7
(4) 16-20	50	13.3
(5) 21-25	82	21.8
(6) 26+	104	27.6
Missing	7	1.9
Total	377	100

Area of Specialization of Respondents

Question 5 was asked to determine the area of specialization of respondents. Results are reported in Table 3.8. A total of 45% of teachers reported their area of specialization as primary/elementary and 54% reported an intermediate/high school area of specialization.

Table 3.8 Area of Specialization of Respondents *

	n	%
Primary/elementary	168	44.9
Intermediate/High	201	53.7
Missing	5	1.4
Total	374	100

* The original question contained four choices: primary, elementary, intermediate, and secondary; there are normally only two designations in Newfoundland: primary/elementary and intermediate/high school.

Degrees Held by Respondents

The study attempted to identify the academic qualifications of the respondents through question 6. As outlined in Table 3.9 the respondents reported that 48.8 % had a Bachelor of Arts Degree, 14.3 % reported a Bachelor of Science Degree, 77.5 % a Bachelor of Education Degree, 4.0 % a Master of Arts in Education, 17.8 % a Master of Education Degree, and 26.5 % reported having a degree other than those listed. Most teachers reported at least two degrees.

Table 3.9 Degrees Held by Respondents

Degrees	n	%
B. A.	184	48.8
B. Sc.	54	14.3
B. Ed.	292	77.5
M. A. (Ed)	15	4
M. Ed.	67	17.8
Other	100	26.5

Previous Training Relevant to Computers and Information Technology

Questions 7, 8 and 9 were included to determine the amount of teacher training in computer and information technology. The number of courses taken by respondents related to computer and information is reported in Table 3.10. The majority (75.6%) of teachers did not have a course, while 18 % had 1-2 courses, 3.4 % had 3-4 courses, and very few teachers (less than 3%) had more than 5 courses.

Table 3.10 Number of Credit or Continuing Education Courses Related to Computers and Technology

Number of Courses	n	%
0	285	75.6
1-2	68	18
3-4	13	3.4
5-6	6	1.6
7-8	1	0.3
9+	3	0.8
Missing	1	0.3
Total	377	100

Table 3.11 reports the number of inservice hours respondents had received related to computers and information technology in the last three years. A significant proportion (26.3 %) received no inservice, 36.7 % received between 1 and 9 hours of inservice, 20.0 % received between 10 and 19 hours of inservice, 9.2 % received between 20 and 29 hours of inservice, and the remainder 7.7 % received more than 30 hours of inservice. Several teachers reported receiving over 100 hours of inservice in the last three years.

Table 3.11 Number of Inservice Hours Related to Computers and Technology

Number of Inservice Hours	n	%
0	99	26.3
0-9	138	36.6
10-19	75	19.9
20-29	35	9.2
30-39	8	2.1
40+	21	5.6
Missing	1	0.3
Total	377	100

The number of institutes respondents participated in related to computers and information technology is reported in Table 3.12 and the number of hours of institute time is reported in Table 3.13. The majority (80.9 %) of teachers had not attended an institute, with 10.1 % having attended one institute, and 3.4 % attended 2 or three institutes.

Table 3.12 Number of Institutes Related to Computers and Technology

Number of Institutes	n	%
0	304	80.9
1	38	10.1
2	21	5.6
3	5	1.3
4	8	2.1
Missing	1	0.3
Total	377	100

Table 3.13 Number of Hours Attending Institutes Related to Computers and Technology

Number of Institute Hours	n	%
0	304	80.6
1-10	30	8
11-20	13	3.4
21-30	12	3.2
31-40	4	1.1
40+	13	3.4
Missing	1	0.3
Total	377	100

Geographic Location of Respondents

Data available from the School Board files allowed locations of schools to be assigned as urban or rural and for the purposes of analysis were coded as urban (1) rural (2). An examination of the data indicated that respondents were reasonably evenly split between urban and rural settings (47.7% and 52.3% respectively).

CHAPTER FOUR

ANALYSIS OF DATA

The analysis of the data collected for the study is presented in this chapter. Tables consisting of descriptive statistics, analysis of variance analyses, and Tukey HSD post hoc multiple comparison tests results, where appropriate, for each of the research questions have been presented. F values, indicating the degree to which relationships are statistically significant, are also presented. Additional statistical analyses were undertaken, as required and are included. A significance level of .05 was considered acceptable. A total of 540 instruments were forwarded to teachers, principals and board personnel in 31 schools; 381 were returned to the researcher from the district office for a return rate of 70 %. Four surveys (1%) were not usable.

Instrument Reliability

A Cronbach coefficient alpha test was used to assess reliability of the data for internal consistency for each of the subscales in the instrument. For part one of the instrument, the Self Assessment of Technology Competencies, the subscales were: productivity - use technology for professional and personal productivity; teaching and learning - integrating technology into the teaching/learning process; and student inquiry - using technology to encourage student inquiry and higher level thinking processes. Respondents were given nine choices on each competency statement on the instrument. The choices were on a continuum ranging from 1 - Not Yet

Ready, 3 - Aware of, 5 - Learning, 7 - Capable and Comfortable, to 9 - Able to Teach Others.

A summary of the results of the Cronbach coefficient alpha analysis, completed for each scale, is reported in Table 4.1 and ranged from .8560 to .9969 on the subscales. For a detailed analysis see Tables E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12 in Appendix E. This analysis consisted of calculation of the correlation coefficients for each scale and subscale of the technology competencies followed by a calculation of Chronbach's alpha coefficient for each scale and subscale.

Table 4.1 Competency Level Scale Reliability Summary

Competency Scale and Subscales	Cronbach's Alpha
Professional Productivity	0.9647
Operate computers, related technologies and software applications	0.9486
Basic	0.9120
Advanced	0.9228
Evaluate technology materials	0.8560
Access Information	0.9228
Integrating Technology	0.9969
Evaluate, select and apply instructional material to the curriculum	0.9301
Use emerging technologies	0.9384
Demonstrate ethical use of technology	0.9189
Student Inquiry	0.9593
Design, develop and support technology activities	0.9531
Use technology in assessing student work	0.8966

For the Teacher Attitudes Toward Computers (TAC) scale, part two of the instrument, the subscales were enthusiasm/enjoyment, anxiety, avoidance, attitude toward email, negative impact on society, and productivity. Respondents were given five choices on each attitudinal statement on this section of the instrument. The choices were S - strongly agree, SA - somewhat agree, U - undecided, SD - somewhat disagree, or D - strongly disagree. For analysis purposes, each choice was assigned a value as follows: Strongly Agree (1), Somewhat Agree (2), Undecided (3), Somewhat Disagree (4), and Strongly Disagree (5).

Results of the Cronbach coefficient alpha analysis reported in summary form in Table 4.2 show that the coefficient ranged from .8466 to .9498 on the attitudinal factors. For a detailed analysis see Tables F1, F2, F3, F4, F5, F6 in Appendix F. The latter consisted of calculation of the correlation coefficients for each of the attitudinal factors followed by a calculation of Chronbach's alpha coefficient for each factor.

Table 4.2 Computer Attitude Factor Reliability Summary

Attitude Factor	Cronbach's Alpha
Enthusiasm/Enjoyment	0.9379
Computer Anxiety	0.9498
Computer Avoidance	0.7977
Attitude Toward Email	0.9197
Negative Impact	0.8466
Productivity	0.8729

Research Question 1

Research Question 1: What is the level of computer and information technology competencies of Newfoundland and Labrador teachers with respect to the ISTE standards ?

In order to address this question, the 48 items were grouped into the three competency scales, each with a number of subscales for analysis purposes. Means and standard deviations are reported in Table 4.3.

An overall examination of the scales and subscales reveals that the means were generally low (less than 5 on a scale of 1 to 9) and standard deviations (spread of scores) were small. The professional productivity scale (mean=4.15, SD=1.9) suggested that the majority of teachers tended not to rate their abilities to use technology for professional and personal productivity very high, and were generally at a stage where they were "Aware of" the competencies but had yet to learn them. On examining the subscales of professional productivity it is evident that teachers tended to rate themselves with highest competency in the basic computer operations subscale of operate computers, related technologies and software applications (mean = 4.90) and with lower competency in the advanced subscale (mean= 3.06).

In the integrating technology scale, the majority of teachers again tended to rate themselves as competent on those skills in the lower half of the range. The highest ranking (mean=4.17) was on the demonstrate ethical use of technology subscale. The lowest scores of all were in their perceived competencies with respect

Table 4.3 Teacher Rankings of their Competency Level

Competency Scale and Subscales	n	mean *	SD
Professional Productivity	364	4.15	1.9
Operate computers, related technologies and software applications	366	3.99	2.0
Basic	368	4.90	2.1
Advanced	370	3.06	2.0
Evaluate technology materials	371	4.33	2.2
Access Information	371	4.49	2.3
Integrating Technology	358	3.27	1.8
Evaluate, select and apply instructional material to the curriculum	368	3.34	1.9
Use emerging technologies	362	2.76	1.8
Demonstrate ethical use of technology	365	4.17	2.4
Student Inquiry	362	3.32	2.0
Design, develop and support technology activities	363	3.58	2.2
Use technology in assessing student work	368	2.68	1.9

* Larger mean represents more technology competency
(range1- Not Yet Aware 9- Able to Teach Others)

to using emerging technologies (mean = 2.76) and using technology to assess student work (mean=2.68). Teachers also tended to rank themselves rather low (mean=3.32) in the student inquiry scale and slightly higher (mean = 3.58) in the design, develop and support technology activities subscale.

Research Question 2

Research Question 2: How do Newfoundland and Labrador teachers vary with respect to their level of computer and information technology competencies when analyzed by selected demographic information and other characteristics (gender, age, school type, and geographic location)?

To answer this question the responses of teachers were analyzed separately by each of the selected demographics of gender, age, school type, and geographic location. Descriptive statistics were computed for each demographic variable and analysis of variance (ANOVA) statistics were used to make comparisons between group variables. Tukey HSD post hoc multiple comparisons were completed in instances where it was necessary to distinguish significance levels of categories within demographic variables. The following sections outline the results of the analysis.

Gender and Technology Competencies

Tables 4.4 and 4.5 contain the descriptive statistics and analysis of variance results with respect to teachers' technology competence and gender differences. The means in column 3 of Table 4.4 indicates both groups tended to rank themselves on the lower portion of the assessment scale.

Examining the means for each of the scales and subscales for gender differences reveals that, on all scales, males perceptions of their levels of technology competencies were higher. Male mean ranks were approximately one scale position higher on each of these scales and subscales than female ranks. This indicated that overall males perceived themselves as having more computer and technology competency than females. ANOVA results (Table 4.5) verify these findings exist and that there were significant differences ($p>.001$) between

Table 4.4 Descriptive Statistics of Competency Level by Gender

Competency Scale and Subscales	n	mean *	SD
Professional Productivity			
Female	193	3.67	1.7
Male	171	4.69	2.1
Total	364	4.15	1.9
Operate computers, related technologies and software applications			
Female	194	3.48	1.6
Male	172	4.56	2.2
Total	366	3.99	2.0
Basic			
Female	196	4.43	1.9
Male	172	5.44	2.2
Total	368	4.90	2.1
Advanced			
Female	198	2.52	1.6
Male	172	3.68	2.3
Total	370	3.06	2.0
Evaluate technology materials			
Female	200	4.09	2.0
Male	171	4.61	2.3
Total	371	4.33	2.2
Access Information			
Female	199	3.97	2.0
Male	172	5.10	2.4
Total	371	4.49	2.3
Integrating Technology			
Female	189	2.87	1.6
Male	169	3.71	2.0
Total	358	3.27	1.8
Evaluate, select and apply instructional material			
Female	197	2.95	1.7
Male	171	3.79	2.1
Total	368	3.34	1.9
Use emerging technologies			
Female	192	2.34	1.4
Male	170	3.24	2.1
Total	362	2.76	1.8
Demonstrate ethical use of technology			
Female	193	3.88	2.3
Male	172	4.50	2.4
Total	365	4.17	2.4
Student Inquiry			
Female	194	2.96	1.8
Male	168	3.73	2.2
Total	362	3.32	2.0
Design, develop and support technology activities			
Female	194	3.28	2.0
Male	169	3.92	2.4
Total	363	3.58	2.2
Use technology in assessing student work			
Female	198	2.22	1.6
Male	170	3.22	2.1
Total	368	2.68	1.9

* Larger mean represents more Technology Competency
(range1- Not Yet Aware 9- Able to Teach Others)

Table 4.5 ANOVA Statistics of Competency Level by Gender

Competency Scale and Subscales	Sum of Squares	df	F	Sig.
Professional Productivity				
Between Groups	93.732	1	26.637	0.000
Within Groups	1273.808	362		
Total	1367.539	363		
Operate computers, related technologies and software applications				
Between Groups	105.937	1	29.130	0.000
Within Groups	1323.753	364		
Total	1429.69	365		
Basic				
Between Groups	92.713	1	21.889	0.000
Within Groups	1550.209	366		
Total	1642.923	367		
Advanced				
Between Groups	124.553	1	32.639	0.000
Within Groups	1404.311	368		
Total	1528.864	369		
Evaluate technology materials				
Between Groups	25.1	1	5.471	0.000
Within Groups	1693.004	369		
Total	1718.104	370		
Access Information				
Between Groups	116.208	1	24.010	0.000
Within Groups	1785.966	369		
Total	1902.174	370		
Integrating Technology				
Between Groups	62.641	1	19.291	0.000
Within Groups	1155.973	356		
Total	1218.615	357		
Evaluate, select and apply instructional material				
Between Groups	64.644	1	17.861	0.000
Within Groups	1324.641	366		
Total	1389.285	367		
Use emerging technologies				
Between Groups	74.155	1	23.587	0.000
Within Groups	1131.814	360		
Total	1205.969	361		
Demonstrate ethical use of technology				
Between Groups	34.885	1	6.360	0.012
Within Groups	1991.193	363		
Total	2026.078	364		
Student Inquiry				
Between Groups	52.817	1	13.090	0.000
Within Groups	1452.56	360		
Total	1505.377	361		
Design, develop and support technology activities				
Between Groups	37.546	1	7.912	0.005
Within Groups	1713.148	361		
Total	1750.694	362		
Use technology in assessing student work				
Between Groups	91.196	1	25.973	0.000
Within Groups	1285.086	366		
Total	1376.282	367		

female and male ranking of their technology competency on all scales and subscales.

Age and Technology Competencies

Descriptive statistics and an analysis of variance were carried out comparing competence levels on the scales and subscales by age group and are reported in Tables 4.6 and 4.7.

Examining the means of the competency levels by age group (Table 4.6) indicates that there was a trend in the data. In each scale and subscale the means of group 1 (20-30 years) was higher than the means of the rest of the age groups. The rankings from highest to lowest were Group 1, 2, 4 and then 3 for each scale and subscale. Generally, therefore, the mean of the groups decreased with age, indicating that younger teachers considered themselves more competent. Group 3 (41-50 years) appeared to be an anomaly, ranking last in competence on every scale and subscale.

This apparent trend was tested using analysis of variance procedures. The results are shown in Table 4.7, and indicated significant differences between age groups in all the competency scales and sub-scales at the $p=0.05$ level or less.

Further analysis in the form of post hoc multiple comparisons (Tukey HSD) tests were run on the data to identify differences between specific groups (see Table 4.8). The main groups showing significant differences were the 20-30 years and 41-50 years age groups. These groups showed significant differences on all the main

Table 4.6 Descriptive Statistics of Competency Level by Age Group

Competency Scale and Subscales	n	mean *	SD
Professional Productivity			
Group 1: 20-30	22	5.30	2.0
Group 2: 31-40	107	4.50	1.8
Group 3: 41-50	198	3.87	1.9
Group 4: 50+	32	4.25	2.0
Total	359	4.18	1.9
Operate computers, related technologies and software applications			
Group 1: 20-30	22	5.12	2.0
Group 2: 31-40	107	4.33	1.9
Group 3: 41-50	200	3.72	2.0
Group 4: 50+	32	4.08	2.0
Total	361	4.02	2.0
Basic			
Group 1: 20-30	23	6.00	2.0
Group 2: 31-40	107	5.31	1.9
Group 3: 41-50	200	4.59	2.2
Group 4: 50+	33	5.07	2.2
Total	363	4.94	2.1
Advanced			
Group 1: 20-30	22	4.12	2.3
Group 2: 31-40	108	3.33	2.0
Group 3: 41-50	202	2.83	2.0
Group 4: 50+	32	3.14	2.0
Total	364	3.08	2.0
Evaluate technology materials			
Group 1: 20-30	23	5.35	2.1
Group 2: 31-40	108	4.71	2.2
Group 3: 41-50	201	4.05	2.1
Group 4: 50+	33	4.36	2.3
Total	365	4.36	2.2
Access Information			
Group 1: 20-30	23	5.62	2.5
Group 2: 31-40	108	4.81	2.1
Group 3: 41-50	201	4.19	2.3
Group 4: 50+	33	4.77	2.4
Total	365	4.52	2.3
Integrating Technology			
Group 1: 20-30	23	4.15	1.9
Group 2: 31-40	102	3.50	1.8
Group 3: 41-50	196	3.05	1.8
Group 4: 50+	31	3.48	1.9
Total	352	3.29	1.9
Evaluate, select and apply instructional material to the curriculum			
Group 1: 20-30	23	4.23	2.0
Group 2: 31-40	106	3.54	1.9
Group 3: 41-50	200	3.15	1.9
Group 4: 50+	33	3.45	2.1
Total	362	3.36	2.0

* Larger mean represents a higher degree of Technology Competency

Table 4.6 (Continued)

Competency Scale and Subscales	n	mean *	SD
Use emerging technologies			
Group 1: 20-30	23	3.63	1.9
Group 2: 31-40	104	2.94	1.8
Group 3: 41-50	198	2.58	1.8
Group 4: 50+	31	2.90	1.8
Total	356	2.78	1.8
Demonstrate ethical use of technology			
Group 1: 20-30	23	5.04	2.5
Group 2: 31-40	105	4.54	2.3
Group 3: 41-50	200	3.86	2.3
Group 4: 50+	31	4.66	2.6
Total	359	4.20	2.4
Student Inquiry			
Group 1: 20-30	23	4.41	2.0
Group 2: 31-40	106	4.00	2.0
Group 3: 41-50	195	3.07	2.1
Group 4: 50+	32	3.55	1.9
Total	356	3.35	2.0
Design, develop and support technology activities			
Group 1: 20-30	23	4.74	2.2
Group 2: 31-40	106	3.91	2.1
Group 3: 41-50	196	3.30	2.2
Group 4: 50+	32	3.79	2.0
Total	357	3.62	2.2
Use technology in assessing student work			
Group 1: 20-30	23	3.65	1.9
Group 2: 31-40	107	2.83	2.0
Group 3: 41-50	200	2.49	1.9
Group 4: 50+	32	2.97	1.9
Total	362	2.71	1.9

* Larger mean represents a higher degree of Technology Competency
(range1- Not Yet Aware 9- Able to Teach Others)

scales and all the subscales except the demonstrate ethical use of technology subscale. In all these cases the mean for group 1 (20-30 years) was significantly higher than that of group 3 (41-50 years). This indicated that 20-30 years age group considered themselves to have greater competency levels than 41-50 years age group on those scales and subscales.

As reported in Table 4.8, significant differences were found between group 2 (31-40 years) and group 3 (42-50 years) for the professional productivity scale, the

Table 4.7 ANOVA Statistics of Teacher Competency Level by Age Category

Competency Scale and Subscales	Sum of Squares	df	F	Sig.
Professional Productivity				
Between Groups	57.22	3	5.268	0.001
Within Groups	1285.251	355		
Total	1342.471	358		
Operate computers, related technologies and software applications				
Between Groups	55.19	3	4.870	0.002
Within Groups	1348.528	357		
Total	1403.718	360		
Basic				
Between Groups	65.575	3	5.104	0.002
Within Groups	1537.447	359		
Total	1603.022	362		
Advanced				
Between Groups	43.243	3	3.539	0.015
Within Groups	1466.228	360		
Total	1509.472	363		
Evaluate technology materials				
Between Groups	54.161	3	3.975	0.008
Within Groups	1639.411	361		
Total	1693.572	364		
Access Information				
Between Groups	60.257	3	4.005	0.008
Within Groups	1810.394	361		
Total	1870.651	364		
Integrating Technology				
Between Groups	34.218	3	3.389	0.018
Within Groups	1171.355	348		
Total	1205.573	351		
Evaluate, select and apply instructional material to the curriculum				
Between Groups	29.676	3	2.636	0.050
Within Groups	1343.387	358		
Total	1373.063	361		
Use emerging technologies				
Between Groups	27.199	3	2.729	0.044
Within Groups	1169.539	352		
Total	1196.738	355		
Demonstrate ethical use of technology				
Between Groups	59.106	3	3.619	0.013
Within Groups	1932.502	355		
Total	1991.609	358		
Student Inquiry				
Between Groups	49.257	3	4.032	0.008
Within Groups	1433.287	352		
Total	1482.544	355		
Design, develop and support technology activities				
Between Groups	58.780	3	4.156	0.007
Within Groups	1664.328	353		
Total	1723.108	356		
Use technology in assessing student work				
Between Groups	33.907	3	3.051	0.029
Within Groups	1326.027	358		
Total	1359.934	361		

operate computers, related technologies and software applications, basic computer operations, and the evaluate technology materials subscales. The means for group 2 were significantly higher than the means for group 3 on this scale and its subscales.

Even though ANOVA results indicated significant differences between groups on the demonstrate ethical use of technology subscale, Tukey HSD post hoc analysis (Table 4.8) could not confirm significant differences between groups on this subscale. The calculated significance value between group 2 and group 3 were close to the accepted limit, but not significant at the .05 level.

School Type and Technology Competencies

Statistical analysis including analysis of variance was carried out comparing competence levels by school type. An examination of the descriptive data (Table 4.9) shows that high school teachers ranked themselves highest in competency of all teachers in the other school types on all scales and subscales.

Among the groups, primary/elementary teachers ranked themselves lowest in all the scales and subscales except on the student inquiry subscale of develop, design and support technology activities where they ranked themselves (mean=3.29), slightly higher than the other group (mean=3.23). A closer examination of the means suggested a trend in group rankings. From highest to

Table 4.8 Results of the Tukey HSD multiple comparison tests by Age Category

Competency Scale and Subscales					
Professional Productivity		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 22	n = 107	n = 32	n = 198
	Mean	5.30	4.50	4.25	3.87
Operate computers, related technologies and software applications		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 22	n = 107	n = 32	n = 200
	Mean	5.12	4.33	4.08	3.72
Basic		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 107	n = 33	n = 200
	Mean	6.00	5.31	5.07	4.59
Advanced		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 22	n = 108	n = 32	n = 202
	Mean	4.12	3.33	3.14	2.83
Evaluate technology materials		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 108	n = 33	n = 201
	Mean	5.35	4.71	4.36	4.05
Access Information		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 108	n = 33	n = 201
	Mean	5.62	4.81	4.77	4.19
Integrating Technology		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 102	n = 31	n = 196
	Mean	4.15	3.50	3.48	3.05

(Continued)

Table 4.8 (Continued)

Competency Scale and Subscales					
Evaluate, select and apply instructional material to the curriculum		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 106	n = 33	n = 200
	Mean	4.23	3.54	3.45	3.15
Use emerging technologies		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 104	n = 31	n = 198
	Mean	3.63	2.94	2.90	2.58
Demonstrate ethical use of technology		Group 1	Group 4	Group 2	Group 3
		20-30	50+	31-40	41-50
		n = 23	n = 31	n = 105	n = 200
	Mean	5.04	4.66	4.54	3.86
Student Inquiry		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 106	n = 32	n = 195
	Mean	4.41	4.00	3.55	3.07
Design, develop and support technology activities		Group 1	Group 2	Group 4	Group 3
		20-30	31-40	50+	41-50
		n = 23	n = 106	n = 32	n = 196
	Mean	4.74	3.91	3.79	3.30
Use technology in assessing student work		Group 1	Group 4	Group 2	Group 3
		20-30	50+	31-40	41-50
		n = 23	n = 32	n = 107	n = 200
	Mean	3.65	2.97	2.83	2.49

lowest the general rankings were: (1) high school, (2) junior high, (3) all-grade, (4) other, and (5) primary/elementary. Junior high teachers ranked themselves second on 7 scales/subscales and third on 6 scales/subscales. All-grade teachers ranked themselves second on 6 scales and subscales and third on 7 scales and subscales.

Table 4.9 Descriptive Statistics of Competency Level by School Type

Competency Scale and Subscales	n	mean *	SD
Professional Productivity			
Primary/Elementary	133	3.53	1.8
Junior High	44	4.36	1.6
High School	78	4.89	2.2
All - Grade	70	4.44	1.7
Other	44	4.01	2.0
Total	369	4.14	1.9
Operate computers, related technologies and software applications			
Primary/Elementary	134	3.32	1.7
Junior High	44	4.24	1.7
High School	78	4.78	2.2
All - Grade	71	4.22	1.8
Other	44	3.91	2.1
Total	371	3.98	2.0
Basic			
Primary/Elementary	135	4.15	2.0
Junior High	44	5.25	1.9
High School	78	5.80	2.2
All - Grade	71	5.12	1.9
Other	45	4.85	2.2
Total	373	4.89	2.1
Advanced			
Primary/Elementary	137	2.46	1.7
Junior High	44	3.23	1.9
High School	78	3.77	2.5
All - Grade	72	3.29	1.9
Other	44	3.02	2.1
Total	375	3.05	2.0
Evaluate technology materials			
Primary/Elementary	137	3.88	2.0
Junior High	44	4.55	2.1
High School	78	4.79	2.4
All - Grade	72	4.67	2.0
Other	45	4.17	2.3
Total	376	4.33	2.1
Access Information			
Primary/Elementary	138	3.83	2.2
Junior High	44	4.57	2.1
High School	78	5.29	2.4
All - Grade	71	4.99	1.9
Other	45	4.24	2.3
Total	376	4.49	2.3
Integrating Technology			
Primary/Elementary	129	2.83	1.7
Junior High	43	3.33	1.6
High School	78	3.88	2.1
All - Grade	70	3.38	1.7
Other	43	3.21	1.9
Total	363	3.27	1.8

* Larger mean represents a higher degree of Technology Competency

Table 4.9 (Continued)

Competency Scale and Subscales	n	mean*	SD
Evaluate, select and apply instructional material to the curriculum			
Primary/Elementary	135	2.85	1.8
Junior High	44	3.48	1.7
High School	78	4.04	2.2
All - Grade	71	3.58	1.8
Other	45	3.12	2.0
Total	373	3.34	1.9
Use emerging technologies			
Primary/Elementary	132	2.35	1.6
Junior High	43	2.83	1.6
High School	78	3.39	2.1
All - Grade	71	2.77	1.7
Other	43	2.80	1.9
Total	367	2.76	1.8
Demonstrate ethical use of technology			
Primary/Elementary	132	3.79	2.3
Junior High	44	4.26	2.5
High School	78	4.57	2.4
All - Grade	72	4.34	2.3
Other	44	4.15	2.2
Total	370	4.16	2.4
Student Inquiry			
Primary/Elementary	132	2.94	1.8
Junior High	44	3.50	1.8
High School	77	4.04	2.4
All - Grade	69	3.27	2.0
Other	45	3.06	2.0
Total	367	3.32	2.0
Design, develop and support technology activities			
Primary/Elementary	133	3.29	2.0
Junior High	44	3.76	2.0
High School	77	4.24	2.5
All - Grade	69	3.52	2.2
Other	45	3.23	2.2
Total	368	3.58	2.0
Use technology in assessing student work			
Primary/Elementary	136	2.09	1.6
Junior High	44	2.90	1.7
High School	77	3.57	2.3
All - Grade	71	2.71	2.0
Other	45	2.67	1.8
Total	373	2.68	1.9

* Larger mean represents a higher degree of Technology Competency
(range1- Not Yet Aware 9- Able to Teach Others)

The survey of high school teachers mean ranges (from mean=3.77 to mean=5.80) on the professional productivity subscale indicated that they were generally "Aware of" and "Learning" about computer technology for professional productivity. On the same subscale primary elementary teachers (mean=2.46 to mean=4.15) were generally "Not Yet Ready" or were "Aware of" computer technology for professional productivity. The teachers in the rest of the school types mean rankings fell somewhere between "Aware of" and "Learning" about computer technology for professional productivity.

Within the other two scales, integrating technology (mean=3.39 to mean=4.57) and student inquiry (mean=3.57 to mean=4.04), high school teachers in general were becoming "Aware of" and "Learning" about integrating computer technology and using it to support student inquiry. Primary and elementary teachers were generally "Not Yet Ready" to integrate and were becoming "Aware of" integrating technology (mean=2.35 to mean=3.79) and using technology to support student inquiry (mean=2.09 to mean=2.94). The other mean ranges of the teachers in the rest of the school types fell between the mean ranges of primary/elementary and high school groups.

To verify these observations based on the descriptive statistics, ANOVA procedures were completed on the data (refer to Table 4.10). These analyses revealed significant differences ($p>.05$), between teachers based on the school type in which they teach, on all scales and subscales except on the demonstrating ethical use of technology subscale.

Table 4.10 ANOVA Statistics of Competency Level by School Type

Competency Scale and Subscales	Sum of Squares	df	F	Sig.
Professional Productivity				
Between Groups	103.262	4	7.400	.000
Within Groups	1269.851	364		
Total	1373.112	368		
Operate computers, related technologies and software applications				
Between Groups	116.656	4	8.088	.000
Within Groups	1319.716	366		
Total	1436.372	370		
Basic				
Between Groups	148.358	4	9.088	.000
Within Groups	1501.789	368		
Total	1650.147	372		
Advanced				
Between Groups	92.766	4	5.939	.000
Within Groups	1444.838	370		
Total	1537.604	374		
Evaluate technology materials				
Between Groups	55.238	4	3.060	.017
Within Groups	1674.317	371		
Total	1729.554	375		
Access Information				
Between Groups	130.702	4	6.807	.000
Within Groups	1781.005	371		
Total	1911.707	375		
Integrating Technology				
Between Groups	54.554	4	4.147	.003
Within Groups	1177.276	358		
Total	1231.829	362		
Evaluate, select and apply instructional material to the curriculum				
Between Groups	77.577	4	5.368	.000
Within Groups	1329.489	368		
Total	1407.066	372		
Use emerging technologies				
Between Groups	53.383	4	4.163	.003
Within Groups	1160.485	362		
Total	1213.868	366		
Demonstrate ethical use of technology				
Between Groups	33.593	4	1.518	.196
Within Groups	2019.856	365		
Total	2053.449	369		
Student Inquiry				
Between Groups	63.363	4	3.944	.004
Within Groups	1454.085	362		
Total	1517.448	366		
Design, develop and support technology activities				
Between Groups	52.705	4	2.796	.026
Within Groups	1710.469	363		
Total	1763.175	367		
Use technology in assessing student work				
Between Groups	110.067	4	7.917	.000
Within Groups	1279.088	368		
Total	1389.155	372		

Post hoc multiple comparisons (Tukey HSD) tests were run on the data to determine which groups were significantly different and are reported in Table 4.11. On the professional productivity scale post hoc analysis revealed significant differences only between primary/elementary (mean=3.53) and high school teachers (mean=4.89) and primary/elementary (mean=3.53) and all-grade schools (mean=4.44). Both the high school teachers and all-grade teachers ranked themselves as having significantly more technology competency than primary/elementary teachers.

On the operate computer, related technologies and software applications subscale there were significant differences between primary/elementary and junior high teachers, primary/elementary and high school teachers and primary/elementary and all-grade teachers. The three groups, junior high (mean=4.24), high school (mean=4.78) and all-grade (mean=4.22) teachers ranked themselves as having significantly more technology competency than primary/elementary (mean=3.32) teachers.

On the subgroups of the operate computers, related technologies and software applications scale, Tukey HSD tests revealed that there were significant differences in the basic operate computers subscale between primary/elementary and junior high school teachers, primary/elementary and high school, and primary/elementary and all-grade school teachers. Again, the three teacher groups, junior high (mean=5.25), high school (mean=5.80), and all-grade (mean=5.12)

Table 4.11 Tukey HSD Multiple Comparison Tests by School Type

Competency Scale and Subscales						
Professional Productivity		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	70	44	44	133
	Mean	4.89	4.44	4.36	4.01	3.53
Operate computers, related technologies and software applications		High Sch.	Jr. High	All-Grade	Other	Prim/Elem
		78	44	71	44	134
	Mean	4.78	4.24	4.22	3.91	3.32
Basic		High Sch.	Jr. High	All-Grade	Other	Prim/Elem
		78	44	71	45	135
	Mean	5.80	5.25	5.12	4.85	4.15
Advanced		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	72	44	44	137
	Mean	3.77	3.29	3.23	3.02	2.46
Evaluate technology materials		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	72	44	45	137
	Mean	4.79	4.67	4.55	4.17	3.88
Access Information		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	71	44	45	138
	Mean	5.29	4.99	4.57	4.24	3.83
Integrating Technology		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	70	43	43	129
	Mean	3.88	3.38	3.33	3.21	2.83
Evaluate, select and apply instructional material to the curriculum		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	71	44	45	135
	Mean	4.04	3.58	3.48	3.12	2.85
Use emerging technologies		High Sch.	Jr. High	Other	All-Grade	Prim/Elem
		78	43	43	71	132
	Mean	3.39	2.83	2.80	2.77	2.35
Demonstrate ethical use of technology		High Sch.	All-Grade	Jr. High	Other	Prim/Elem
		78	72	44	44	132
	Mean	4.57	4.34	4.26	4.15	3.79
Student Inquiry		High Sch.	Jr. High	All-Grade	Other	Prim/Elem
		77	44	69	45	132
	Mean	4.04	3.50	3.27	3.06	2.94
Design, develop and support technology activities		High Sch.	Jr. High	All-Grade	Prim/Elem	Other
		77	44	69	133	45
	Mean	4.24	3.76	3.52	3.29	3.23
Use technology in assessing student work		High Sch.	Jr. High	All-Grade	Other	Prim/Elem
		77	44	71	45	136
	Mean	3.57	2.90	2.71	2.67	2.09

ranked themselves as having significantly more technology competency than the primary/elementary (mean=4.15) teachers. The analysis of the advanced operate computers subscale shows significant differences only between primary/elementary and high school and primary/elementary and all-grade teachers. The high school (mean=3.77) and the all-grade (mean=3.29) teachers ranked themselves as having significantly more technology competency than primary/elementary (mean=2.46) group.

Tukey HSD analysis revealed significant differences between primary/elementary and high school teacher groups on the evaluate technology materials subscale. High school teachers tended to rank themselves as having significantly more competency on this subscale than primary/elementary teachers.

Post hoc analysis of the integrating technology scale and its subscales identifies significant differences only between groups on the major scale and the subscales evaluate, select and apply instructional materials and use emerging technology. On both scales the high school teachers mean rank was higher than the primary/elementary mean rank indicating again, that the high school teachers ranked themselves as having significantly more technology competency than primary/elementary teachers on those scales. There were no significant differences between groups on the demonstrate ethical use of technology subscale.

ANOVA analysis of the student inquiry scale revealed significant differences in the scale and its subscales, design, develop and support technology activities and use technology in assessing student work. Tukey HSD post hoc analysis identified significant differences between primary/elementary and high school teachers on this scale and its subscales. Primary/elementary (mean=2.94) teachers ranked themselves as having significantly less competency than high school teachers (mean=4.04).

Geographic Location and Technology Competencies

An examination of the descriptive statistics for teacher competency by geographic location (Table 4.12) reveals some differences between urban and rural teachers. Rural teachers tended to rank themselves slightly higher than urban teachers in the professional productivity scale and its subscales. On the integrating technology scale rural teachers again ranked themselves higher than urban teachers. The mean difference on the student inquiry scale was small with rural teachers ranking themselves higher on the student inquiry scale and the use technology in assessing student work subscale. Urban teachers ranked themselves slightly higher than rural teachers on the design, develop and support technology activities subscale.

These findings indicate that rural teachers may have slightly higher computer and technology competencies than did urban teachers. However, a further examination using ANOVA statistics (Table 4.13) revealed that the rural - urban differences were not significant at the 0.05 level for any of the scales or subscales.

Table 4.12 Descriptive Statistics of Teacher Competency by Geographic Location

Competency Scale and Subscales	n	mean *	SD
Professional Productivity			
Urban	178	4.04	1.9
Rural	191	4.25	2.0
Total	369	4.14	1.9
Operate computers, related technologies and software applications			
Urban	178	3.89	1.9
Rural	193	4.06	2.1
Total	371	3.98	2.0
Basic			
Urban	179	4.87	2.1
Rural	194	4.91	2.2
Total	373	4.89	2.1
Advanced			
Urban	180	2.90	1.9
Rural	195	3.19	2.1
Total	375	3.05	2.0
Evaluate technology materials			
Urban	181	4.14	2.2
Rural	195	4.51	2.1
Total	376	4.33	2.1
Access Information			
Urban	181	4.33	2.3
Rural	195	4.64	2.2
Total	376	4.49	2.3
Integrating Technology			
Urban	174	3.15	1.8
Rural	189	3.37	1.9
Total	363	3.27	1.8
Evaluate, select and apply instructional material to the curriculum			
Urban	179	3.23	1.9
Rural	194	3.45	2.0
Total	373	3.34	1.9
Use emerging technologies			
Urban	175	2.69	1.7
Rural	192	2.83	1.9
Total	367	2.76	1.8
Demonstrate ethical use of technology			
Urban	177	3.97	2.4
Rural	193	4.33	2.3
Total	370	4.16	2.4
Student Inquiry			
Urban	180	3.30	2.0
Rural	187	3.33	2.1
Total	367	3.32	2.0
Design, develop and support technology activities			
Urban	180	3.60	2.2
Rural	188	3.56	2.2
Total	368	3.58	2.2
Use technology in assessing student work			
Urban	181	2.59	1.8
Rural	192	2.76	2.0
Total	373	2.68	1.9

* Larger mean represents more technology competency (range1- Not Yet Aware 9- Able to Teach Others)

Table 4.13 ANOVA Statistics of Teacher Competency by Geographic Location

Competency Scale and Subscales	Sum of Squares	df	F	Sig.
Professional Productivity				
Between Groups	4.053	1	1.086	0.298
Within Groups	1369.06	367		
Total	1373.112	368		
Operate computers, related technologies and software applications				
Between Groups	2.388	1	0.615	0.434
Within Groups	1433.984	369		
Total	1436.372	370		
Basic				
Between Groups	0.163	1	0.037	0.848
Within Groups	1649.984	371		
Total	1650.147	372		
Advanced				
Between Groups	7.674	1	1.871	0.172
Within Groups	1529.93	373		
Total	1537.604	374		
Evaluate technology materials				
Between Groups	12.812	1	2.791	0.096
Within Groups	1716.743	374		
Total	1729.554	375		
Access Information				
Between Groups	8.851	1	1.740	0.188
Within Groups	1902.856	374		
Total	1911.707	375		
Integrating Technology				
Between Groups	4.703	1	1.384	0.240
Within Groups	1227.126	361		
Total	1231.829	362		
Evaluate, select and apply instructional material to the curriculum				
Between Groups	4.572	1	1.210	0.272
Within Groups	1402.494	371		
Total	1407.066	372		
Use emerging technologies				
Between Groups	1.717	1	0.517	0.473
Within Groups	1212.151	365		
Total	1213.868	366		
Demonstrate ethical use of technology				
Between Groups	12.042	1	2.171	0.142
Within Groups	2041.407	368		
Total	2053.449	369		
Student Inquiry				
Between Groups	0.06486	1	0.016	0.902
Within Groups	1517.384	365		
Total	1517.448	366		
Design, develop and support technology activities				
Between Groups	0.196	1	0.041	0.840
Within Groups	1762.978	366		
Total	1763.175	367		
Use technology in assessing student work				
Between Groups	2.554	1	0.683	0.409
Within Groups	1386.601	371		
Total	1389.155	372		

Question 3

What is the current attitude of Newfoundland and Labrador teachers toward computer and information technologies (scales: enthusiasm/enjoyment, anxiety, avoidance, attitude toward email, negative impact on society, productivity)?

Analysis of the computer attitude data (Table 4.14) revealed that the attitudes of the majority of teachers toward computer technology measured with the TAC instrument was generally positive. This revealed that the majority of teachers were somewhat enthusiastic about and derived enjoyment from working with computers. The means of the computer avoidance and computer productivity factors were again relatively low which indicated that the majority of teachers did not avoid computers and thought they were a positive productivity tool. Computer anxiety and attitude toward email factor means were still positive, but slightly higher (less positive) than the other factor means on the Attitude Scale.

Table 4.14 Computer Attitude of the District Teachers

Attitude Scale	N	$\overline{X}$ *	SD
Enthusiasm/Enjoyment	346	1.90	0.7
Computer Anxiety	358	2.26	1.0
Computer Avoidance	348	1.52	0.4
Attitude Toward Email	353	2.39	0.6
Negative Impact	347	2.22	0.7
Productivity	348	1.77	0.5

* Smaller mean represents more positive attitudes (range1-5)

Question 4

How do Newfoundland and Labrador teachers vary with respect to their attitude toward computer and information technologies when analyzed by selected demographic information and other characteristics (gender, age school type and geographic location)?

To answer question 4 the responses of teachers were analyzed by the selected demographics of gender, age, school type, and geographic location. ANOVA statistics were generated and, where further comparison between variable groups were applicable, Tukey HSD post hoc multiple comparisons were performed. The following sections outline the results of these analyses.

Gender and Computer Attitude

Tables 4.15 and 4.16 show the descriptive statistics and ANOVA results used to compare gender and the six TAC factors. A review of the descriptive statistics (Table 4.15) for the TAC scale by gender reveals a number of differences.

On the enthusiasm/enjoyment scale, males (mean=1.89) had a tendency to indicate more enthusiasm and enjoyment than females (mean=1.92). On the computer anxiety factor males (mean=2.11) tended to be less anxious about computer technology than females (mean=2.40). The means of the computer avoidance factor shows that females (mean=1.51) indicated that they avoided use of computers slightly less than males (mean=1.53). Males and females had the same mean score (mean=2.39) on the attitude toward email scale. Examining the data on

Table 4.15 Descriptive Statistics of Computer Attitude by Gender

Attitude Scale	n	mean *	SD
Enthusiasm/Enjoyment			
Female	184	1.92	0.7
Male	162	1.89	0.6
Total	346	1.90	0.7
Computer Anxiety			
Female	190	2.40	1.0
Male	168	2.11	0.9
Total	358	2.26	1.0
Computer Avoidance			
Female	189	1.51	0.4
Male	159	1.53	0.4
Total	348	1.52	0.4
Attitude Toward Email			
Female	190	2.39	0.7
Male	163	2.39	0.6
Total	353	2.39	0.6
Negative Impact			
Female	184	2.15	0.7
Male	163	2.31	0.7
Total	347	2.22	0.7
Productivity			
Female	188	1.75	0.5
Male	160	1.78	0.5
Total	348	1.77	0.5

* Smaller mean represents a more positive attitude
(ranging from 1 -strongly agree to 5 strongly disagree)

the negative impact on society factor showed that females (mean=2.15) tended to have a more positive view of the impact of computers on society than males (mean=2.31). On the computer productivity factor females (mean=1.75) indicated a slightly more positive attitude than males (mean=1.78). From the analysis of variance (Table 4.16) it was found that there were no significant differences between males and females on four of the six attitude factors.

Table 4.16 ANOVA Statistics for Computer Attitude Scale by Gender

Attitude Scale	Sum of Squares	df	F	Sig.
Enthusiasm/Enjoyment				
Between Groups	0.06774	1	0.147	0.702
Within Groups	158.923	344		
Total	158.99	345		
Computer Anxiety				
Between Groups	7.576	1	8.542	0.004
Within Groups	315.747	356		
Total	323.324	357		
Computer Avoidance				
Between Groups	0.0319	1	0.167	0.683
Within Groups	66.188	346		
Total	66.22	347		
Attitude Toward Email				
Between Groups	0.000512	1	0.001	0.972
Within Groups	146.688	351		
Total	146.689	352		
Negative Impact				
Between Groups	2.239	1	4.873	0.028
Within Groups	158.481	345		
Total	160.719	346		
Productivity				
Between Groups	0.07456	1	0.289	0.591
Within Groups	89.379	346		
Total	89.453	347		

Significant differences were found between males and females in computer anxiety and negative impact on society factors. Examination of the means on the computer anxiety factor suggested that males (mean=2.11) were significantly less anxious about computers than females (mean=2.40). On the negative impact on society factor females (mean=2.15) viewed the impact of computers on society significantly more positively than did males (mean=2.31).

Age and Computer Attitude

Examining the means of the attitude factors by age group (Table 4.17) indicates a trend in the data. In each of the factors the means of group 1 (20-30 years) was lower than the means of the rest of the groups for all attitudinal factors. This suggests that the youngest teachers reported the most positive attitude toward computer technology. Generally the rankings from highest to lowest were group 1, 2, 4 and then 3 for each scale and subscale. Ignoring group 3, the mean of the groups generally increased with age indicating that the younger teachers had a more positive attitude toward computers. Group 3 (31-40 years) was the least positive, ranking least positive in 5 of the 6 attitudinal factors.

In order to test these observations ANOVA tests were performed on the data (see Table 4.18). Results indicated that age had a significant effect on three factors of the attitude scale: enthusiasm/enjoyment ($p=.016$), computer avoidance ($p=.000$), and productivity ($p=.005$). There were no significant differences attributed to age for the computer anxiety, attitude toward email or negative impact on society factors.

Post hoc analysis of the scales and age variables (Table 4.19) revealed that there were significant differences between groups on the enthusiasm/enjoyment, computer avoidance and productivity factors. There were significant differences between group 2 (31-40 years) and group 3 (41-50 years) on the enthusiasm/enjoyment factor. The 41-50 age group reported that they enjoyed and/or were more enthusiastic about computers than the 31-40 age group. For the computer avoidance and productivity factors there were significant differences

Table 4.17 Descriptive Statistics for Attitude by Age Category

Attitude Scale	n	mean *	SD
Enthusiasm/Enjoyment			
Group 1: 20-30	22	1.65	0.6
Group 2: 31-40	99	1.77	0.6
Group 3: 41-50	189	1.99	0.7
Group 4: 50+	30	2.00	0.7
Total	340	1.90	0.7
Computer Anxiety			
Group 1: 20-30	23	2.02	1.1
Group 2: 31-40	103	2.13	0.9
Group 3: 41-50	195	2.35	0.9
Group 4: 50+	31	2.34	1.1
Total	352	2.26	1.0
Computer Avoidance			
Group 1: 20-30	22	1.35	0.4
Group 2: 31-40	102	1.39	0.3
Group 3: 41-50	189	1.60	0.5
Group 4: 50+	29	1.54	0.5
Total	342	1.52	0.4
Attitude Toward Email			
Group 1: 20-30	22	2.25	0.8
Group 2: 31-40	103	2.43	0.6
Group 3: 41-50	191	2.38	0.6
Group 4: 50+	31	2.38	0.8
Total	347	2.39	0.6
Negative Impact on Society			
Group 1: 20-30	23	1.98	0.6
Group 2: 31-40	101	2.20	0.6
Group 3: 41-50	189	2.25	0.7
Group 4: 50+	28	2.25	0.8
Total	341	2.22	0.7
Productivity			
Group 1: 20-30	22	1.56	0.4
Group 2: 31-40	106	1.67	0.4
Group 3: 41-50	187	1.85	0.5
Group 4: 50+	27	1.71	0.4
Total	342	1.76	0.5

* Smaller mean represents a more positive attitude
(ranging from 1 -strongly agree to 5 strongly disagree)

Table 4.18 ANOVA Statistics of Computer Attitude by Age Category

Attitude Scale	Sum of Squares	df	F	Sig.
Enthusiasm/Enjoyment				
Between Groups	4.725	3	3.497	0.016
Within Groups	151.337	336		
Total	156.062	339		
Computer Anxiety				
Between Groups	4.682	3	1.728	0.162
Within Groups	314.301	348		
Total	318.983	351		
Computer Avoidance				
Between Groups	3.675	3	6.887	0.000
Within Groups	60.117	338		
Total	63.792	341		
Attitude Toward Email				
Between Groups	0.575	3	0.460	0.710
Within Groups	143.009	343		
Total	143.584	346		
Negative Impact				
Between Groups	1.514	3	1.112	0.344
Within Groups	152.902	337		
Total	154.416	340		
Productivity				
Between Groups	3.217	3	4.403	0.005
Within Groups	82.311	338		
Total	85.528	341		

between the groups 31-40 and 41-50 years. Age group 2 (31-40) avoided computers significantly less than the 41-50 age group. The 31-40 age group reported a significantly more positive view of computers as productivity tools than did the 41-50 age group. Group 1 (20-30 years) avoided computers significantly less than group 3 (41-50 years).

Table 4.19 Results of the Tukey HSD multiple comparison tests by Age Category

Attitudinal Scale					
Enthusiasm/Enjoyment		Group 4	Group 3	Group 2	Group 1
		30	189	99	22
	Mean*	2.00	1.99	1.77	1.65
Computer Anxiety		Group 3	Group 4	Group 2	Group 1
		195	31	103	23
	Mean*	2.35	2.34	2.13	2.02
Computer Avoidance		Group 3	Group 4	Group 2	Group 1
		189	29	102	22
	Mean*	1.60	1.54	1.39	1.35
Attitude Toward Email		Group 2	Group 3	Group 4	Group 1
		103	191	31	22
	Mean*	2.43	2.38	2.38	2.25
Negative Impact		Group 3	Group 4	Group 2	Group 1
		189	28	101	23
	Mean*	2.25	2.25	2.20	1.98
Productivity		Group 3	Group 4	Group 2	Group 1
		187	27	106	22
	Mean*	1.85	1.71	1.67	1.56

* Smaller mean represents a more positive attitude
(ranging from 1 -strongly agree to 5 strongly disagree)

School Type and Computer Attitude

To examine the relationship between school type and computer attitudes, descriptive statistics were generated and ANOVA tests were performed on the data.

The descriptive statistics (Table 4.20) were examined and few trends were found in the data. High school teachers tended to rank themselves lowest (most

Table 4.20 Descriptive Statistics for Attitude by School Type

Attitude Scale	n	mean *	SD
Enthusiasm/Enjoyment			
Primary/Elementary	126	1.97	0.7
Junior High	40	2.04	0.6
High School	74	1.88	0.7
All - Grade	67	1.75	0.6
Other	43	1.96	0.6
Total	350	1.91	0.7
Computer Anxiety			
Primary/Elementary	131	2.39	1.0
Junior High	42	2.10	0.8
High School	75	2.04	0.9
All - Grade	71	2.25	1.0
Other	44	2.44	1.0
Total	363	2.26	0.9
Computer Avoidance			
Primary/Elementary	127	1.58	0.5
Junior High	40	1.51	0.5
High School	72	1.46	0.4
All - Grade	69	1.46	0.4
Other	43	1.53	0.4
Total	351	1.52	0.4
Attitude Toward Email			
Primary/Elementary	129	2.33	0.7
Junior High	42	2.59	0.6
High School	73	2.49	0.7
All - Grade	70	2.29	0.6
Other	43	2.45	0.7
Total	357	2.40	0.7
Negative Impact on Society			
Primary/Elementary	130	2.17	0.7
Junior High	41	2.45	0.7
High School	73	2.14	0.7
All - Grade	63	2.20	0.7
Other	44	2.33	0.6
Total	351	2.22	0.7
Productivity			
Primary/Elementary	129	1.81	0.5
Junior High	39	1.87	0.6
High School	72	1.73	0.5
All - Grade	70	1.71	0.5
Other	42	1.75	0.4
Total	352	1.77	0.5

* Smaller mean represents a more positive attitude
(ranging from 1 -strongly agree to 5 strongly disagree)

positive) on four of the six factors. The mean scores based on this demographic variable tended to be small and discernable patterns were not evident.

ANOVA statistics (Table 4.21) revealed that for all but one attitudinal factor, computer anxiety, there was no significant difference between groups. The computer anxiety factor fell just below the acceptable significance level of .05 (p=.049) and indicated that there was a significant difference between groups on this factor. Further analysis using Tukey HSD post hoc multiple comparison tests

Table 4.21 ANOVA Statistics for Computer Attitude by School Type

Attitude Scale	Sum of Squares	df	F	Sig.
Enthusiasm/Enjoyment				
Between Groups	3.022	4	1.629	0.166
Within Groups	160.047	345		
Total	163.07	349		
Computer Anxiety				
Between Groups	8.561	4	2.140	0.049
Within Groups	317.944	358		
Total	326.504	362		
Computer Avoidance				
Between Groups	0.973	4	1.284	0.276
Within Groups	65.555	346		
Total	66.528	350		
Attitude Toward Email				
Between Groups	3.778	4	2.240	0.064
Within Groups	148.424	352		
Total	152.202	356		
Negative Impact				
Between Groups	3.378	4	1.835	0.122
Within Groups	159.256	346		
Total	162.635	350		
Productivity				
Between Groups	1.033	4	0.994	0.411
Within Groups	90.206	347		
Total	91.24	351		

could not verify any significant differences between groups on the computer anxiety factor.

Geographic Location and Computer Attitude

Descriptive statistics were generated and ANOVA tests were computed for the data to examine the relationship between geographic location and computer attitudes and are reported in Tables 4.22 and 4.23.

Table 4.22 Descriptive Statistics for Computer Attitude by Geographic Location

Attitude Scale	n	mean *	SD
Enthusiasm/Enjoyment			
Urban	168	1.98	0.7
Rural	182	1.85	0.6
Total	350	1.91	0.7
Computer Anxiety			
Urban	172	2.22	1.0
Rural	191	2.31	0.9
Total	363	2.26	0.9
Computer Avoidance			
Urban	169	1.54	0.5
Rural	182	1.50	0.4
Total	351	1.52	0.4
Attitude Toward Email			
Urban	174	2.48	0.7
Rural	183	2.32	0.6
Total	357	2.40	0.7
Negative Impact			
Urban	173	2.18	0.7
Rural	178	2.26	0.7
Total	351	2.22	0.7
Productivity			
Urban	171	1.81	0.5
Rural	181	1.73	0.5
Total	352	1.77	0.5

* Smaller mean represents a more positive attitude
(ranging from 1 -strongly agree to 5 strongly disagree)

An examination of the means (Table 4.22) for the groups indicated that the rural teachers tended to report more positively on four of the six attitudinal scales than urban teachers. The urban teachers' rank attitude mean scores were lower on the enthusiasm/enjoyment, computer avoidance, attitude toward email, and productivity factors. Urban teachers mean scores were lower on the computer anxiety and negative impact scales. In most cases the mean differences between the groups were small.

Analysis of variance (Table 4.23) was used to determine if these relationships held. These statistics indicate there is only one factor, attitude toward email, in

Table 4.23 ANOVA Statistics for Computer Attitude by Geographic Location

Attitude Scale	Sum of Squares	df	F	Sig.
Enthusiasm/Enjoyment				
Between Groups	1.461	1	3.145	0.077
Within Groups	161.609	348		
Total	163.07	349		
Computer Anxiety				
Between Groups	0.688	1	0.762	0.383
Within Groups	325.816	361		
Total	326.504	362		
Computer Avoidance				
Between Groups	0.141	1	0.743	0.389
Within Groups	66.387	349		
Total	66.528	350		
Attitude Toward Email				
Between Groups	2.063	1	4.879	0.028
Within Groups	150.138	355		
Total	152.202	356		
Negative Impact				
Between Groups	0.594	1	1.278	0.259
Within Groups	162.041	349		
Total	162.635	350		
Productivity				
Between Groups	0.541	1	2.088	0.149
Within Groups	90.698	350		
Total	91.24	351		

which there was a significant difference between groups. Examination of the means indicated that rural teachers (mean=2.32) were significantly more positive than urban teachers (mean=2.48) toward email.

Question 5

What is the relationship between attitude toward computers and levels of computer and information technology competencies?

To answer question 5, Pearson product moment correlations were calculated between the competency scales and subscales and the computer attitude factors. Examination of the data in Table 4.24 revealed that the correlations computed were all highly significant ($p=.05$ or less). Generally the correlations between the attitude scales; i.e., computer enthusiasm/enjoyment (ENTENJ) and the other attitude scales: computer anxiety (COMANX), computer avoidance (COMAVOI), attitude toward email (EMAIL), negative impact on society (NEGIMP) and productivity (PRODUCT) was positive and the correlations were all moderate to strong ($r= 0.247$ to 0.814). For the competency scales, the correlation between each scale and subscale and all the other scales and subscales were positive and strong ($r= 0.630$ to 0.986).

The correlations between the attitudinal scale and the computer competency scale is the main crux of this question. An examination of the general trends shows that the correlations were negative and generally moderate to strong ($r= -0.162$ to -0.678). This indicates that there was a correlation between self reported positive

Table 4.24 Pearson Correlation Matrix between Computer Competency and Attitude Toward Computers

	ENTENJ	COMANX	COMAVOI	EMAIL	NEGIMP	PRODUCT	PROFPRO	BASIC16	ADV712
ENTENJ									
COMANX	.555*								
COMAVOI	.740*	.539*							
EMAIL	.511*	.247*	.344*						
NEGIMP	.541*	.480*	.562*	.417*					
PRODUCT	.814*	.445*	.732*	.578*	.560*				
PROFPRO	-.452*	-.678*	-.428*	-.233*	-.337*	-.423*			
BASIC16	-.408*	-.654*	-.407*	-.187*	-.302*	-.381*	.932*		
ADV712	-.402*	-.557*	-.343*	-.205*	-.280*	-.368*	.920*	.811*	
OCRT	-.425*	-.639*	-.396*	-.207*	-.305*	-.392*	.973*	.953*	.950*
ETM	-.392*	-.590*	-.407*	-.192*	-.339*	-.390*	.835*	.692*	.674*
ACCINF	-.447*	-.652*	-.418*	-.259*	-.347*	-.411*	.918*	.794*	.766*
INTTECH	-.444*	-.628*	-.422*	-.251*	-.341*	-.436*	.896*	.770*	.838*
EVASAP	-.433*	-.623*	-.392*	-.261*	-.346*	-.426*	.878*	.766*	.816*
USEEMTE	-.393*	-.573*	-.359*	-.243*	-.318*	-.380*	.860*	.729*	.844*
DEMETHT	-.409*	-.551*	-.434*	-.175*	-.276*	-.417*	.732*	.630*	.636*
STUDINQ	-.415*	-.578*	-.409*	-.240*	-.321*	-.418*	.844*	.743*	.802*
DDS	-.409*	-.563*	-.408*	-.249*	-.315*	-.424*	.809*	.708*	.755*
USETECAS	-.363*	-.536*	-.347*	-.162*	-.286*	-.330*	.816*	.728*	.815*

Computer Attitude Scales:- ENTENJ - entertainment/enjoyment, COMANX - computer anxiety, COMAVOI - computer avoidance, EMAIL - attitude toward email, NEGIMP - negative impact on society, PRODUCT - productivity. Technology Competencies: PROFPRO - professional productivity, BASIC16 - basic computer operations, ADV712 - advanced computer operations, OCRT - operate computers and related technologies, ETM - evaluate technology materials, ACCINF - access information, INTTECH - integrating technology, EVASAP - evaluate, select and apply instructional materials, USEEMTE - use emerging technologies, DEMETHT - develop, design and support technology activities, STUDINQ - student inquiry, DDS - develop, design and support technology activities, USETECAS - use technology in assessing student work.

* Correlation is significant at the 0.01 level (2-tailed) (Continued)

Table 4.24 (Continued)

	OCRT	ETM	ACCINF	INTTECH	EVASAP	USEEMTE	DEMETHT	STUDINQ	DDS	USETECAS
ENTENJ										
COMANX										
COMAVOI										
EMAIL										
NEGIMP										
PRODUCT										
PROFPRO										
BASIC16										
ADV712										
OCRT										
ETM	.718*									
ACCINF	.821*	.799*								
INTTECH	.843*	.804*	.853*							
EVASAP	.830*	.786*	.831*	.956*						
USEEMTE	.826*	.726*	.810*	.957*	.889*					
DEMETHT	.665*	.729*	.711*	.856*	.734*	.726*				
STUDINQ	.811*	.736*	.776*	.885*	.841*	.855*	.752*			
DDS	.769*	.723*	.753*	.852*	.808*	.813*	.743*	.986*		
USETECAS	.809*	.667*	.723*	.846*	.807*	.846*	.672*	.898*	.813*	

Computer Attitude Scales:- ENTENJ - entertainment/enjoyment, COMANX - computer anxiety, COMAVOI - computer avoidance, EMAIL - attitude toward email, NEGIMP - negative impact on society, PRODUCT - productivity. Technology Competencies: PROFPRO - professional productivity, BASIC16 - basic computer operations, ADV712 - advanced computer operations, OCRT - operate computers and related technologies, ETM - evaluate technology materials, ACCINF - access information, INTTECH - integrating technology, EVASAP - evaluate, select and apply instructional materials, USEEMTE - use emerging technologies, DEMETHT - develop, design and support technology activities, STUDINQ - student inquiry, DDS - develop, design and support technology activities, USETECAS - use technology in assessing student work.

* Correlation is significant at the 0.05 level or less (2-tailed)

attitudes and reported higher technology competency levels. To examine the data in more detail each computer attitude scale factor was compared with the competency level scales and subscales.

For the enthusiasm/enjoyment factor correlated with the factors for the competency levels scales, the data shows a moderate negative correlation (r= -0.363 to -0.452). The measures for the attitudinal scales ranged from 1-5 where the lower measure represents a more positive attitude. The measures for the competency levels ranged from 1 - 9 where the larger measure represents more technology competency. Based on this, the relationship between computer enthusiasm and competency level was positive; i.e., persons who are enthusiastic about and get enjoyment from working with computers, correlate positively with having higher computer competency. Teachers who reported greater computer competency tended to be more positive on the computer enthusiasm/enjoyment scale.

The correlation coefficients between computer anxiety and the competency scales and subscales were negative and the largest of the attitudinal groups (r= -0.536 to -0.678). The highest correlation of this factor was on the professional productivity scale (r= -0.678), the lowest with use technology in assessing student work subscale. This indicated a strong positive correlation between computer anxiety and computer competency. Teachers who reported greater technological competency tended to have less computer anxiety.

The computer avoidance scale correlates positively with the computer competency scales. This is a moderate relationship with the strongest correlation being with the professional productivity scale (r= -0.428), the lowest with the advanced subscale of operate computers, related technologies and software applications (r= -0.343).

The smaller negative correlation coefficients (r= -0.162 to -0.261) indicated a weak positive correlation between attitude toward email and computer competency.

An examination of the correlation coefficients (r= -0.276 to -0.347) for the negative impact on society factor revealed a moderately positive relationship with the computer competency scales. This indicated that teachers who were more competent tended to have a more positive view of the impact of computers on society.

The correlation coefficients between computer productivity and the competency scales and subscales were negative and moderate (r= -0.330 to -0.436). This indicated that there was a moderate positive correlation between computer anxiety and computer competency. Teacher who reported greater levels of technological competency tended to have a more positive view of computers as productivity tools.

CHAPTER FIVE

DISCUSSION OF RESULTS

The aim of this study was to investigate teacher technology competencies and attitudes and attempt to determine if a relationship existed between computer attitudes and technology competency. The analysis of the data collected for the study was presented in chapter 4. This section discusses the results presented.

Research Question 1

What is the level of computer and information technology competencies of Newfoundland and Labrador teachers with respect to the ISTE standards ?

Results of the data analysis based on teachers self-assessment of technology competency indicated that the majority of teachers in the sample reported that they required a significant amount of professional development to reach the ISTE foundation standards.

Teachers rated themselves between the "Aware of" and "Learning" about computer technology measure of the scale for professional productivity, suggesting that the majority of teachers tended not to be very confident in their abilities to use technology for professional and personal productivity. Breaking this scale down and looking at the subscales, it is evident that teachers tend to rate themselves of highest competency in the basic subscale of operate computers, related technologies and software applications and of lower competency in the advanced subscale. These findings are consistent with those of Ely (1995) and the U.S. Congress Office of Technology Assessment (1995) who suggest that because teachers still feel uncomfortable integrating technology into their instructional activities, most who do attempt to do so, continue to use computers for low-level, supplemental tasks such as drill and practice, word processing, educational games, and computer based games.

In the integrating technology scale the majority of teachers tended to rate their competence on those skills in the lower half of the range. The highest ranking in the subscales was in the demonstrate ethical use of technology subscale. Perhaps this is a carryover to technology activities from other disciplines. Teachers routinely deal with ethical issues in the classroom, including such issues as copyright, discussions of euthanasia, abortion, religion and other sensitive issues.

Teachers also tended to rank themselves rather low in the student inquiry scale which deals with supporting and assessing students in using technology to encourage student inquiry and higher level thinking processes.

These findings confirm the observations of Schofield (1995), who points out that computers often do not live up to their promise because no one shows teachers how to integrate their new technology into their instruction or, sadly, into their students' learning processes. McFadden & Johnson (1993) states that "despite its proven effectiveness, teachers have been slow to employ advanced computer applications in their classrooms. Why ? Mainly because teachers have had very little training in media use" (p. 27). Researchers conclude that teachers are being inadequately prepared to use instructional technology and consequently are unable to effectively integrate technology into the classroom (U.S. Congress Office of Technology Assessment, 1995).

It is not surprising to find these results when examining the number of training hours reported by the respondents (see Chapter 3). In his study Mathews (1998) found that one-third of teachers never actually used technology for any instructional purpose and more than half perceived themselves to be novices in the use of technology. The large number of teachers, in this study, with no previous training or small amounts of training almost guarantee that the majority of teachers will not rate themselves as being competent in technology. The findings of Serogan reported in Beasley & Sutton (1993) indicate that 100 hours of inservice are required for teachers to become comfortable and competent in computer and technology use.

Research Question 2

How do Newfoundland and Labrador teachers vary with respect to the level of computer and information technology competencies when analyzed by selected demographic information and other characteristics (gender, age, school type, and geographic location.)?

Gender and Technology Competencies

This study found that there were significant differences between females and males ranking of their technology competency on all scales and subscales of the competency instrument. On every scale used to measure technology competency, males tended to perceive themselves as having significantly higher ability in technology competency compared with females This corroborates the results of Mathews (1998). He concluded that gender was a significant factor in technology use and that this was the second best predictor of teachers' perception of their ability to use technology.

These findings may in fact be due to actual competency differences between males and females. An examination of the reported number of hours of previous technology training indicates that, on average, males have 10 more hours of computer technology training than females. Often, due to gender socialization females do not tend to associate themselves with science and technology because of the notion that these pursuits are in the male domain. It is also a possibility that the differences are the result of males over reporting their abilities while females under report theirs. It would be an interesting to do further research to determine if either of these possibilities are plausible explanations.

Age and Technology Competencies

Results of the analysis of age and competency data produces few tangible results. The analysis produced no significant trends. Significant differences were found between the youngest age group 20-30 years and the 41-50 age group on several of the scales. Perhaps this indicates that for those scales younger teachers are more competent. These results are inconclusive and are not unlike the mixed results found by Meskill & Melendez (1997) and Cambre & Cook (1997). The 20-30 age group are part of the generation that were in school when computer technology was introduced and perhaps are more competent as a result of the computer experience gained. The 41-50 age group are likely to have had little training except for inservice.

School Type and Technology Competencies

As a result of the analysis of data it was found that high school teachers ranked themselves significantly more competent than did primary/elementary teachers on all scales and subscales except the demonstrate ethical use of technology subscale of the integrating technology scale. Primary and elementary school teachers ranked themselves significantly less competent on several competency scales than did all-grade school teachers.

The review of the literature uncovered no studies which addressed this particular issue. It is possible these findings are the result of more exposure to computers by high school teachers and all-grade school teachers as opposed to primary and elementary school teachers. Computer and technology courses have been in Newfoundland and Labrador high (and all-grade) schools for most of the last 15 years. As a result, high schools tend to have developed staff expertise in the use of computer technology. Computers in the schools for courses in computer and technology provide access to computers for other teachers and classes. This would also increase the likelihood that inservice in computers and technology was available more readily in high school settings.

Geographic Location and Technology Competencies

The results of the study reveal no significant differences between urban or rural teachers for either of the scales or subscales. It would appear that the location of the school is not a significant factor in teachers technology competency. No studies were located in the literature review which would elucidate the issue of geographic location.

Question 3

What is the current attitude of Newfoundland and Labrador teachers toward computer and information technologies (scales: enthusiasm/enjoyment, anxiety, avoidance, attitude toward email, negative impact on society, productivity)?

While the majority of teachers reported that their technology competency was in the middle to the lower portion of the measurement scale, the majority reported positive attitudes towards computers and related technologies on all attitudinal scales but reported that they do not have the required competencies to implement technology in the classroom.

This is significant since Stern & Keislar (1977) did an extensive review of teachers' attitudes and attitude change in teachers and discovered that teachers' attitudes do make a difference in the teaching process. These finding are supported by Zoller & Ben-Chaim (1996). Lillard (1985) confirmed the importance of teachers' attitudes in the successful implementation of an instructional innovation. Positive teacher attitudes toward computers are recognized as a condition for their effective use (Woodrow, 1992). These findings are significant in that the attitude of teachers toward computer technology tends to suggest that they are open to leaning about and using technology. If attitude is not the problem there must be other barriers to teachers becoming more competent in the use of computer technology.

Question 4

How do Newfoundland and Labrador teachers vary with respect to their attitude toward computer and information technologies when analyzed by selected demographic information and other characteristics (gender, age school type, and geographic location)?

Gender and Computer Attitude

The findings from this study indicates no significant differences between males and females on four of the six attitude factors. This tends to confirm previous studies by Lyons and Carlson (1995), Fary (1988), Grasty (1985), Smith (1985), and Sacks, Bellisimo & Mergendoller (1994) which showed no significant difference between males and females in their use of computer and information technologies.

Significant differences were found between males and females in computer anxiety and negative impact on society factors. Males tended to be significantly less anxious about computers than females. On the negative impact on society factor females viewed the impact of computers on society significantly more positively than did males. The fact that there are differences in two factors tends to confirm other studies. Much of the literature on gender and computing reveals that there are marked differences between male and female use of and attitudes toward computers (Chen, 1986; Coley, Cradler & Engel, 1997; Fetler, 1985; Loyd & Loyd, 1988; Shashaani, 1993; Shashaani, 1994; Siann et al., 1990; Zoller & Ben-Chaim, 1996).

Age and Computer Attitude

On half of the six attitudinal factors no significant differences between groups were found. In three of the attitudinal factors: enthusiasm/enjoyment, computer avoidance and productivity there were significant differences between groups. The 31-40 years age group were more enthusiastic toward computers, enjoyed computers more and avoided computers significantly less than the 41-50 age group. The 31-40 age group had a significantly more positive view of computers as productivity tools than did the 41-50 age group. These findings are contrary to those of Dyck & Smither (1994) whose study indicated that older adults were less anxious, had more positive attitudes, and had more liking for computers than young adults. The findings may support those of Meskill and Melendez (1997) who found that, even after training, age was found to correlate negatively with computer liking and computer use. The U. S. Congress Office of Technology Assessment (1988) recognized that age plays a part by stating that frequently the first step in inservice training for technology is to establish opportunities for experienced teachers to overcome their anxiety toward computers.

School Type and Computer Attitude

A review of the literature shed no light on the relationship between school type and computer attitude. The results of this study were that there were no significant differences between groups confirmed on any of the TAC factors for school type in this study. This result may be due to the type of statistical procedures used. Other less stringent procedures may have revealed different results.

Geographic Location and Computer Attitude

This study indicated that for all factors but one there are no significant differences between urban and rural teachers. Significant differences were found on the attitude toward email factor. Rural teachers were significantly more positive toward email than urban teachers. It is possible that this difference is due to the contact rural teachers experience through email whereas urban teachers may have more face to face interactions. Possibly urban teachers experience frustration trying to access email accounts in competition with others for modem pools. It certainly did not appear from the data that it was the result of more computer competency on the part of rural teachers.

Question 5

What is the relationship between attitude toward computers and levels of computer and information technology competencies?

An examination of the general trends shows that the correlation is negative and generally moderate to strong. This indicates that there is a strong significant correlation between positive attitudes and higher technology competency levels. The strongest relationships occurred between the computer attitude factor computer anxiety and the competency scales and subscales. Of these factors, professional productivity was the highest correlated scale (r= -0.678), and the lowest was with use technology in assessing student work scale. This seems to indicate that more technologically competent persons tended to have less computer anxiety.

For the enthusiasm/enjoyment, computer avoidance, negative impact on society, and computer productivity factors the correlations shows moderately positive relationships . The attitude toward email factor shows a weak but positive correlation with computer competency.

The literature review did not reveal any studies specific to examining the relationship between teachers' attitudes toward computer technology and technology competency. However, Shashaani (1994) found positive correlations between computer experience and attitude, suggesting that more exposure to computers was associated with more positive attitudes. In many related studies it has been shown that with knowledge, familiarity, and competence any established negative feelings and anxiety toward computers tend to disappear or become more positive (Beasley & Sutton, 1993; Chopra, 1994; Dyck & Smither, 1994; Lillard, 1985; Loyd & Gressard, 1996; McInerney et al., 1994; Sacks et al., 1994; Stern & Keislar, 1977)

This study shows that, although the majority of teachers ranked themselves in the lower portions of the technology competency scales, the majority had positive attitudes towards computer and information technology. In fact, many teachers had demonstrated a willingness to take part in workshops, inservice, conferences, and other activities which could help them become more technologically competent and become better able to provide for the educational technology needs of children in their care.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

Purpose and Introduction

The purpose of this study was to determine which computer and information technology skills teachers had along with their level of readiness to integrate computer and information technology into the classrooms of Newfoundland and Labrador schools. The study assessed the current level of teacher computer and information technology competencies, assessed the attitude of teachers toward computer and information technologies, and related the level of teacher competencies and attitudes toward computers with age, gender, school type and geographic location.

Work on incorporating computer technology into practice for teachers is new, the focus has been on preservice teachers. The literature on teachers and technology inservice is more meager (Marx, Blumenfeld, Krajcik, & Soloway, 1998).

This study can be considered exploratory in the sense that no studies were found during the literature review that dealt directly the with specific issues of school type and computer and technology competency, school type and teacher attitudes toward technology, geographic location and teacher attitudes, geographic location and competencies, or correlation of attitude toward computers and technology competencies. There were relatively few studies that dealt directly with inservice teacher attitudes, technology competencies, or differences between teachers on the basis of gender, age, or teaching experience. Many of the studies cited in the literature review dealt with these issues for students in primary, elementary, intermediate, and high school programs and/or students in teacher preservice programs.

Since the birth of microcomputers, the education community has recognized that redesigned teacher training would be essential to the successful integration of technology into classroom instruction. The increased use of technology in K-12 classrooms has created a massive inservice training need in technology for practicing teachers (Northrup & Little, 1996). Training teachers and administrators is the key to successful implementation of technology in the classroom (Banks et al., 1997).

Because teachers still feel uncomfortable integrating technology into their instructional activities, most who do attempt to do so, continue to use computers for low-level, supplemental tasks such as drill and practice, word processing, educational games, and computer based games (Ely, 1995; U.S. Congress Office of Technology Assessment, 1995). Researchers conclude that teachers are being inadequately prepared to use instructional technology and consequently are unable to effectively integrate technology into the classroom (U.S. Congress Office of Technology Assessment, 1995).

There must be a plan for technology integration to succeed (Chopra, 1994; Fawson & Smellie, 1990). Many educational jurisdictions are planning for and requiring teachers to become competent in the integration of computer and information technology into classroom practice (Council for Educational Technology, 1996).

These technology plans require standards outlining what is expected of students, teachers, administrators, resources and support. Standards provide criteria by which judgements can be made at the national, regional, state, provincial, or local levels on the quality of education (Dugger, 1997).

In this planning, the focus of attention should be concentrated on the target audience, the learner. The tools presented by technology should be appropriately applied to improve the quality of education, increase equity of opportunity, and provide access to information sources available for learning (Fawson & Smellie, 1990). The promise of our future does not lie in technology alone, but in a person's ability to use, manage, and understand it (Dugger, 1997). Technology is the catalyst, but the chemical starters for such fundamental changes are teachers highly skilled in technology, with a deep understanding of curriculum and a knowledge of how children learn (Lee, 1996; p.12).

Teachers can gain competence with computer technology through structured staff-development classes that feature a solid technology curriculum geared toward adult learners (Moran, 1997). Since technology changes at such a rapid pace, teachers will find it challenging to keep up. Teachers need to be proactive, analyze their personal staff development needs and options, investigate opportunities and ask questions, to get the professional development they need. Teachers as individuals and professionals need to enter a life-long learning style of self-improvement. As Connie Feil (1996) states in her article, *Teacher, Teach, Thyself!* "The do it yourself method may be the only way to get what you need" (p. 4).

Teachers who have not yet decided to adopt technology personally should continue to be exposed to the possibilities, gently encouraged, and offered support; but, their participation cannot be forced. More will result from supporting the willing than from cajoling the reluctant. To try to interest reluctant colleagues, inquire as to the areas of their teaching that cause the most difficulty. Explore the potential for technology intervention. If there is an acknowledged problem, that teacher may be more willing to consider a new approach. If not, try again next year (Lockard, Abrams and Many, 1997, p. 377). Meanwhile, what about students ? Our roles are defined by their needs, not the other way around.

Conclusions

This has been an exploratory study having the limitation of surveying subjects from School District #3 only. Given the similarity of teachers in other districts and similarities between this district and other school districts the results can likely be extended to most, if not all, of the province. From this study of teachers and their computer and information technology competencies and attitude towards computer and information technology the following conclusions are drawn:

1. There is a strong positive correlation between positive attitudes toward computers and teacher competency levels in computer and information technology.

2. Teachers in Newfoundland and Labrador require a significant amount of training to meet the International Society for Technology in Education foundation standards for all educators.

3. There is a significant difference in the view of males and females with regard to their technology competency.

4. Younger teachers tend to view themselves as being more competent in the use of technology than older teachers.

5. Elementary teachers appear to view themselves as having less technology competence than other teachers. High School teachers tend to view themselves as having more technology competence than other teachers.

6. The attitude of Newfoundland and Labrador teachers toward computer technology is generally positive.

7. Teachers, generally, have a positive attitude towards technology but there are some attitudinal difference between males and females, younger and older teachers, and urban and rural teachers.

8. There is a strong positive correlation between positive attitudes toward computers and teacher competency levels in computer and information technology.

Recommendations

Based on the literature review, the results of the study, the preceding conclusions, and the extent that these results can be generalized to the whole province, the following actions are recommended:

1. Training and support of teacher technology use in the classroom should become a priority at all levels.

   (a) The Government of Newfoundland and Labrador, Department of Education, School Districts and Memorial University of Newfoundland should allocate a greater portion of their budgets to teacher training and support.

   (b) School Districts and Schools should put technology plans in place that specify which standards should be used for student learning, teacher education and inservice, technology resources, and technical support.

(c) Centers for teacher training should be developed in each region of the province which support, encourage and assist teachers in the integration of technology in the classroom.

(d) The Department of Education, School Boards, Newfoundland and Labrador Teachers Association, Memorial University of Newfoundland and teacher centers should work together to explore ways to provide cost effective, easily accessible distance education programs in computer and information technology to teachers in their schools and homes.

2. Technology is an ever-changing field and, for teachers to keep up, life long learning and a commitment to self training is required.

3. Stakeholders should implement programs which attempt to determine the perceived or factual difference between genders and, if substantiated, address gender issues in the training and use of computers and other technologies for educational purposes.

4. Where possible, cadres of younger and older teachers should be created in schools to share technology training and practical classroom experience to enhance their professional lives and inform the practice of both groups.

5. Quality district inservice programs should be provided with special attention given to introducing technology into primary and elementary schools giving teachers good foundation technology skills.

6. Stakeholders should capitalize on the positive attitude of most teachers by providing support, resources and encouragement to enhance the integration of technology into our classrooms

7. During technology planning at each level, stakeholders should keep in mind the attitudinal difference between the various groups and attempt to address these issues with individuals and groups during ongoing training.

8. Stakeholders should identify and implement methods in their technology plans which build on the positive attitudes of teachers and provide and improve training opportunities which take advantages of and reinforce these attitudes.

A Final Word

Computer and related technologies, educational technologies, and computer integration are now playing an important role in the efforts to improve our education system and teachers are on the front lines of this technology use. Programs and initiatives must be put in place at the provincial, district, school and individual level. These programs and initiatives must include the competencies required to effectively use technology and should be geared to the demonstrated need of the teachers in the district. These programs must be multi-faceted and allow teachers to access training at their level of need. Mehlinger (1996) states:

> This revolution is not like any other school reform movement that I have observed, and I have been in the profession for more than 40 years. First, it is a grassroots movement. Actions by state and federal governments and by business and industry have helped fuel the revolution, but they did not provide the spark. Teachers and local school administrators are leading this revolution, and they are not leading it in order to save American business or to prove a new theory of learning. They are buying, installing, and using technology simply because they believe that students will be less bored and will learn more through the use of the technology than without it. In short, they are using technology to make schools better. (p. 6)

The application of technology to education holds much promise, but can only be realized if teachers are given the education, resources, and time required to utilize the technology properly and to reap the most benefit for students. As Means & Olson (1994) state: "Technology plays an important role, but it is a supporting role. The students are the stars. The playwright and director - and the power behind the scene - is, as always, the teacher" (p. 18).

Recommendations for Further Research

Based on the limitations of this study, future studies should focus on teachers throughout the whole province. This would create a more solid foundation for making recommendations about inservice and training. Another interesting area to explore, which evolves out of this research, would be an examination of competency levels and attitudes concurrent with an inservice and training plan implementation. This type of longitudinal study would allow for adjustments in the instruments to get at the heart of the effect of training on teachers competency and attitude toward computers. Also, a comparison of actual technology competencies based on testing with self-reported technology competency would ascertain the accuracy and reliability of the self-reporting method of assessing the need technology inservice. Comparison of the actual competencies and self-reported competency between males and females would prove interesting. Other potential studies could attempt to delineate if other relationships exist between technology competency and/or computer attitude and factors such as the amount and type of technology in schools, access to computers in schools or in teachers' homes, and the levels of support available to teachers. One very interesting study would be to identify the actual technology literacy and capabilities that students need by graduation and determine if teachers have the literacy and capabilities to deliver on these student requirements.

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Appendix A

Technology Needs

Assessment

Instrument

for Educators

Technology Needs

Assessment

Instrument

for Educators

Technology Needs Assessment for Educators

Instructions:

Part I - Demographic Data

Please complete the demographic information on the next page by filling in the blank spaces or circling the appropriate selection.

Part II - Technology Needs Assessment

For each question you are asked to assess your level of experience and/or proficiency in the competencies which best reflects your current independent level of skill attainment or practice. Circle the appropriate response on the continuum for each item on a scale of 1 to 9 (note the scale: 1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others).

Part II - Attitudes Toward Computers

For each item you are asked to circle the choice which best describes you feelings about the statement on the scale: S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

Part I - Demographic data

Confidentiality Statement: No subjects will be individually identified

School Name ______________________________________

1. School Type

   - Primary ❑ Elementary ❑ Junior High ❑ Senior High
   - K-12 ❑ K-9 ❑ 6-12 ❑ 9-12

2 Sex

   1. Female ❑ Male

3. Age

   2. 20-25 ❑ 26-30 ❑ 31-35 ❑ 36-40
   3. 41-45 ❑ 46-50 ❑ 50+

4. Teaching Experience

   4. 1-5 ❑ 6-10 ❑ 11-15 ❑ 16-20 ❑ 21-25 ❑ 25+

5. Area of Specialization

   5. Primary ❑ Elementary ❑ Intermediate ❑ Secondary

6. Degrees Held (check all that apply)

   6. B.A. ❑ B.Sc ❑ B. Ed. ❑ M.A(Ed) ❑ M.Ed. (Area____________)
   7. Other (please specify ___________________________)

7. The number of courses (accredited or continuing education) relevant to computers and information technology taken (in the last 3 years or since graduation whichever is less)

   ____

8. The number of in-service hours in the last 3 years related to computer and information technology.

   ____

9. The number and length of institutes attended in the last 3 years relating to computer and information technology.

   Number: 1 Length: ________
   Number: 2 Length: ________
   Number: 3 Length: ________
   Number: 4 Length: ________

Part II - Technology Needs Assessment

1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others

1. Professional Productivity

A. Operate computers, related technologies and software applications:

1.	I can create, edit, save and retrieve word processing documents. (e.g.: create a student handout, parent letter)	1 2 3 4 5 6 7 8 9
2.	I can use teacher utility and classroom management programs. (e.g.: using a computer to calculate and manage grades and student demographics)	1 2 3 4 5 6 7 8 9
3.	I can use a variety of technology tools in the classroom. (e.g.: use a VCR, content specific software)	1 2 3 4 5 6 7 8 9
4.	I can use advanced features of word processors in creating written communications. (e.g.: creating columns of information in a document, setting tabs and margins)	1 2 3 4 5 6 7 8 9
5.	I can use spreadsheets for analyzing, organizing and displaying data geographically. (e.g.: enter information from a science lab and chart it, input and graph student survey data)	1 2 3 4 5 6 7 8 9
6.	I can manipulate databases and generate customized reports. (e.g.: create class mailing labels, sort on different fields. perform Boolean searches)	1 2 3 4 5 6 7 8 9
7.	I can use a variety of technologies to support multiple curriculum areas. (e.g.: use overhead projection device for math with tessellation tiles to create patterns in math/science, scientific calculator to graph algebraic equations)	1 2 3 4 5 6 7 8 9
8.	I can design databases. (e.g.: work with a group of students to create fields for a database, use a database to create your own book/equipment inventory create reports in different formats)	1 2 3 4 5 6 7 8 9
9.	I can design and manipulate spreadsheets. (e.g.: use functions and formulas in spreadsheets, exchange information to other types of applications)	1 2 3 4 5 6 7 8 9
10.	I can use productivity tools for creating multi-media presentations. (e.g.: authoring a presentation that includes scanned images and sound, presentation for parents incorporating different media)	1 2 3 4 5 6 7 8 9
11.	I can identify, select, and integrate video and digital images in varying formats for use in presentations, publications, and/or other products. (e.g.: scan a graphic and save it properly for the presentation software in use, use a digital photo in a student portfolio/newsletter)	1 2 3 4 5 6 7 8 9
12.	I can use applications that integrate word processing, database, spreadsheet, communication, and other tools. (e.g.: attaching a file to e-mail, merging a word processing file with a database, etc.)	1 2 3 4 5 6 7 8 9

Part II - Technology Needs Assessment

1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others

B. Evaluate technology materials:

13. I can identify computer and related technology resources appropriate for classroom and teacher use. (e.g.: choosing appropriate content software, using a camcorder to record a student performance, etc.) 1 2 3 4 5 6 7 8 9

14. I can identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator. (e.g.: setting criteria for content area software evaluation, know the differences between using CD ROMs as compared to performing an Internet search) 1 2 3 4 5 6 7 8 9

15. I can observe and evaluate demonstrations or uses of broadcast instruction, audio/video conferencing, and other distance learning applications. (e.g.: visit schools using various distance learning technologies and list pros and cons of each) 1 2 3 4 5 6 7 8 9

C. Access Information:

16. I can use computer-based technologies including telecommunications to access information. (e.g.: browsing the web, opening an attached file, gaining information from a CD-ROM) 1 2 3 4 5 6 7 8 9

17. I can access and use telecommunications tools and resources for information sharing, remote information access and retrieval, and multimedia/hypermedia publishing. (e.g.: sending an email message, attaching a word processing document to an email message, including web graphics in a multimedia presentation) 1 2 3 4 5 6 7 8 9

18. I can use sophisticated on-line search tools to identify, acquire and organize desired information resources. (e.g.: know what search engine to use for a particular purpose, use advanced features such as Boolean logical operators) 1 2 3 4 5 6 7 8 9

19. I can conduct research that supports and enhances the curriculum. (e.g.: a list of subject related web sites) 1 2 3 4 5 6 7 8 9

Part II - Technology Needs Assessment

1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others

II. Integrating Technology

A. Evaluate, select and apply instructional technology in the curriculum:

20. I can explore, evaluate, and use computer and related technology resources including applications, tools, educational software and associated documentation. (e.g.: explore and select appropriate software for a social studies research project. use science probes attached to a computer)	1 2 3 4 5 6 7 8 9
21. I can identify and, where appropriate, use resources for adaptive/assistive devices for students with special needs. (e.g.; use a touch screen, writing prompt software)	1 2 3 4 5 6 7 8 9
22. I can evaluate and use appropriate technology resources and on-line sources of information. (e.g.: validate information from the web, choose a CD that is developmentally appropriate for students, etc)	1 2 3 4 5 6 7 8 9
23. I can use effective methods and strategies for teaching technology concepts and skills. (e.g.: teaching scanning for a student publication, teaching the use of a digital camera on a field trip)	1 2 3 4 5 6 7 8 9
24. I can apply specific-purpose technology devices in appropriate content areas. (e.g.. a graphing calculator in a math class, scientific probeware in a science lab or electronic thesaurus in an English class)	1 2 3 4 5 6 7 8 9
25. I can synthesize the integration of technology resources across the curriculum. (e.g.: revise curriculum to include the infusion of technology)	1 2 3 4 5 6 7 8 9
26. I can design, deliver, and assess student learning activities that integrate computers and related technologies for a variety of student grouping strategies and for diverse student populations. (e.g.: technology is integrated naturally, appropriately, consistently and effectively into all aspects of the teaching and learning, design demonstration classroom activities for other colleagues)	1 2 3 4 5 6 7 8 9

B. Use emerging technologies:

27. I can use emerging technology to gather information for the classroom. (e.g.: use the web to find classroom lesson plans, select CD-ROMs for a specific content)	1 2 3 4 5 6 7 8 9
28. I can select appropriate technology tools for communicating concepts, conducting research, and solving problems for an intended audience and purpose. (e.g.: use an LCD and/or video projector to show your presentation, using a listserver to send out a survey)	1 2 3 4 5 6 7 8 9
29. I am able to experiment with and demonstrate emerging technologies to students. (e.g.: set up a video conference with a professional artist for an art class, capturing video into a multimedia presentation)	1 2 3 4 5 6 7 8 9
30. I can use imaging devices. (e.g.: scanners, digital cameras, and/or video cameras with computer systems and software)	1 2 3 4 5 6 7 8 9

Part II - Technology Needs Assessment

1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others

31.	I can use a computer projection device to support and deliver oral presentations. (e.g.: smart boards, LCD panel, electronic white board)	1 2 3 4 5 6 7 8 9
32.	I can apply emerging technologies to project-based learning activities. (e.g.: create a web site to develop a virtual learning community distribute a news program through closed circuit, centralized video, participate in an online classroom project)	1 2 3 4 5 6 7 8 9
33.	I can serve as a mentor to initial and emerging technology users. (e.g.: coach a colleague on using the Internet, design workshops for school staff)	1 2 3 4 5 6 7 8 9
34.	I can describe and implement basic troubleshooting techniques for multimedia computer systems, peripheral devices and related technologies. (e.g.: form and advise a student technology task team for the school, develop a handbook for colleagues on troubleshooting techniques)	1 2 3 4 5 6 7 8 9
C.	Demonstrate ethical use of technology:	
35.	I can demonstrate knowledge of equity, ethics, legal, and human issues concerning use of computers and technology. (e.g.: require students to cite sources; develop strategies for students to become aware of and apply ethical usage of computers in their work)	1 2 3 4 5 6 7 8 9
36.	I can practice responsible, ethical and legal use of technology, information, and software resources. (e.g.: use only licensed software as per vendor's agreement.)	1 2 3 4 5 6 7 8 9
37.	I can design student learning activities that foster ethical and legal use of technology by students. (e.g.: set criteria for projects that require students to create original text, graphics and organization)	1 2 3 4 5 6 7 8 9
38.	I can use ethical and legal practices involving school purchasing and policy decisions. (e.g.: insist that copies of software are purchased for each computer on which it will be used)	1 2 3 4 5 6 7 8 9

Part II - Technology Needs Assessment

1 - Not Yet Ready, 3- Aware of, 5 - Learning, 7 - Capable and Comfortable, and 9 - Could Teach Others

III. Student Inquiry

A. Design, develop and support technology activities:

39. I can design and practice methods and strategies for teaching concepts and skills associated with computers and related technologies including keyboarding. (e.g.: teaching keyboarding skills, develop and deliver a lesson on safely connecting and utilizing computer science probes)	1 2 3 4 5 6 7 8 9
40. I can design and implement integrated technology classroom activities that involve teaming and/or small group collaboration. (e.g.: groups of three to fours students are given a project in which they must research a subtopic and combine their learning into a final group performance)	1 2 3 4 5 6 7 8 9
41. I can design and practice methods and strategies for teaching concepts and skills for applying productivity tools. (e.g.: develop and deliver a lesson on editing, writing using a word processor)	1 2 3 4 5 6 7 8 9
42. I can design student learning activities that foster equitable use of technology by students. (e.g.: structure an interdisciplinary unit on water in which every student of varying proficiencies has equal computer access time in school)	1 2 3 4 5 6 7 8 9
43. I can develop a community of learners who learn and teach each other using technology as a vehicle. (e.g.: develop technology based cooperative learning activities)	1 2 3 4 5 6 7 8 9
44. I can design a set of evaluation strategies and methods that assess the effectiveness of instructional units that integrate computers /technology. (e.g.: creating a checklist to monitor the incorporation into all subject areas)	1 2 3 4 5 6 7 8 9
45. I can empower students to use their skills to develop their own communities of learners. (e.g.: guiding a group of students who work together as a student technology team in their school to assist teachers and fellow students)	1 2 3 4 5 6 7 8 9

B. Use technology in assessing student work:

46. I can use software to manage student assessment. (e.g.: doing scannable student observations in a variety of skill areas, using a database or spreadsheet to record and analyze student grades)	1 2 3 4 5 6 7 8 9
47. I can develop and apply assessment rubrics (checklists) for student multimedia projects. (e.g.: develop a set of rubrics which reflect collaboration, use of software and hardware, and of content learning)	1 2 3 4 5 6 7 8 9
48. I can develop assessment strategies using video and data management tools that demonstrate student learning in technology related projects. (e.g.: creation of an assessment method of a videotaped team performance that reflects student use of technology and their articulation of new learning)	1 2 3 4 5 6 7 8 9

Part III - Teacher Attitude Toward Computers

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

1.	I think that working with computers would be enjoyable and stimulating.	S	SA	U	SD	D
2.	I get a sinking feeling when I think of trying to use a computer.	S	SA	U	SD	D
3.	If I had a computer at my disposal, I would try to get rid of it.	S	SA	U	SD	D
4.	The use of E-mail makes the student feel more involved.	S	SA	U	SD	D
5.	Computers are changing the world too rapidly.	S	SA	U	SD	D
6.	Computers would increase my productivity.	S	SA	U	SD	D
7.	I want to learn a lot about computers.	S	SA	U	SD	D
8.	Working with a computer makes me feel tense and uncomfortable.	S	SA	U	SD	D
9.	Studying about computers is a waste of time.	S	SA	U	SD	D
10.	The use of E-mail helps provide a better learning experience.	S	SA	U	SD	D
11.	I am afraid that if I begin to use computers I will become dependent upon them and loose some of my reasoning skills.	S	SA	U	SD	D
12.	Computers would help me learn.	S	SA	U	SD	D
13.	The challenge of learning about computers is exciting.	S	SA	U	SD	D
14.	Working with a computer would make me very nervous.	S	SA	U	SD	D
15.	I can't think of any way that I will use computers in my career.	S	SA	U	SD	D
16.	The use of E-mail makes courses more interesting.	S	SA	U	SD	D
17.	Computers dehumanize society by treating everyone as a number.	S	SA	U	SD	D
18.	I feel computers are necessary tools in both educational and work settings.	S	SA	U	SD	D
19.	Learning about computers is boring to me.	S	SA	U	SD	D
20.	Computers intimidate and threaten me.	S	SA	U	SD	D

Part III - Teacher Attitude Toward Computers

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

21.	I will probably never learn to use a computer.	S	SA	U	SD	D
22.	The use of E-mail helps the student to learn more.	S	SA	U	SD	D
23.	Our country relies too much on computers.	S	SA	U	SD	D
24.	Computers can be a useful instructional aid in all subject areas.	S	SA	U	SD	D
25.	I like learning on a computer.	S	SA	U	SD	D
26.	Computers frustrate me.	S	SA	U	SD	D
27.	I see the computer as something I will rarely use in my daily life as an adult.	S	SA	U	SD	D
28.	The use of E-mail increases motivation for the course.	S	SA	U	SD	D
29.	Computers isolate people by inhibiting normal social interactions among users.	S	SA	U	SD	D
30.	Computers improve the overall quality of life.	S	SA	U	SD	D
31.	I enjoy learning how computers are used in our daily lives.	S	SA	U	SD	D
32.	I have a lot of self confidence when it comes to working with computers.	S	SA	U	SD	D
33.	Not many people can use computers.	S	SA	U	SD	D
34.	More courses should use E-mail to disseminate class information and assignments.	S	SA	U	SD	D
35.	Use of computers in education reduces the personal treatment of students.	S	SA	U	SD	D
36.	Knowing how to use computers is a worthwhile skill.	S	SA	U	SD	D
37.	I would like to learn more about computers.	S	SA	U	SD	D
38.	I sometimes get nervous just thinking about computers.	S	SA	U	SD	D
39.	Learning to operate computers is like learning any new skill - the more you practice, the better you become.	S	SA	U	SD	D
40.	The use of E-mail creates more interaction between students enrolled in courses.	S	SA	U	SD	D

Part III - Teacher Attitude Toward Computers

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

41.	Computers have the potential to control our lives.	S	SA	U	SD	D
42.	Having a computer available to me would improve my general satisfaction.	S	SA	U	SD	D
43.	I would like working with computers.	S	SA	U	SD	D
44.	A computer test would scare me.	S	SA	U	SD	D
45.	Knowing how to use computers is a worthwhile skill.	S	SA	U	SD	D
46.	The use of E-mail creates more interaction between student and instructor.	S	SA	U	SD	D
47.	Working with computers makes me feel isolated from other people.	S	SA	U	SD	D
48.	Computers will improve education.	S	SA	U	SD	D
49.	A job using computers would be very interesting.	S	SA	U	SD	D
50.	I feel apprehensive about using a computer terminal.	S	SA	U	SD	D
51.	I do not think that I could handle a computer course.	S	SA	U	SD	D
52.	E-mail provides better access to the instructor.	S	SA	U	SD	D
53.	I dislike working with machines that are smarter than I am.	S	SA	U	SD	D
54.	Someday I will have a computer in my home.	S	SA	U	SD	D
55.	I enjoy computer work.	S	SA	U	SD	D
56.	Computers are difficult to understand.	S	SA	U	SD	D
57.	I would never take a job where I had to work with computers.	S	SA	U	SD	D
58.	Electronic mail (E-mail) is an effective means of disseminating class information and assignments.	S	SA	U	SD	D
59.	Using a computer prevents me from being creative.	S	SA	U	SD	D
60.	I will use a computer in my future occupation.	S	SA	U	SD	D

Part III - Teacher Attitude Toward Computers

S = Strongly Agree; SA = Somewhat Agree; U = Undecided; SD = Somewhat Disagree; D = Strongly Disagree

61.	I will use a computer as soon as possible.	S	SA	U	SD	D
62.	I feel at ease when I am around computers.	S	SA	U	SD	D
63.	If given the opportunity, I would like to learn about and use computers.	S	SA	U	SD	D
64.	I prefer E-mail to traditional class handouts as an information disseminator.	S	SA	U	SD	D
65.	Working with computers means working on your own, without contact with others.	S	SA	U	SD	D
66.	If I had to use a computer for some reason, it would probably save me time and work.	S	SA	U	SD	D
67.	Figuring out computer problems does not appeal to me.	S	SA	U	SD	D
68.	I sometimes feel intimidated when I have to use a computer.	S	SA	U	SD	D
69.	You have to be a "brain" to work with computers.	S	SA	U	SD	D
70.	Computers can be used successfully with courses which demand creative activities.	S	SA	U	SD	D
71.	If given the opportunity, I would like to learn about and use computers.	S	SA	U	SD	D
72.	I feel comfortable working with a computer.	S	SA	U	SD	D
73.	Someday I will have a computer in my home.	S	SA	U	SD	D
74.	Teacher training should include instructional applications of computers.	S	SA	U	SD	D
75.	Computers are not exciting.	S	SA	U	SD	D
76.	Computers are difficult to use.	S	SA	U	SD	D
77.	I'll need a firm mastery of computers for my future work.	S	SA	U	SD	D
78.	Computer lessons are a favorite subject for me.	S	SA	U	SD	D
79.	Computers do not scare me.	S	SA	U	SD	D
80.	I believe that it is important for me to learn how to use a computer.	S	SA	U	SD	D

Appendix B

Computer Integration
General Curriculum Outcomes

Computer Integration General Curriculum Outcomes

Foundational Concepts and Attitudes

F1	Students will demonstrate an understanding of the nature of computer technology
F2	Students will exhibit a discriminating attitude towards selection and use of information from digital sources
F3	Students will demonstrate a positive, analytical attitude towards the use of computer technology as a tool for lifelong learning
F4	Students will employ ergonomic principles and safe practices when using computer technology

Communication and Information Capabilities

C1	Students will demonstrate the fundamental skills required to use computer systems
C2	Students will use computer-based tools to access, create, assess, organize, manipulate, and communicate information

Information Processes and Strategies

I1	Students will employ information tools, strategies, and processes to examine alternate viewpoints, solve problems, and construct personal knowledge and meaning

Social, Ethical, and Human Issues

S1	Students will demonstrate an understanding of moral, ethical, and legal issues in their use of computer technologies
S2	Students will demonstrate an understanding of impact of computer technologies on self, work, culture, society, and global relationships

Foundational Concepts and Attitudes 1

Students will demonstrate an understanding of the nature of computer technology

Primary:	**At the End of Grade 3, Students will**
F101p	understand that computers are technological tools created by people
F102p	associate common computer technology with specific tasks
F103p	understand that a computer performs functions based on instructions
F104p	recognize the potential for human error when using computers
F105p	apply troubleshooting strategies to address computer problems
F106p	understand that files may be saved to and retrieved from a disk
F107p	demonstrate awareness that adaptive computer technology may be used by persons with disabilities

Elementary:	**At the End of Grade 6, Students will**
F101e	associate common computer technology with specific tasks
F102e	apply troubleshooting strategies to address computer problems
F103e	demonstrate an understanding that files from one application may not work in another application

F104e	demonstrate an understanding that some software applications have specific hardware requirements
F105e	understand that a computer performs functions based on a logical sequence of instructions
F106e	understand that files may be organized in folders and sub-folders
F107e	demonstrate understanding that folders and files may be located on local, network, and distant drives
F108e	understand that software is designed to enable people to perform tasks, that there are many categories of software, and that all software for a category of tasks will have similar features and methods of doing work.

Intermediate: At the End of Grade 9, Students will

F101i	demonstrate an understanding of the concept of software and hardware compatibility
F102i	understand that a computer performs functions based on a logical sequence of instructions
F103i	apply troubleshooting strategies to address computer problems
F104i	demonstrate understanding that folders and files may be located on local, network, and distant drives
F105i	demonstrate understanding of the necessity of folder and file management
v06i	develop awareness that all media can be digitized
F107i	develop awareness that computer technology is constantly changing and evolving
F108i	understand that there are common features across all categories of software

High School: Students will

F101h	continue to demonstrate understanding of all previous key stage outcomes
F102h	recognize that computer technologies can facilitate the solution of complex problems

Foundational Concepts and Attitudes - 2

Students will exhibit a discriminating attitude towards selection and use of information from digital sources

Primary: At the End of Grade 3, Students will

F201p	compare similar types of information from two different electronic sources

Elementary: At the End of Grade 6, Students will

F201e	recognize that graphics, video and sound enhance communication
F202e	describe how the use of various texts and graphics can alter perception
F203e	discuss how computer technology can be used to create special effects
F204e	understand that computer technology can be used to manipulate the intent by altering images and sound

Intermediate: At the End of Grade 9, Students will

F201i	identify computer technology used to access information
F202e	identify aspects of style in a presentation
F203e	understand the nature of various media and how they are consciously used to influence an audience
F204i	analyze the impact of multimedia documents on the intended audience
F205i	identify specific techniques used by the media to elicit particular responses from users

F206i recognize the ability of computer technology to manipulate images and sound can alter the meaning of a communication

High School: Students will

F201h discriminate between style and content in information products
F202h evaluate the influence and results of digital manipulation on perceptions
F203h identify and analyze a variety of factors that affect the authenticity of information derived from mass media and electronic communication

Foundational Concepts and Attitudes - 3

Students will demonstrate a positive, analytical attitude towards the use of computer technology as a tool for lifelong learning

Primary: At the End of Grade 3, Students will

F301p demonstrate a willingness to work independently and/or cooperatively when using computer technology
F302p display confidence when using computer technology through an appropriate level of independence and self-reliance
F303p demonstrate a positive attitude and a willingness to use computer technology
F304p exhibit perseverance and commitment to improving skills and completing tasks
F305p demonstrate desirable attitudes and work habits
F306p demonstrate a willingness to apply trouble shooting strategies to address computer problems

Elementary: At the End of Grade 6, Students will

F301e continue to demonstrate understanding of all previous key stage outcomes

Intermediate: At the End of Grade 9, Students will

F301i continue to demonstrate understanding of all previous key stage outcomes

High School: Students will

F301h continue to demonstrate understanding of all previous key stage outcomes
F302h demonstrate willingness to adopt new computer technologies and to use existing technology in new ways

Foundational Concepts and Attitudes - 4

Students will employ ergonomic principles and safe practices when using computer technology

Primary: At the End of Grade 3, Students will

F401p demonstrate the proper posture when using a computer
F402p demonstrate safe behaviors when using computer technology

Elementary:	**At the End of Grade 6, Students will**
F401e	demonstrate the application of ergonomics to promote personal health and well being
F402e	identify and apply safety procedures required for the computer technology being used
Intermediate:	**At the End of Grade 9, Students will**
F401i	identify risks to health and safety that result from improper use of computer technology
F402i	identify and apply safety procedures required for the computer technology being used
High School:	**Students will**
F401h	assess new physical environments with respect to ergonomics
F402h	identify safety regulations specific to the computer technology being used

Communication and Information Capabilities -1

Students will demonstrate the fundamental skills required to use computer systems

Primary:	**At the End of Grade 3, Students will**
C101p	identify techniques and tools for communication, storing, retrieving and selecting information
C102p	apply terminology and develop a vocabulary appropriate to the computer technologies being used
C103p	perform basic computer operations, including powering up, inserting disks, moving the cursor, clicking on an icon, using pull down menus, executing programs, saving files, retrieving files, printing, ejecting disks, and powering down
C104p	use the keyboard, including shift, enter, space bar, tab, back space, delete and cursor keys appropriately
C105p	make adjustments to computer based audio and video devices
C106p	demonstrate and understanding that information can be transmitted through computer technologies
Elementary:	**At the End of Grade 6, Students will**
C101e	apply terminology and develop a vocabulary appropriate to the computer technologies being used
C102e	identify and apply techniques and tools for communicating, storing, retrieving and selecting information
C103e	correctly Power up and power down various computers and peripherals
C104e	use and organize files and folders
C105e	use peripherals such as scanners, digital cameras, modes and bar code readers
C106e	use appropriate keyboarding techniques for the alphabetic and punctuation keys
C107e	load, download, and save text, images audio and video files
C108e	convert digital text files by opening the and saving them as different file types
Intermediate:	**At the End of Grade 9, Students will**
C101i	perform routine data maintenance and management of personal files on computers and networks
C102i	identify and apply procedures, such as backups and virus scans, use to maintain data integrity and security

C103i	connect and use computer audio, video, and digital devices such as speakers, microphones and cameras
C104i	demonstrate proficiency in loading, downloading and saving text, image, audio and video files
C105i	identify and use a variety of input and output devices
C106i	apply terminology and develop a vocabulary appropriate to the technologies being used
C107i	perform basic computer operations including formatting floppy diskettes
C108i	demonstrate proficiency in keyboarding skills
C109i	demonstrate proficiency in applying techniques and tools for selecting, retrieving, communicating, and storing information
C110i	demonstrate proficiency in keyboarding skills

High School: Students will

C101h	perform routing data maintenance and management of personal files on computers, servers and remote servers
C102h	identify and apply safety procedures, such as backups and virus scans, to maintain data integrity and security
C103h	connect and use computer audio, video and digital devices
C104h	demonstrate proficiency in loading, downloading and saving text, image, audio and video files
C105h	identify and use a variety of input and output devices
C106h	apply computer terminology and develop a vocabulary appropriate to the technology being used

Communication and Information Capabilities - 2

Students will use computer-based tools to access, create, assess, organize, manipulate, and communicate information

Primary: At the End of Grade 3, Students will

C201p	create and revise original text, using word-processing software
C202p	edit documents using features such as cut, copy, and paste to modify sentences
C203p	read information from a prepared database
C204p	create visual images by using tools such as paint and draw programs for particular audiences and purposes
C205p	access sound clips or recorded voice for information purposes
C206p	balance text and graphics for visual effect
C207p	navigate hypertext links
C208p	communicate electronically

Elementary: At the End of Grade 6, Students will

C201e	create and revise original text
C202e	edit, format, clarify and enhance text using features such as thesaurus, spell checking, find/change, text alignment, font size and style
C203e	edit and manipulate data for specific purposes using spreadsheet and/or database tools
C204e	display data electronically through graphs and charts
C205e	create multimedia presentations for a variety of audiences and purposes, incorporating features such as still images, audio clips, and animated images
C206e	integrate a spreadsheet, or graphs generated by a spreadsheet, into a text document

C207e	create a specific visual effect in a document through the use of font style and size, and organization of text and graphics.
C208e	create and navigate a multi-link document
C209e	navigate the Internet and intranet with appropriate software
C210e	select and use the technology appropriate to a given communication situation

Intermediate: At the End of Grade 9, Students will

C201i	select and use the technology appropriate to a given communication situation
C202i	create and revise original text
C203i	design, create and modify a database for a specific purpose
C204i	design, create and modify a spreadsheet for a specific purpose
C205i	use a computer to solve mathematical problems related to issues in any subject area
C206i	create presentations for a variety of audiences and purposes, incorporating multimedia features
C207i	integrate information from a database into other documents
C208i	create and edit web pages, employing links to images, audio and video files
C209i	create a specific visual effect in a document through the use of font style and size, and organization of text and graphics.
C210i	demonstrate proficiency in the use of information retrieval and storage
C211i	communicate with a target audience, within a controlled environment, using communications strategies and tools such as discussion groups and web browsers
C212i	plan a conduct a search using a wide variety of electronic sources and tools
C213i	refine searches so that sources are limited to a manageable number

High School: Students will

C201h	create and modify text
C202h	design, create and modify databases for specific purposes
C203h	design, create and modify spreadsheets for specific purposes
C204h	use a variety of computer tools to construct graphs showing relationships
C205h	use a computer to solve problems in other subject areas
C206h	select the appropriate computer tool to manipulate and communicate data
C207h	create presentations for a variety of audiences and purposes, incorporating multimedia features
C208h	use macros to combine and simplify tasks
C209h	integrate information from databases and spreadsheets into documents
C210h	demonstrate proficiency in keyboarding
C211h	apply principles of graphic design to enhance meaning and audience appeal
C212h	create web pages incorporating links to a variety of digital media and sources
C213h	communicate with a target audience, within a controlled environment, using communications strategies and tools such as discussion groups and web browsers
C214h	plan and conduct a search using a wide variety of electronic sources and tools
C215h	refine searches so that sources are limited to a manageable number

Information Processes and Strategies

Students will employ information tools, strategies, and processes to examine alternate viewpoints, solve problems, and construct personal knowledge and meaning

Primary:	**At the End of Grade 3, Students will**
I101p	develop questions that reflect a personal information need
I102p	follow a prepared plan to complete an inquiry
I103p	distinguish between relevant and irrelevant information from electronic sources
I104p	summarize data by picking key words from gathered information and by using jot notes, point form or retelling
I105p	formulate new questions as inquiry progresses
I106p	organize information from more than one source
I107p	compare and contrast information from similar types of electronic sources
I108p	recognize that various authorities can hold different viewpoints
I109p	share information collected from electronic sources to add to a group task
I110p	draw conclusions and/or make predictions based on organized information

Elementary:	**At the End of Grade 6, Students will**
I101e	identify and develop questions pertinent to a problem or issue
I102e	use brainstorming and webbing to generate ideas for solving a problem, and use computer technology to record and share the results
I103e	given predetermined criteria, assess ideas to solve a problem by employing computer technology
I104e	design and follow a plan, including a schedule, for an inquiry process, and make revisions as necessary
I105e	seek responses to inquiries from various authorities through electronic media
I106e	identify and distinguish points of view expressed in electronic sources
I107e	recognize that data from electronic sources may need to be verified
I108e	organize, analyze and synthesize information using tools such as a database, spreadsheet or hypertext
I109e	extend collaboration beyond the classroom by using communication technologies
I110e	communicate the results using a variety of computer technologies
I111e	reflect on and describe the processes involved in completing an inquiry

Intermediate:	**At the End of Grade 9, Students will**
I11i	identify and develop questions pertinent to a problem or issue
I102i	use networks to brainstorm, plan and share ideas with group members
I103i	assess complex social, economic and environmental relationships by employing simulation tools such as Civilization and Ant
I104i	create a plan for an inquiry that includes consideration of time management
I105i	demonstrate the advanced search skills necessary to limit the number of hits desired for online and offline databases; for example, the use of appropriate descriptors and Boolean operators
I106i	develop a process to manage volumes of information that can be available through electronic sources
I107i	evaluate choices and the progress in problem solving, then redefine the plan of action as appropriate
I108i	assess different viewpoints and identify bias, fact and opinion
I109i	assess electronic sources for authority and reliability
I110i	use technology to find information that supports or refute diverse viewpoints
I111i	organize data by making connections and assemble it into a coherent message
I112i	extend collaboration beyond the classroom by using communication technologies to network with other individuals and groups
I113i	communicate the results using a variety of computer technologies
I114i	reflect on and describe the processes involved in completing an inquiry

I115i	use appropriate strategies to locate and assess information
I116i	demonstrate discriminatory selection of information from electronic sources
I117i	evaluate the problem solving process and redefine the plan of action as necessary

High School: Students will

I101h	identify and develop questions pertinent to a problem or issue (researchable, chance of success)
I102h	participate in a variety of electronic group formats
I103h	generate new understandings of problem situations by using modeling software such as Sim Earth, GIS and molecular simulators
I104h	manage an inquiry by using computer tools such as calendars, time management or project management tools
I105h	use appropriate strategies to locate and assess information
I106h	demonstrate discriminatory selection of information from electronic sources
I107h	evaluate the problem solving process and change the plan as necessary
I108h	consult a wide variety of sources that reflect varied viewpoints on particular topics
I109h	evaluate the validity of gathered viewpoints against other sources
I110h	use telecommunications to pose critical questions to experts
I111h	assess the authority, reliability and validity of electronically accessed information
I112h	analyze and synthesize information to determine patterns and links among ideas
I113h	use appropriate presentation software to demonstrate personal understandings
I114h	develop a personal opinion on the issue of censorship on the Internet

Social, Ethical, and Human Issues - 1

Students will demonstrate an understanding of moral, ethical, and legal issues in their use of computer technologies

Primary: At the End of Grade 3, Students will

S101p	demonstrate courtesy and proper procedures when using computer technologies
S102p	demonstrate willingness to share resources
S103p	recognize and acknowledge the ownership of electronic material
S104p	use proper netiquette
S105p	understand that there are acceptable and unacceptable practices

Elementary: At the End of Grade 6, Students will

S101e	comply with the school's acceptable use policy for computers
S102e	demonstrate willingness to share resources
S103e	use proper communication language and netiquette
S104e	document electronic sources, including web site addresses
S105e	respect the products and privacy of others
S106e	comply with copyright regulations
S107e	demonstrate an understanding of the need for security and privacy of electronic information
S108e	practice the socially responsible use of use of electronic information

Intermediate: At the End of Grade 9, Students will

S101i	comply with the school acceptable use policy for computers
S102i	use time and computer resources wisely
S103i	cite sources when using copyright and/or public domain material

S104i	model and assume personal responsibility for ethical behavior and attitudes
S105i	consider ethical and legal issues when using information
S106i	use proper communication language and netiquette
S107i	respect ownership and integrity of electronic information

High School: Students will

S101h	comply with the school acceptable use policy for computers
S102h	use time and computer resources wisely
S103h	demonstrate an understanding of how changes in computer technology can benefit or harm society
S104h	record relevant data for acknowledging sources of information and cite sources
S105h	understand the need for and the use of copyright legislation
S106h	develop guidelines for evaluating and using information and emerging technologies in ethical ways
S107h	apply ethical and legal principles when presenting information
S108h	understand the issues involved in balancing the right of access with the right to personal privacy in electronic communications
S109h	advocate legal and ethical behaviors amongst colleagues and acquaintances regarding the use of technology and information

Social, Ethical, and Human Issues - 2

Students will demonstrate an understanding of impact of computer technologies on self, work, culture, society, and global relationships

Primary: At the End of Grade 3, Students will

S201p	identify ways computers are used at work and play, at school and home, and in the community
S202p	recognize that proficiency in the use of computers is essential for all people
S203p	describe how computer technology allows communication with others

Elementary: At the End of Grade 6, Students will

S201e	identify ways computers are used at work and play, at school and home, and in the global community
S202e	recognize that proficiency in the use of computers is essential for all people
S203e	compare computer mediated communications to other forms of communication
S204e	recognize that information can be digitally modified to influence peoples perceptions, attitudes, and decisions

Intermediate: At the End of Grade 9, Students will

S201i	recognize ways that computers have been used to help build the global community
S202i	recognize that proficiency in use of computers is essential, but that individual uses and skills may vary
S203i	describe how computer mediated communications affects the way we communicate and what we communicate
S204i	recognize that information can be digitally modified to influence peoples perceptions, attitudes, and decisions

High School: Students will

S201h	describe the consequences of the emergence of a computer-based global community
S202h	recognize that proficiency in use of computers is essential and enables a citizen to become a more effective participant in society
S203h	describe how computer-mediated communications affects the nature of human relationships between individuals and within groups, including within families, at work, and within organizations
S204h	identify ways that information can be digitally modified to influence peoples perceptions, attitudes, and decisions
S205h	describe how computer-mediated communications affects the structure and dynamics of organizations
S206h	analyze the effect of computer technologies on innovation and creativity
S207h	analyze the impact on society of innovativeness and creativity in the design and development of computer-based technology

Sample Specific Learning Outcomes

C104p	Demonstrate keyboarding skills, including: alphabetic, punctuation, and control keys (ie. shift, enter, space bar, etc.)				
	The student will	K	1	2	3
c104p.1	understand the relative position of the keys on a keyboard				
0.2	identify and use: letter and number keys; punctuation and symbol keys; space bar, return/enter, delete, backspace keys;				
0.3	use informal keyboarding skills to type words, phrases, and sentences				
0.4	use informal keyboarding skills to type a paragraph				
0.5	use: shift, caps lock, tab, arrow and control keys				
0.6	demonstrate formal keyboarding skills in using the alphabetic and punctuation keys				

C1-e04	use and organize files and folders				
	The student will	K	1	2	3
C104e.1	change the name of a file				
0.2	select single and multiple files with a mouse				
0.3	delete selected files with a mouse				
0.4	create, move, and delete folders				
0.5	organize files into appropriately named folders				
0.6	write-protect a disk				
0.7	copy files from one disk to another				
0.8	backup files				

Appendix C

International Society for Technology in Education Recommended Foundation Standards for Teachers

ISTE Recommended Foundation Standards for Teachers

International Society for Technology in Education Recommended Foundations in Technology for All Teachers

I. Foundations. The ISTE Foundation Standards reflect professional studies in education that provide fundamental concepts and skills for applying information technology in educational settings. All candidates seeking initial certification or endorsements in teacher preparation programs should have opportunities to meet the educational technology foundation standards.

A. Basic Computer/Technology Operations and Concepts. Candidates will use computer systems and run software to access, generate, and manipulate data and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed.

1. Operate a multimedia computer system with related peripheral devices to successfully install and use a variety of software packages.
2. Use terminology related to computers and technology appropriately in written and oral communications.
3. Describe and implement basic troubleshooting techniques for multimedia computer systems with related peripheral devices.
4. Use imaging devices such as scanners, digital cameras, and/or video cameras with computer systems and software.
5. Demonstrate knowledge of uses of computers and technology in business, industry, and society.

B. Personal and Professional Use of Technology. Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research, and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer/technology resources.

1. Use productivity tools for word processing, data base management, and spreadsheet applications.
2. Apply productivity tools for creating multimedia presentations.
3. Use computer-based technologies, including telecommunications, to access information and enhance personal and professional productivity.

4. Use computers to support problem-solving, data collection, information management, communications, presentations, and decision-making.
5. Demonstrate awareness of resources for adaptive assistive devices for students with special needs.
6. Demonstrate knowledge of equity, ethics, legal, and human issues concerning use of computers and technology.
7. Identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator.
8. Observe demonstrations or uses of broadcast instruction, audio/video conferencing, and other distance learning applications.

C. Application of Technology in Instruction. Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software, applications, and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.

1. Explore, evaluate, and use computers/technology resources, including applications, tools, educational software, and associated documentation.
2. Describe current instructional principles, research, and appropriate assessment practices as related to the use of computers and technology resources in the curriculum.
3. Design, deliver, and assess student learning activities that integrate computers/technology for a variety of student group strategies and for diverse student populations.
4. Design student learning activities that foster equitable, ethical, and legal use of technology by students.
5. Practice responsible, ethical, and legal use of technology, information, and software resources.

Appendix D

Correspondence

School District #3

Corner Brook-Deer Lake-St. Barbe

David Quick, Assistant Director - Programs

Tel. (709) 637-4014; (709) 637-4016 Fax. (709) 639-1733

P.O. Box 368, 10 wellington Street
Corner Brook, NF A2H 6G9

Memo

TO:	All Principals
From:	David Quick, Assistant Director - Programs
Subject:	Professional Development Needs Survey
Date:	February 5, 1999

The attached survey has been approved by District Office to assess the Professional Development Needs of teachers and schools with respect to technology literacy.

We are asking your cooperation to have each teacher in your school complete a survey and return the survey to you. We would like to have the surveys returned to District Office by Friday February 19, 1999. The survey will take approximately twenty (20) minutes to complete. It is important that every member of the staff complete the survey.

The primary goal of this survey is to gather information to:

1. Plan programs and inservice sessions for the Technology Education Center
2. Prepare short term and long term professional development plans for teachers in the District.
3. Allow schools to plan professional development opportunities for their staff.

Bruce King has prepared the instrument in conjunction with the School District and the Technology Education Center. He has been given permission to use some of the data collected for a Master of Education thesis under the direction of Dr. Don Downer and Dr. Dennis Sharpe, Memorial University of Newfoundland. You will note that teachers are not asked to identify themselves. If any teachers have reservations about the use of the data for this purpose, they should contact me as soon as possible.

Once the data has been analyzed, a copy of the results for your school will be returned to you to assist in your professional development.

Thank-you for your cooperation in this matter

David Quick

Technology Education Center
University Drive
Corner Brook, NF

To All Staff Members

A number of weeks ago a Technology needs survey was distributed to schools by the district. The intent of this survey was to determine the actual need of technology inservice for teachers. We need to do this for a number of reasons:

1. Technology literacy is a recognized need by parents, teachers, school councils, school boards, the province and the nation.
2. In dozens of recent educational studies student use of technology has been cited for improved student performance, interest, motivation and behavior.
3. In the near future there will be a set of provincial computer integration outcomes that will be implemented across the curriculum. (Draft Copy available from district office.)
4. Schools and teachers are asking for Professional development in computers and technology
5. The district is attempting to develop a 3-5 year plan for technology inservice
6. The Technology Education Center is in the process of developing summer institutes and programs for the next school year.
7. Schools are planning technology professional development
8. Schools are implementing school improvement plans.
9. We need to reverse the cut in the number of inservice days available.
10. We need to justify a person in the schools to assist teachers with technology.

If we are to meet student and curriculum needs in the area of technology literacy we need to train teachers in the use of technology in the classroom. In order to develop sound professional development plans for technology in the district, at the TEC, and in the schools we need a thorough analysis of the technology related skills of teachers. For a solid assessment we need all the surveys sent back. In order to return usable data for a school to create an effective technology PD plan for the teachers in the school we need virtually all of the teachers in that school to complete and return the technology needs assessment survey.

The demonstrated need for inservice will allow the district and school councils to show the Provincial Department of Education the need for increasing the allocation for professional development days. As well some of the schools councils in this area are in the process of gathering support for increasing the formulas for allocation of specialist personnel to schools. Included in the presentation is a proposal to add a specialist person to the school allocation formulas whose time is allocated to working with teachers and students in computer technology.

These are important issues for the technology literacy development of students. Planning time for these issues is getting short. We need to get the information now, to get on with this planning as soon as possible. Those teachers who have not completed and returned the technology needs assessment are asked to do so in the next couple of days and principals are asked to send them to the board office by the end of the week. We realize that teachers are busy people and that the survey will take 20 minutes of valuable time to complete. We appreciate your cooperation in this matter.

Thank you

Bruce King

Bruce King

Appendix E

Reliability Correlation Matrix for the Competency Scale and Subscales

Table E.1 Reliability Correlation Matrix for the Professional Productivity Scale

	PPA1	PPA2	PPA3	PPA4	PPA5	PPA6	PPA7	PPA8	PPA9	PPA10	PPA11	PPA12
PPA1												
PPA2	0.6152											
PPA3	0.6267	0.5498										
PPA4	0.7685	0.6635	0.5860									
PPA5	0.6139	0.7052	0.4754	0.7287								
PPA6	0.5394	0.6353	0.4578	0.6553	0.8307							
PPA7	0.3842	0.4217	0.4547	0.4076	0.5010	0.5279						
PPA8	0.4843	0.5653	0.4388	0.5843	0.7528	0.8227	0.5534					
PPA9	0.4783	0.6140	0.4178	0.5993	0.8360	0.8031	0.4955	0.8377				
PPA10	0.5004	0.5722	0.4409	0.6152	0.7472	0.7675	0.4906	0.7609	0.7867			
PPA11	0.4386	0.5191	0.4278	0.5630	0.6760	0.7258	0.4749	0.6914	0.7078	0.8557		
PPA12	0.5381	0.5873	0.4423	0.6473	0.7253	0.7375	0.4481	0.7038	0.7342	0.8077	0.8077	
ETMB13	0.5207	0.4354	0.5183	0.5087	0.4733	0.4545	0.4190	0.4375	0.4235	0.5132	0.5000	0.5187
ETMB14	0.6000	0.5360	0.5377	0.6030	0.5753	0.5914	0.4210	0.5448	0.5087	0.5921	0.5871	0.6195
ETMB15	0.4254	0.4334	0.3961	0.4692	0.4995	0.5300	0.3912	0.4881	0.4674	0.5648	0.5647	0.5712
ETMC16	0.6857	0.6188	0.5526	0.7100	0.6502	0.6267	0.3837	0.5461	0.5425	0.6116	0.6019	0.6708
ETMC17	0.5653	0.5901	0.4525	0.6317	0.6729	0.6664	0.4232	0.5937	0.6192	0.6635	0.6756	0.7637
ETMC18	0.4897	0.5896	0.4364	0.5867	0.6259	0.6700	0.4016	0.6067	0.6252	0.6909	0.6994	0.7313
ETMC19	0.5509	0.5625	0.4880	0.6391	0.6233	0.6362	0.3988	0.5804	0.5641	0.6239	0.6181	0.6564

(Continued)

Table E.1 (Continued)

	ETMB13	ETMB14	ETMB15	ETMC16	ETMC17	ETMC18	ETMC19	mean	SD
PPA1								6.30	2.5
PPA2								4.75	2.8
PPA3								6.65	2.1
PPA4								5.13	2.8
PPA5								3.64	2.6
PPA6								2.93	2.3
PPA7								4.06	2.6
PPA8								2.82	2.3
PPA9								2.83	2.4
PPA10								2.89	2.3
PPA11								2.72	2.2
PPA12								3.10	2.4
ETMB13								4.96	2.4
ETMB14	0.7735							4.86	2.6
ETMB15	0.5698	0.6469						3.20	2.3
ETMC16	0.6392	0.7662	0.5759					5.53	2.5
ETMC17	0.5758	0.6814	0.6105	0.7742				4.33	2.5
ETMC18	0.5441	0.6753	0.5641	0.7089	0.7546			3.42	2.5
ETMC19	0.6037	0.7476	0.6066	0.7870	0.7357	0.7546		4.75	2.6

Cronbach's alpha = .9647

Table E.2 Reliability Correlation Matrix for Subscale - Operate Computers, Related Technologies and Software Applications

	PPA1	PPA2	PPA3	PPA4	PPA5	PPA6	PPA7	PPA8	PPA9	PPA10	PPA11	PPA12	mean	SD
PPA1													6.29	2.6
PPA2	0.6185												4.75	2.8
PPA3	0.6259	0.5498											6.66	2.1
PPA4	0.7704	0.6672	0.5852										5.13	2.8
PPA5	0.6156	0.7060	0.4749	0.7294									3.63	2.6
PPA6	0.5399	0.6343	0.4563	0.6545	0.8308								2.92	2.3
PPA7	0.3860	0.4227	0.4524	0.4092	0.5023	0.5291							4.05	2.6
PPA8	0.4850	0.5649	0.4376	0.5840	0.7531	0.8230	0.5543						2.81	2.3
PPA9	0.4790	0.6131	0.4167	0.5988	0.8361	0.8034	0.4966	0.8380					2.83	2.4
PPA10	0.5039	0.5763	0.4429	0.6185	0.7468	0.7649	0.4896	0.7584	0.7841				2.89	2.3
PPA11	0.4426	0.5246	0.4303	0.5670	0.6733	0.7188	0.4708	0.6851	0.7013	0.8567			2.73	2.2
PPA12	0.5385	0.5864	0.4406	0.6464	0.7256	0.7380	0.4496	0.7043	0.7347	0.8044	0.7991		3.10	2.4

Cronbach's alpha = .9486

Table E.3 Reliability Correlation Matrix for the subscale - Basic

	PPA1	PPA2	PPA3	PPA4	PPA5	PPA6	mean	SD
PPA1							6.30	2.6
PPA2	0.6247						4.73	2.8
PPA3	0.6268	0.5574					6.66	2.1
PPA4	0.7734	0.6689	0.5884				5.12	2.8
PPA5	0.6170	0.7086	0.4799	0.7298			3.63	2.6
PPA6	0.5423	0.6365	0.4605	0.6552	0.8316		2.92	2.3

Cronbach's alpha = .9120

Table E.4 Reliability Correlation Matrix for the subscale - Advanced

	PPA6	PPA7	PPA8	PPA9	PPA10	PPA11	PPA12	mean	SD
PPA6								2.92	2.3
PPA7	0.5291							4.05	2.6
PPA8	0.8230	0.5543						2.81	2.3
PPA9	0.8034	0.4966	0.8380					2.83	2.4
PPA10	0.7649	0.4896	0.7584	0.7841				2.89	2.3
PPA11	0.7188	0.4708	0.6851	0.7013	0.8567			2.73	2.2
PPA12	0.7380	0.4496	0.7043	0.7347	0.8044	0.7991		3.10	2.4

Cronbach's alpha = .9228

Table E.5 Reliability Correlation Matrix for Subscale - Evaluate Technology Materials

	ETMB13	ETMB14	ETMB15	mean	SD
ETMB13				4.97	2.4
ETMB14	0.7760			4.86	2.6
ETMB15	0.5664	0.6465		3.18	2.3

Cronbach's alpha = .8560

Table E.6 Reliability Correlation Matrix for Subscale - Access Information

	ETMC16	ETMC17	ETMC18	ETMC19	mean	SD
ETMC16					5.53	2.5
ETMC17	0.7708				4.32	2.5
ETMC18	0.7057	0.7500			3.41	2.5
ETMC19	0.7844	0.7363	0.7489		4.74	2.6

Cronbach's alpha = .9228

Table E.7 Reliability Correlation Matrix for the Integrating Technology Scale

	ITA20	ITA21	ITA22	ITA23	ITA24	ITA25	ITA26	ITB27	ITB28	ITB29	ITB30	ITB31A
ITA20												
ITA21	0.6526											
ITA22	0.7294	0.6329										
ITA23	0.6758	0.6165	0.7226									
ITA24	0.6318	0.5084	0.5687	0.6675								
ITA25	0.6761	0.5027	0.6856	0.7271	0.6771							
ITA26	0.6764	0.5592	0.7043	0.7217	0.6116	0.8041						
ITB27	0.6809	0.5340	0.7733	0.6620	0.5921	0.6961	0.7080					
ITB28	0.6455	0.6036	0.6468	0.7408	0.5977	0.6566	0.6723	0.6811				
ITB29	0.5791	0.6025	0.5619	0.6632	0.5584	0.5893	0.6184	0.5454	0.7413			
ITB30	0.6727	0.5404	0.6490	0.7935	0.6171	0.6736	0.6979	0.6755	0.7200	0.6796		
ITB31A	0.5967	0.5884	0.5939	0.7149	0.5844	0.6441	0.6614	0.5580	0.7489	0.7321	0.6974	
ITB31B	0.5809	0.5399	0.6098	0.7600	0.6018	0.6525	0.6526	0.5688	0.6649	0.6491	0.6884	0.7500
ITB32	0.6207	0.4669	0.5880	0.6975	0.5608	0.6438	0.6512	0.6479	0.6440	0.5880	0.6957	0.7011
ITB33	0.5577	0.4870	0.5381	0.6972	0.5275	0.6131	0.6167	0.5599	0.6125	0.5972	0.6414	0.6946
ITC34	0.6334	0.5122	0.6677	0.6552	0.5352	0.6616	0.6525	0.6488	0.6302	0.5639	0.5972	0.6182
ITC35	0.4649	0.3798	0.5489	0.4402	0.3207	0.4881	0.4893	0.5316	0.4739	0.4075	0.4196	0.4473
ITC36	0.6354	0.5112	0.6925	0.6402	0.5194	0.6704	0.6542	0.6546	0.6267	0.5526	0.6202	0.6103
ITC37	0.5302	0.4412	0.6030	0.5382	0.4117	0.5750	0.5692	0.5853	0.5688	0.5008	0.5351	0.5216

(Continued)

Table E.7 (Continued)

	ITB31B	ITB32	ITB33	ITC34	ITC35	ITC36	ITC37	mean	SD
ITA20								3.86	2.4
ITA21								2.70	1.9
ITA22								4.00	2.4
ITA23								3.05	2.4
ITA24								3.08	2.4
ITA25								3.43	2.4
ITA26								3.22	2.3
ITB27								4.51	2.5
ITB28								2.97	2.2
ITB29								2.37	1.9
ITB30								3.03	2.3
ITB31A								2.28	1.9
ITB31B								2.28	1.9
ITB32	0.6968							2.66	2.5
ITB33	0.7170	0.8449						2.05	2.0
ITC34	0.6038	0.6670	0.6120					3.70	2.6
ITC35	0.4007	0.4533	0.3865	0.6679				4.76	2.6
ITC36	0.5656	0.6254	0.5787	0.8018	0.7177			3.90	2.6
ITC37	0.4784	0.5334	0.4555	0.6809	0.8008	0.7621		4.29	2.7

Cronbach's alpha = .9969

Table E.8 Reliability Correlation Matrix for the subscale - Evaluate, Select and Apply Technology

	ITA20	ITA21	ITA22	ITA23	ITA24	ITA25	ITA26	mean	SD
ITA20								3.85	2.4
ITA21	0.6450							2.73	2.0
ITA22	0.7263	0.6405						4.02	2.4
ITA23	0.6677	0.6210	0.7238					3.08	2.4
ITA24	0.6239	0.4983	0.5691	0.6633				3.08	2.4
ITA25	0.6739	0.5023	0.6906	0.7263	0.6784			3.44	2.4
ITA26	0.6689	0.5646	0.7104	0.7268	0.6137	0.8057		3.24	2.4

Cronbach's alpha = .9301

Table E.9 Reliability Correlation Matrix for the subscale - Use Emerging Technologies

	ITB27	ITB28	ITB29	ITB30	ITB31A	ITB31B	ITB32	ITB33	mean	SD
ITB27									4.51	2.5
ITB28	0.6765								2.97	2.2
ITB29	0.5445	0.7415							2.37	1.9
ITB30	0.6696	0.7212	0.6798						3.02	2.3
ITB31A	0.5539	0.7464	0.7309	0.6957					2.26	1.9
ITB31B	0.5645	0.6628	0.6481	0.6866	0.7509				2.27	1.9
ITB32	0.6465	0.6397	0.5863	0.6897	0.6988	0.6945			2.66	2.5
ITB33	0.5536	0.6106	0.5960	0.6398	0.6953	0.7176	0.8420		2.04	2.0

Cronbach's alpha = .9384

Table E.10 Reliability Correlation Matrix for Subscale - Demonstrate Ethical Use of Technology

	ITC34	ITC35	ITC36	ITC37	mean	SD
ITC34					3.69	2.6
ITC35	0.6682				4.77	2.6
ITC36	0.8055	0.7173			3.91	2.6
ITC37	0.6815	0.7996	0.7624		4.29	2.7

Cronbach's alpha = .9189

Table E.11 Reliability Correlation Matrix for the Student Inquiry Scale

	DDSTAA39	DDSTAA40	DDSTAA41	DDSTAA42	DDSTAA43	DDSTAA44	DDSTAA45	DDSTAB46	DDSTAB47	DDSTAB48	mean	SD
DDSTAA39											3.56	2.5
DDSTAA40	0.7533										3.91	2.5
DDSTAA41	0.7620	0.8047									4.25	2.7
DDSTAA42	0.6929	0.7850	0.7918								3.65	2.5
DDSTAA43	0.6605	0.8027	0.7633	0.8207							3.38	2.7
DDSTAA44	0.6556	0.7633	0.7546	0.7906	0.8647						3.18	2.4
DDSTAA45	0.6130	0.6717	0.6377	0.7241	0.7744	0.8237					3.14	2.3
DDSTAB46	0.5759	0.6115	0.6305	0.6236	0.6121	0.6912	0.6863				3.14	2.4
DDSTAB47	0.6441	0.6869	0.6675	0.6988	0.7130	0.7803	0.7261	0.7700			2.60	2.1
DDSTAB48	0.6034	0.6411	0.5887	0.6680	0.6830	0.6788	0.7022	0.6781	0.8294		2.35	1.8

Cronbach's alpha = .9593

Table E.12 Reliability Correlation Matrix for the subscale - Design, Develop, and Support Technology Activities

	DDSTAA39	DDSTAA40	DDSTAA41	DDSTAA42	DDSTAA43	DDSTAA44	DDSTAA45	mean	SD
DDSTAA39								3.57	2.50
DDSTAA40	0.7474							3.90	2.50
DDSTAA41	0.7566	0.8041						4.24	2.70
DDSTAA42	0.6930	0.7810	0.7863					3.66	2.50
DDSTAA43	0.6572	0.8026	0.7530	0.8191				3.37	2.40
DDSTAA44	0.6532	0.7638	0.7659	0.7895	0.8654			3.17	2.30
DDSTAA45	0.6095	0.6741	0.6397	0.7205	0.7753	0.8235		3.13	2.40

Cronbach's alpha = .9531

Table E.12 Correlation Matrix for Subscale - Use Technology in Assessing Student Work

	DDSTAB46	DDSTAB47	DDSTAB48	ITC37	mean	SD
DDSTAB46					3.12	2.4
DDSTAB47	0.7701				2.58	2.1
DDSTAB48	0.6796	0.8321			2.34	1.8

Cronbach's alpha = .8966

Appendix F

Reliability Correlation Matrices for the Attitudinal Scale

Table F.1 Reliability Correlation Matrix for the Enthusiasm/Enjoyment Scale

	TATC1	TATC7	TATC13	RTATC19	TATC25	TATC31	TATC37	TATC43
TATC1								
TATC7	0.5142							
TATC13	0.5925	0.5981						
RTATC19	0.4100	0.5057	0.5425					
TATC25	0.5159	0.6147	0.6876	0.5877				
TATC31	0.5304	0.5430	0.6305	0.4820	0.6136			
TATC37	0.4663	0.4794	0.5057	0.4798	0.4518	0.5180		
TATC43	0.5463	0.5919	0.6272	0.5585	0.6839	0.6444	0.5011	
TATC49	0.5388	0.4814	0.5927	0.4744	0.6183	0.5309	0.4348	0.5811
TATC55	0.5280	0.5132	0.6087	0.5311	0.7507	0.6050	0.4858	0.7145
TATC61	0.4772	0.5151	0.5506	0.4707	0.6283	0.5656	0.4139	0.6726
RTATC67	0.3352	0.3217	0.3847	0.3389	0.4164	0.3729	0.2379	0.4589
TATC71	0.5104	0.5171	0.5335	0.4648	0.5119	0.5228	0.6135	0.5758
RTATC75	0.5449	0.4829	0.6216	0.5326	0.5388	0.5495	0.4965	0.6594
TATC78	0.4877	0.4290	0.5101	0.3743	0.5675	0.5393	0.3540	0.5628

(continued)

Table F.1 (Continued)

	TATC49	TATC55	TATC61	RTATC67	TATC71	RTATC75	TATC78	mean	SD
TATC1								1.57	0.7
TATC7								1.59	0.8
TATC13								1.77	0.9
RTATC19								1.58	0.9
TATC25								1.81	0.9
TATC31								1.97	0.9
TATC37								1.36	0.7
TATC43								1.78	0.9
TATC49								2.23	1.1
TATC55	0.6202							1.95	1.0
TATC61	0.5077	0.6506						1.85	1.0
RTATC67	0.5151	0.5233	0.3626					3.00	1.3
TATC71	0.4724	0.5267	0.5430	0.2634				1.44	0.7
RTATC75	0.5709	0.6061	0.5619	0.4221	0.5570			1.87	1.0
TATC78	0.5904	0.6020	0.4917	0.5308	0.3966	0.4919		2.91	1.2

Cronbach's alpha = .9379

Table F.2 Reliability Correlation Matrix for the Computer Anxiety Scale

	RTATC2	RTATC8	RTATC14	RTATC20	RTATC26	TATC32	RTATC38	RTATC44
RTATC2								
RTATC8	0.7146							
RTATC14	0.5996	0.6861						
RTATC20	0.6263	0.7394	0.6625					
RTATC26	0.6185	0.6385	0.5484	0.6068				
TATC32	0.5769	0.6037	0.5291	0.5662	0.5809			
RTATC38	0.6432	0.6918	0.3579	0.6444	0.5538	0.5851		
RTATC44	0.5042	0.5204	0.4410	0.4440	0.4387	0.5251	0.6092	
RTATC50	0.6390	0.6839	0.5919	0.5901	0.5744	0.6232	0.5978	0.5475
RTATC56	0.4339	0.4241	0.4677	0.4107	0.4707	0.5140	0.4829	0.4993
TATC62	0.5986	0.6428	0.5410	0.5960	0.5321	0.6676	0.5802	0.5016
RTATC68	0.5571	0.6235	0.5270	0.5703	0.5609	0.6824	0.5957	0.5709
TATC72	0.5838	0.7013	0.5980	0.6303	0.5724	0.7533	0.5942	0.4567
RTATC76	0.4819	0.4943	0.4559	0.4742	0.5345	0.4685	0.4715	0.4582
TATC79	0.4945	0.5953	0.4970	0.5619	0.4448	0.5674	0.5551	0.4545

(Continued)

Table F.2 (Continued)

	RTATC50	RTATC56	TATC62	RTATC68	TATC72	RTATC76	TATC79	mean	SD
RTATC2								1.99	1.3
RTATC8								2.03	1.2
RTATC14								1.81	1.1
RTATC20								1.87	1.2
RTATC26								2.27	1.3
TATC32								2.92	1.3
RTATC38								2.06	1.2
RTATC44								2.64	1.4
RTATC50								2.19	1.2
RTATC56	0.4574							2.54	1.2
TATC62	0.5918	0.4747						2.37	1.2
RTATC68	0.6592	0.5344	0.5979					2.58	1.3
TATC72	0.6402	0.4604	0.7641	0.6283				2.16	1.1
RTATC76	0.4661	0.5868	0.5211	0.4979	0.4934			2.16	1.1
TATC79	0.5855	0.4285	0.5601	0.5728	0.6232	0.3945		2.35	1.3

Cronbach's alpha = .9498

Table F.3 Reliability Correlation Matrix for the Computer Avoidance Scale

	RTATC3	RTATC9	RTATC15	RTATC21	RTATC27	RTATC33	TATC39	TATC45
RTATC3								
RTATC9	0.1632							
RTATC15	0.2594	0.2263						
RTATC21	0.3989	0.2121	0.3052					
RTATC27	0.2988	0.3216	0.4549	0.4528				
RTATC33	0.0979	0.1600	0.1179	0.1387	0.1778			
TATC39	0.1606	0.2011	0.2990	0.2070	0.2235	0.0306		
TATC45	0.1609	0.2724	0.3224	0.2402	0.3314	0.1412	0.4794	
RTATC51	0.2553	0.0857	0.2145	0.3370	0.2517	0.0528	0.2485	0.2655
RTATC57	0.2946	0.2158	0.2997	0.3672	0.4331	0.0578	0.2264	0.3521
TATC63	0.2924	0.2685	0.4044	0.3605	0.4324	0.0677	0.2559	0.5006
RTATC69	0.2576	0.2235	0.1602	0.2955	0.2443	0.1606	0.1922	0.2562
TATC73	0.2868	0.1398	0.2184	0.2845	0.3027	0.0352	0.2100	0.3441

(Continued)

Table F.3 (Continued)

	RTATC51	RTATC57	TATC63	RTATC69	TATC73	mean	SD
RTATC3						1.16	0.5
RTATC9						1.37	0.8
RTATC15						1.37	0.7
RTATC21						1.4	0.8
RTATC27						1.91	1.2
RTATC33						2.25	1.1
TATC39						1.23	0.5
TATC45						1.29	0.5
RTATC51						1.59	0.9
RTATC57	0.4263					1.87	1.1
TATC63	0.2192	0.4310				1.45	0.7
RTATC69	0.1384	0.2983	0.2574			1.47	0.7
TATC793	0.2678	0.1988	0.2749	0.1754		1.35	0.7

Cronbach's alpha = .7977

Table F.4 Reliability Correlation Matrix for the Attitude Toward Email Scale

	TATC4	TATC10	TATC16	TATC22	TATC28	TATC34	TATC40
TATC4							
TATC10	0.6565						
TATC16	0.6333	0.7417					
TATC22	0.6478	0.7053	0.7507				
TATC28	0.6233	0.6216	0.7351	0.6809			
TATC34	0.4552	0.4459	0.4940	0.4699	0.4947		
TATC40	0.5592	0.5359	0.5800	0.6012	0.5792	0.5413	
TATC46	0.4924	0.4841	0.5192	0.5219	0.5461	0.4434	0.5720
TATC52	0.4952	0.5082	0.5141	0.5512	0.6044	0.4511	0.5616
TATC58	0.4613	0.4382	0.4889	0.5335	0.5196	0.4753	0.5497
TATC64	0.3159	0.3144	0.3620	0.3325	0.3530	0.3570	0.3156

(Continued)

Table F.4 (Continued)

	TATC46	TATC52	TATC58	TATC64	mean	SD
TATC4					2.09	0.9
TATC10					2.11	0.9
TATC16					2.24	0.9
TATC22					2.24	0.9
TATC28					2.37	0.9
TATC34					2.64	0.9
TATC40					2.28	0.8
TATC46					2.52	0.9
TATC52	0.5793				2.33	0.9
TATC58	0.5588	0.6073			2.41	0.9
TATC64	0.3594	0.3049	0.3120		3.16	1.0

Cronbach's alpha = .9197

Table F.5 Reliability Correlation Matrix for the Negative Impact on Society Scale

	RTATC5	RTATC11	RTATC17	RTATC23	RTATC29	RTATC35	RTATC41
RTATC5							
RTATC11	0.2651						
RTATC17	0.3354	0.2639					
RTATC23	0.4612	0.2345	0.5097				
RTATC29	0.3019	0.2206	0.4776	0.4406			
RTATC35	0.3113	0.3240	0.3911	0.4102	0.4510		
RTATC41	0.3978	0.2325	0.4937	0.4578	0.4332	0.3301	
RTATC47	0.2646	0.3585	0.4260	0.4105	0.5037	0.3815	0.3651
RTATC53	0.1936	0.1867	0.2330	0.2379	0.1922	0.1205	0.1603
RTATC59	0.3128	0.3035	0.3463	0.3043	0.3344	0.3545	0.2340
RTATC65	0.1820	0.2998	0.4253	0.2767	0.4120	0.3545	0.3009

(Continued)

Table F.5 (Continued)

	RTATC47	RTATC53	RTATC59	RTATC65	mean	SD
RTATC5					2.67	1.3
RTATC11					1.54	0.9
RTATC17					2.27	1.2
RTATC23					2.15	1.1
RTATC29					2.57	1.1
RTATC35					2.47	1.0
RTATC41					2.81	1.2
RTATC47					2.24	1.1
RTATC53	0.2423				1.63	1.0
RTATC59	0.3410	0.4147			1.87	0.9
RTATC65	0.5152	0.1890	0.3803		2.21	1.0

Cronbach's alpha = .8466

Table F.6 Reliability Correlation Matrix for the Computer Productivity Scale

	TATC6	TATC12	TATC18	TATC24	TATC30	TATC36	TATC42	TATC48	TATC54
TATC6									
TATC12	0.4502								
TATC18	0.3373	0.4405							
TATC24	0.4035	0.3521	0.4554						
TATC30	0.3447	0.3411	0.2803	0.3578					
TATC36	0.2745	0.3216	0.3762	0.3295	0.2687				
TATC42	0.5009	0.4079	0.3761	0.4228	0.4330	0.2881			
TATC48	0.4737	0.4420	0.3916	0.4336	0.4395	0.4077	0.4011		
TATC54	0.1769	0.2737	0.1815	0.1529	0.1870	0.2366	0.2850	0.2128	
TATC60	0.3783	0.2842	0.2519	0.2940	0.2301	0.2242	0.4544	0.3179	0.3017
TATC66	0.4932	0.3103	0.3372	0.3564	0.2950	0.3522	0.4087	0.4554	0.2243
TATC70	0.2796	0.2630	0.2014	0.3086	0.3278	0.2342	0.3163	0.3145	0.1627
TATC74	0.2711	0.2943	0.2791	0.2615	0.1713	0.2779	0.3344	0.2815	0.2968
TATC77	0.3555	0.2735	0.1659	0.2299	0.2056	0.1761	0.4023	0.3361	0.2306
TATC80	0.3760	0.3833	0.3867	0.3536	0.2915	0.4442	0.5029	0.4299	0.3062

(Continued)

Table F.6 (Continued)

	TATC60	TATC66	TATC70	TATC74	TATC77	TATC80	mean	SD
TATC6							2.05	1.0
TATC12							1.61	0.8
TATC18							1.46	0.7
TATC24							1.55	0.7
TATC30							2.42	1.0
TATC36							1.29	0.5
TATC42							2.07	1.1
TATC48							1.70	0.7
TATC54							1.38	0.8
TATC60							1.95	1.1
TATC66	0.3263						1.97	0.9
TATC70	0.3538	0.3112					1.83	0.8
TATC74	0.2775	0.2964	0.2395				1.30	0.6
TATC77	0.5352	0.2831	0.2884	0.3177			2.56	1.1
TATC80	0.4233	0.3088	0.3219	0.9930	0.4242		1.39	0.6

Cronbach's alpha = .8729