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A Survey of the Use of Information Technology in the Teaching/Learning Environment of Science 10 in Selected Alberta Schools

by

Graham Jones

A thesis Submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education

In

Instructional Technology

Department of Educational Psychology

Edmonton, Alberta

Spring, 2000

University of Alberta

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Degree: Master of Education

Year this Degree Granted: 2000

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Abstract

Over the past two decades information technology (IT) has gradually been introduced into the classroom. Initially, there appeared to be a great deal of ambiguity on how it should be used in the school environment or even whether it should be used at all. More recently, educational stakeholders have realized the potential that IT holds as a learning tool, and have determined that students need to become literate in its use. These factors have resulted in the development of a carefully organized framework within which school boards must work to ensure that technology is integrated into the core curricula. Students are expected to learn the concepts of the various core subjects, as well as demonstrating that they possess the skills, competencies, and knowledge of how to use information technology. A significant aspect of the framework for integration of technology consists of provision for the evaluation of learner outcomes and illustrations of learner expectations at all grade levels.

The purpose of this research was to determine to what extent teachers of Science 10 are integrating IT into the curriculum and what role it plays in the teaching of Science 10. Four large urban school districts in the cities of Edmonton and Calgary were requested to participate in the research with a questionnaire being sent to a Science 10 teacher in each high school in the participating school districts.

Results from this research suggest; the majority of Science 10 teachers and students in these school districts presently use IT hardware and software tools during Science 10; that the major roles of IT in the Science 10 classroom are as a tool for searching and retrieving information, as a productivity tool, and as a means of demonstrating scientific concepts and/or simulations; and, that teachers intend to retain their present level of integration of IT (or to increase it).

Acknowledgements

I wish to express sincere thanks to my advisor Dr. Peter Wright for his patience, support, and advice during the preparation and completion of this research thesis, and for making it such a profound, personal learning experience.

I am appreciative and indebted to Dr. Mike Szabo for agreeing to sit on the committee for the defense of this thesis and for his continuous encouragement and advice during the course of my graduate program.

I would also like to recognize the support offered by Professor Art Deane who has given me the encouragement to continue to be a reflective and caring educator.

I wish to thank everyone who participated in this study especially the principals and teachers who made this research more meaningful.

Finally, I wish to thank my wife Katherine, my daughter Melissa, and the rest of my family for their patience, encouragement and support as I traveled this pathway of learning.

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CHAPTER I

OVERVIEW OF THE PROBLEM

Introduction

As early as 1978, it was evident that educators were on the brink of a major revolution in education that would have profound implications for the educational establishment, and which was unparalleled "since the invention of the printing press" (Bork, 1981, p. 269). Leonard (1968) predicted that by the year 2001 computer technology would be so far advanced that the majority of the goals of education would be realized through its use. Bork (1981) forecast that mainframe computers, storing large amounts of information, would be replaced by more economical and effective personal computers that would be more compact in size, easier to use, and with faster processing speeds. He also envisaged fundamental changes in the basic institutions of education, the role of educators, and the way that curricula would be delivered.

Dr. Donald Blitzer from the University of Illinois at Urbana Champaign concurred with Bork that the use of computers would definitely change the way that education was delivered. He envisaged an alternate educational system in which a million computer terminals would be connected to three communication satellites circling the earth. These satellites would then be connected to large central processing units and terminal users would be able to communicate with one another. He believed this system would provide educational computing throughout the United States and possibly beyond its borders (Jones & Weinstock, 1977).

Nearly twenty years later, many of the above predictions have materialized, and many other advances in technology have also come to fruition. In fact, millions of individual

terminals referred to as personal computers exist in homes, offices, and schools. In comparison to the terminals of the mainframe computer, personal computers have powerful processing capabilities. Frequently, they are connected, through telephone lines, high speed cables, or satellite data communication systems to larger memory processing units called servers. Many personal computers are connected through communication devices to local area networks, wide area networks, or the Internet. The price of both computer hardware and software has continued to decline, and data processing capabilities have improved exponentially. Although the actual impact of computing technology on the teaching/learning process did not appear to be very significant, according to Lafollette, (1992) and Sheingold (1991), the present use of technology has created "new opportunities within the traditional classroom" and serves "to expand learning experiences beyond the popular notion of 'classroom'" (Wegner et al, 1999, p.98).

Purpose of the Study

This purpose of this study is to determine the extent to which information technology is presently being used in high schools and its role in the teaching/learning process. If the goal of Alberta Education is to integrate technology into the curriculum, and this research can determine to what extent it is presently being done, the results may assist teachers in realizing this goal. At present, the role of information technology in education may range from replacing the typewriter to being used for multimedia rich, online, interactive learning. It may also be used as an adjunct to teacher demonstrations or lectures, as a stand-alone medium, and can be successfully utilized across a broad range of subjects (Szabo & Montgomerie 1992).

Problem Statements

Problem 1

What does the integration of information technology mean to Science 10 teachers?

Problem 2

What role does information technology currently play in the teaching and learning environment of Science 10 in selected high schools in Alberta?

Problem 3

To what extent are teachers in selected Alberta high schools using information technology to enhance the teaching/ learning process in the Science 10 curriculum?

Problem 4

Do teachers in Science 10 intend to decrease, maintain, or increase the integration of information technology in the 1998/1999 school year?

Delimitations

This study was delimited to high schools in Edmonton School District #7, Calgary School District #19, and Calgary Roman Catholic Separate School District #1 within the province of Alberta, and was restricted to the teaching /learning process of the Science 10 curriculum. No inferences can be made regarding the use of information technology in any other subjects or grade levels, in any smaller school districts, or in any rural school districts.

The questionnaire was delimited to the perceptions and opinions of Science 10 teachers in the above mentioned school jurisdictions.

This study is delimited to the use of information technology by students and teachers during Science 10 classes, and the use of information technology by teachers for the support of teaching the Science 10 curriculum.

Limitations

The study was limited to the teaching of Science 10 in regular high schools and does not include home schooling, or institutional schools where students may be transient. For example, this study does not include education in residential group homes, hospital schools, penal institution schools, schooling in centres for specific populations (e.g. pregnant teenagers, parenting teenagers), or private schools.

Assumptions

It is assumed that respondents answered the questionnaire honestly and were aware of their local school board and Alberta Education plans for the integration of technology into the Science 10 curriculum.

Definitions of Terms

Chats are "real-time, text-based communication between two or more users, via computer." (Alberta Education, 1998, p.30)

Computer-Managed Instruction (CMI) is "the procedure employed to manage the instructional process by assisting teachers in diagnosing instructional needs, testing and

monitoring student achievement, prescribing learning activities, and matching instructional materials to teaching/learning activities" (Bluhm, 1987, p. 153).

Computer Assisted instruction (CAI) is an instructional methodology in which the computer is used to teach a lesson usually by simulation, or tutorial and review and practice.

Information technology (IT) in this study refers to the use of computers and related communication technologies.

Integrated Learning System (ILS) is a system in which courseware and management software are run conjointly on a network (Van Dusen & Worthen, 1995).

Internet is a global network of interconnected networks that communicate using a common set of procedures or protocols.

JPEG (Joint Photographic Experts Group) - a file format for storing and sending graphic images on a network computer (Roblyer, Edwards, & Havriluk, 1997, p. 352).

Local Area Network (LAN) is defined as a series of computers connected through cabling or wireless methods to share programs through a central file server computer (Roblyer, Edwards, & Havriluk, 1997, p. 353).

Meta-analysis " is the statistical analysis of a large collection of results from individual studies for the purpose of integrating findings" (Kulik, Kulik & Cohen 1980, p. 525).

Newsgroups " are online discussion forums where information can be exchanged. Each newsgroup usually focuses on a specific topic.

PLATO Learning Management (PLM) is a software package used within the PLATO system for Computer-Managed Instruction.

Programmed Logic for Automatic Teaching Operations (PLATO) is the Control Data Corporation educational system under which the PLM system works and consists of : hardware in the form of a high speed mainframe central processing unit (CPU), peripheral devices, input/output devices, cables and connectors, and software.

Wide Area Network (WAN) is defined as the interconnection of a group of computers and their peripheral devices linked by modems and other technologies (Roblyer, Edwards, & Havriluk, 1997, p. 355).

World Wide Web (WWW) is a collection of hypertext documents and files that are linked together through the Internet.

Significance of the Study

As a result of extensive reviews of the literature, information gained from questionnaires sent out to the public, deliberations and presentations, and reviews of technology initiatives throughout North America, the Education Minister of Alberta released a report called Framework For Technology Integration in Education: A Report of the MLA Implementation Team on Business Involvement and Technology Integration. (Alberta Education 1996a). This report, commonly referred to as the MLA I-Team Report,

elaborated on the key elements of the integration and use of computer technology in Alberta schools.

The MLA I-Team report led to or significantly influenced the integration of information technology into teaching and learning through a number of Alberta Education initiatives including: the provision of funding for the acquisition/upgrading of information technology; the provision of funding to facilitate school jurisdiction access to the Internet; the Alberta Education web site; the establishment of the Computers for Schools project (in which donated computers are refurbished and made available free of charge to schools); various collaborative/ partnership initiatives; and, perhaps most important of all, a commitment to the development and implementation of the Information and Communication Technology (ICT) program of studies.

It is important to note that the research associated with this thesis was carried out at a time when the impetus to integrate technology was already well under way. The Information and Communication Technology (ICT) interim program of studies (Alberta Education, 1998) had been developed, and was being pursued in some school jurisdictions. The ICT Program of Studies is scheduled for province wide implementation in September, 2000. It is also important to note that, during the collection of data for this thesis, a government restructuring initiative resulted in the former departments of Education, and Advanced Education and Career Development being combined into a single department called Alberta Learning.

This research focuses on the use of computers and related communication devices in the instruction of Science 10 in selected Alberta high schools. Research data provided could guide pre-service and in-service training for teachers, and assist them in reaching the goal of Alberta Education, which is to integrate information technology, wherever possible, into all facets of education. Results of this study may provide examples of where teachers are

applying information technology to improve the teaching/learning environment in specific sections of the Science 10 curriculum. This information can then be used to provide effective strategies for using this medium in the teaching milieu.

CHAPTER II

LITERATURE REVIEW

Introduction

From the available literature it is easy to see that although computers have been used in schools for many years, the impetus to study the integration of technology into the school curriculum is a fairly recent phenomena not only in Alberta but throughout North America. This has resulted in a negligible amount of research in this area. There has, however, been research carried out on the breadth of use of information technology (IT) in Alberta schools (Petruk, 1981, 1986; Alberta Education, 1993), of the utilization of IT by school districts in Texas (Hiett, 1990), and of using IT to teach science (Kulik, Kulik, & Carmichael, 1974; Martin &Szabo, 1990). Therefore, the following literature review was carried out to examine a selection of the research pertaining to the effectiveness of using information technology in the educational environment; of its use in selected educational settings within the Province of Alberta; of factors influencing the integration of technology in education; and comments regarding the direction of Alberta Education as it attempts to overcome these barriers and integrate IT into all facets of the curricula.

Towards the Use of Computers in Schools

Computers in Schools- A General Overview

Alberta schools have used information technology for nearly twenty years, and historically there was ambiguity in the perceived role of computer technology in education (e.g. whether it should be used for teaching programming, whether this medium should be used in the curriculum, or even to what extent it should be used) (Lafollette, 1992; Lapointe &

Martinez, 1988; Wright, 1993). It is apparent that before media can be successfully integrated into the curriculum, many issues must be addressed.

At present, Alberta Learning, previously known as Alberta Education, clearly defines how information technology will be used in schools and what knowledge and skills should be acquired by the time that students graduate from grade 12. Although a separate Program of Studies is being developed for Information and Communication Technology (ICT) it is envisaged that the curriculum will be interlaced with other subject curricula, that is, technology will be learned within a context of meaningful applications during the study of Math, Science, Language Arts, etc. The underlying principal behind the integration of ICT is that technology incorporates the processes, the tools, and the techniques that we use to process information and learn.

Ely et al (1995), conclude that the four main reasons why information technology is used in schools, as proposed by Hawkridge, Jaworski, and McMahon (1990), are :

- *The pedagogical rationale.* There are advantages to using information technology over any conventional methodology for learning. "Computers can teach".
- *The social rationale* which implies that students must be made aware of the pervasiveness of information technology is in an industrial society and its role in society.
- *The catalytic rationale* . Computers are a catalyst for change in education. Using information technology encourages learning.
- *The vocational rationale.* Schools should assist students to acquire skills necessary for future employment or pursuing post-secondary education.(Alberta, Government of Alberta, 1996a; Johnson, 1981)

In Framework for technology integration in education : A report of the MLA implementation team on business involvement and technology integration. (Alberta Education, 1996a), it is clear that Albertans want students to have opportunities to access information technology, while ensuring that they have the necessary skills, competencies, and knowledge to use this medium. They conclude that there should be a "stronger relationship between the technology skills students learn in school and those required for the workplace" (p.3).

Despite the available research regarding the effectiveness of computer-based education, very little empirical evidence is available to ascertain whether instruction on computers has made consistent, significant contributions to the learning process. In fact, "extensive research with computer-based methods supports only a general conclusion that technology has made a difference – sometimes" (Roblyer et al 1997, p.28). Some studies indicate that computer assisted learning results in a moderate improvement in learning, when compared with learning by conventional instruction (Swan & Mitrani, 1993; Clark & Sugrue, 1995; Ely et al., 1995; Becker, 1992; Berson, 1996; Ingram, 1995),while other research indicates that it is "as effective as the conventional instruction method and instructors may choose to use it as an alternative strategy to complement their instructional practices" (Wang & Sleeman, 1993, p .225). Van Dusen and Worthen (1995) suggest that the reason why significant improvements in academic achievement are not identified in test results is not because they do not have the potential to improve learning, but because frequently, computer-based learning systems are not used appropriately as defined by the system designers.

Clarke (1983, 1994) questions the validity of all media comparison research suggesting that no type of medium will ever influence learning, since learning is influenced more by the methodology and content of a lesson than the medium. Although Clarke does not rule out

the effectiveness of computer technology, he proposes that "media research is a triumph of enthusiasm over substantive examination of structural processes in learning and instruction" (p.27), and any achievement gains recorded are actually due to "robust instructional methods embedded in the computer based instruction treatment" (Clark, 1985, p.249).

In a meta-analysis of 42 studies concerning mainframe computers, Bangert-Drowns, Kulik, and Kulik (1985) found that computer-based teaching had an overall positive effect on achievement, raising the examination scores of some students by 0.26 standard deviations. However, the authors cautioned that different results were obtained when evaluating the effects of computer-enriched, computer-assisted, or computer-managed instruction. The effects of computer-based education on student learning appeared to be stronger on populations of disadvantaged students, and weaker on high achieving students. Results of the studies varied with age-related populations.

Roblyer (1988) points out that there exists minimal data to verify the claims supporting learning with computers. He also notes that unstructured computer-assisted instruction (CAI) was found to be very ineffective in teaching general thinking, critical thinking, and problem-solving skills. On the positive side, results emanating from word processing studies identified significant improvements in students' attitudes towards writing, and the greatest impact on learning occurred in studies where science subjects (mainly simulations) were involved . Roblyer (1988) suggests that additional research needs to be conducted to validate the extent of his findings.

Kulik, Kulik, and Cohen (1980) conducted a meta-analysis to determine the effectiveness of computer-based college teaching when compared to conventional methods of instruction. It was concluded:

> In studies in which different teachers taught computer-based and conventional sections of a course, examination differences were more clear-cut and favored computer-based teaching. In studies in which a single teacher taught both experimental and control classes, differences were less pronounced. (Kulik, Kulik, and Cohen, 1980, p.539)

Results from this study suggested that computer assisted instruction (CAI) substantially reduced the time needed for instruction.

Petruk (1978), in his study on the effectiveness of CAI on electrical apprentices found that although there was no statistically significant improvement on final test scores, overall the apprentices using CAI as a learning medium scored higher, there was a smaller failure rate (as identified by the provincial examining body), and there was a significant saving of time when using CAI compared to conventional methods of apprentice training. The subjects that were evaluated were electrical theory and mathematics.

Szabo (1987), in his research on computer-based training with a large police department, identified an improvement in on-the-job performance measures, an improvement in the quality and quantity of performance records (through PLM), and a significant saving of instructional time when students were trained via computer technology. The results of this research translated into increased efficiency and significant financial savings for the organization involved with the training.

In the K -12 environment, it would be extremely difficult to justify the use of technology based on its cost saving attributes, since billions of educational dollars are spent annually on computer technology (D'Amico, 1990 ; Noble, 1996 ; O'Neil, 1996). A great deal of this money is spent on capital expenditures such as upgrading hardware and software, maintaining computer equipment, and, training teachers to utilize technology. All of these costs burden a shrinking educational budget.

Equity in education can best be described as providing equal educational opportunities to all students and is an ideal sought by educators and administrators alike. However, information technology, in its various forms, has the potential to offer greater learning opportunities to more students especially those constrained by time or location. For example, distance learning at one time consisted solely of correspondence courses incorporating pencil and paper exercises, and using the regular postal system to communicate between student and teacher. Nowadays, distance education can still be taken using the same methodology, or students can enroll in courses, access course materials, submit assignments and receive their final grades by using information technology as a medium.

In its mandate for educational equity, Alberta Education (1995a) advocates that all students should have "equitable access to technology and technology experiences regardless of where they go to school, or what their particular learning circumstances may be", and all teachers in Alberta should be provided with equal opportunity to have access to the necessary training and support required to promote this ideal.

Information technology also has the potential to furnish disabled and handicapped students with educational opportunities, either in the classroom or at home which they would not have normally had in the past (Carlson & Silverman, 1986 ; Anandam, 1989; Ryba et al, 1995 ; Wissick, 1996).

Computers in Alberta Schools

Early Initiatives at the University of Alberta

The evolution of computer use in universities has had a profound effect on their use in Alberta schools. First of all, Faculties of Education are responsible for computer education

programs for teachers and secondly they are responsible for research on the effectiveness of using computers.

During the 1960's, North American universities were trying to find effective and efficient ways to provide alternative methods of instructional delivery. In 1968, the University of Alberta's faculty of Education became involved with computer-assisted instruction and installed its first mainframe computer system in the education department and developed software to meet the educational needs of its students. Commonly known as the IBM 1500 system, this new piece of technology was capable of storing and processing large amounts of information (by 1968 standards), and consisted of an IBM 1130 central processing unit with several remote terminals for student use, and various peripheral devices such as light pens, keyboards, and random-access image projectors. In the years following, the IBM 1500 system, was gradually upgraded through additional student terminals, more efficient storage devices, and by increasing the number of hours of course material that was available to students (Petruk, 1977).

Concomitant with the development of the IBM 1500 CAI system, was the development of the PLATO computer system and its accompanying learning management software. The purpose of developing the PLATO system was to automate the process of individualized instruction, implement the tenets of mastery learning (Lyman, 1978), and provide an efficient and cost-effective means of providing educational services to a large number of students.

In 1959, a group of engineers, physicists, and educators at the University of Illinois became involved in interdepartmental discussions which resulted in the design and construction of PLATO I. This first system consisted of a high speed mainframe digital computer named ILLIAC I, one solitary external terminal for student use, and very limited

amounts of software written in a basic machine language (which was also named Illiac). This situation did not suffice for long as the PLATO system was expanded from version I to II to III to meet student needs. The demand for the computer's services exceeded the supply with "authors of the lessons being relegated to writing their lessons on the system from late evening until the early hours of the morning, while system programmers had to experiment on and correct the basic program problems during the rest of the night" (Lyman, 1978, p.3).

By 1968, the year that the IBM 1500 system was first used at the University of Alberta, the PLATO system was experiencing its second revision. PLATO III as it was known, consisted of a larger capacity, faster operating Control Data Corporation 1604 CERL mainframe computer, complemented by an improved software language named TUTOR. Because of the powerful features of this upgraded system, there was provision for "time-sharing of the system by students and authors simultaneously, as well as adding new features to the language" (Lyman, 1978, p.3).

In 1980, a PLATO IV system was installed at the University of Alberta. To support the powerful processing capabilities of this advanced central processing unit, Control Data Corporation developed an advanced software package called PLATO Learning Management (PLM). A key feature of the PLM system was its ability to link mastery learning to CAI lessons. That is, if learners failed to master any course objectives, they could be seamlessly whisked into the appropriate lesson (Szabo,1992).

Microcomputers in Alberta Schools.

After nearly a decade of success at the University of Alberta, the PLATO system was finally de-commissioned in 1987. However, by this time, the microcomputer was clearly

showing its presence in the classrooms of Alberta. In 1981, Petruk surveyed computer use in Alberta schools and determined that approximately 12% of Alberta schools had at least one computer, a large proportion of the schools anticipated purchasing computers, while a few schools reported that they had no reason to use them at all . The most common types of computers used at that time were the Commodore PET, the Apple II, and the Radio Shack TRS 80.

Following this survey, microcomputers gradually became introduced into Alberta schools. According to Petruk (1985), the number of computers in use experienced exponential growth: from 256 in 1981 to an estimated 16 234 by January 1985. Most of the computers at that time consisted of Apple II's (58%) and Commodores (26.8%), with the remainder being manufactured by other parties (15.2%) . Although computers had been in use in Alberta schools for several years :

> It was not until 1981 that Alberta Education began formally to encourage the use of computers in schools. This encouragement came in many different forms. It came in the form of leadership as the result of the creation of the Computer Technology Project in Alberta Education and the formation of a Minister's Task Force on Computers in Schools. It came in the form of instructional support as the result of new curricula in computer literacy and. . . perhaps most important, it came in the form of funds to assist school boards to purchase computers. (Petruk, 1986, p. 1)

Computers were regarded as one of the "most powerful learning tools ever invented", possessing the ability to manipulate, store, retrieve and integrate information. A tool that should be used by teachers to improve the delivery of instruction and quality of education. (Alberta Education, 1983, p. 7)

In 1993, surveys were sent to 1 524 schools to "gain a measure of how microcomputers were being used in school in the province"(Alberta Education, 1993, p.ii). It was found that computer use had increased substantially: 46 336 microcomputers were available in the 125 school jurisdictions of Alberta with a student to microcomputer ratio of 9.8 :1.

Although this figure had decreased from the 1986 level when the ratio of students to computers was 20.3 :1, the average use of computers directly related to curriculum objectives in 1993 was still under two and a half hours per week per student (Alberta Education, 1993 ; Schwarz, 1996).

The government of Alberta and Alberta Education are committed to the process of integrating technology into schools. In 1994, a task force was established by the provincial government to facilitate the development and restructuring of education in Alberta. Various stakeholders (over 600) from Alberta communities were contacted to complete a questionnaire or give brief reports on educational directions. The MLA I-Team Report that resulted from these consultations suggests that there was overwhelming support from the community to integrate technology into the curricula (Alberta Education, 1996a).

Factors Influencing the Integration of Information Technology

If computer technology is to be successfully integrated into the curriculum it will involve more than providing hardware and software, and supplying teachers with a modicum of training on how to use a specific type (platform) of computer or software (Willis, 1993). What is needed is a concerted effort by all levels of administration to provide a vision of where they see information technology being used in the classroom, how they feel that this media should be integrated into the curriculum, and what they actually mean by "integration". Shwartz (1996) suggests that without a clearly articulated vision, educational administrators "will be unable to provide the necessary leadership, guidance and organizational support . . .that are necessary for the successful implementation of new programs or ideas"(p.11).

D'Amico (1990), and Chin and Hortin (1993) concur with Shwartz by adding that strong leadership and support at all levels of administration are imperative for the successful

integration of computer technology into schools. Once a long-range vision for technology use in schools has been developed, teachers should be actively "included in the decision-making process"(Brennan, 1991, p 13), and there should be a commitment by administrators to remove perceived barriers that prevent change in classrooms. Barriers include insufficient planning at the school board level, insufficient support to teachers, inadequate funding, little or no appropriate technology training, poorly designed facilities, and negative attitudes and images of technology.

Planning for Integration

The use of computer -based instructional technology in Alberta schools continues to interest educators, administrators, politicians and parents. However, many factors have to be considered before this media is successfully integrated into the school curriculum. According to Stafford (1989):

> Curriculum integration is a job for professionals. It is an ongoing process that requires an understanding of technology and a sensitivity to curriculum objectives. It is not a casual, one-shot, unrelated effort, and it must be tailored to support the mission of the school. (p.31)

After consultation with various stakeholders throughout the province, Alberta Education (1996c) developed an Implementation Plan For Technology in Education. This document incorporates the department's vision for technology education and its plan for implementation in Alberta schools. Within this provincial framework, school boards are required to prepare, update and make available, their own three-year technology plans, with the explicit purpose of meeting the needs of the stakeholders and students of Alberta. The Three-Year Technology Integration Plans should be linked to the School Board Three-Year Education Plans. According to Lafollette (1992), "where significant outcomes favored a technological delivery system, highly effective planning took place" (p. 111).

Funding for Technology

The government of Alberta has attempted to address the issue of funding for technology integration by providing school boards with financial assistance in the form of grants to cover the period from 1996-1998, at a cost of $45 million. This funding was intended for upgrading computers, purchasing software, and increasing student access to a wide range of resources (Mar, 1996). Local school boards were expected to match the payments received from the government with equal amounts of money from their regular sources of revenue. This matching agreement was eliminated effective April 1998. A further twenty million dollars per year have been allocated for technology upgrading for 1999, 2000, and 2001. "This funding for technology related initiatives will increasingly be integrated into the conventional funding envelopes" (Alberta Education, 1999b, p.1) since the long term objective is to have information technology completely integrated into the curriculum and form part of the overall source of learning. Therefore, Alberta Education believes the financing of it should be blended into the core funding. Initially, during the years 1995 to 1997, an additional amount of money was allocated to school districts by Alberta Education to increase access to the Internet or at least to provide a basic connection to the Internet. By 1997, seventy-four percent (74%) of Alberta school jurisdictions had continuous access to the Internet and twenty-six percent (26%) had dial-up connections (Alberta Learning, 1999b). At present, Alberta Learning is working on developing improved bandwidth connections to schools.

Howley and Howley (1995) caution educators about educational funding based on the community's tax base model because rural schools do not have the same tax base as urban schools and consequently do not receive equitable access to instructional technology. Funding for education in Alberta is no longer defined by a community's tax base.

Professional Development and Training

According to the literature, a large number of teachers lack training in the use of information technology, and even when they are taught how to use computers, they are not taught how to teach with computers. This problem is compounded by the fact that educational leaders at all levels appear to lack knowledge, understanding and empathy for the processes of technology, which limits their ability to support and guide their staff, and advise them on the most desirable uses of technology for schools (Lafollette, 1992 ; Shwartz, 1996). Kearsley and Lynch, (1992) suggest that information technology education should not simply focus on teacher education but must also focus on the teaching of technology leadership if integration is to be successful.

Leadership Training for Administration.

To address the issues of educational leadership training in Canada, a School Administrators Technology Integration Source (SATIR) has been developed. The major focus of this resource is to provide school administrators with a selection of on-line resources and strategies for dealing with the integration of Information and Communication Technology (ICT) in their jurisdictions. It is envisaged that through this method of professional development, school-based administrators will develop the necessary skills and knowledge to help them to provide technology leadership in their schools. Partners in the development of SATIR consisted of Industry Canada (who provided some of the start-up funding), the Canadian Association of Principals, the Canadian Association of School Administrators, and Alberta Education. Local area representatives (principals) in Alberta sit on a local Advisory Committee and "25 school based administrators (with representation from every province and territory) sit on an on-line Virtual Advisory Committee" (SATIR, 1999).

Teacher Education.

Research, carried out in 1994, on teacher education in Alberta, identifies many issues that influence the utilization of computers by teachers. The most crucial factors appear to be time, support, and appropriate training (Shwartz, 1996). It appears that with greater demands placed on teachers to teach larger class sizes and still meet educational objectives, there is barely enough time for teachers to develop lessons and at the same time teach themselves how to use information technology. Unfortunately, pre-service and in-service training have not been used to the advantage of teachers and have not met teacher expectations in the area of technology education. The reasons for this may be because of a paucity in the number of proficient trainers available who are experienced in teaching the use of technology, or insufficient time provided for teacher development. According to Shwartz (1996), a vast majority of teachers in New Brunswick are also reluctant to use information technology. They cite lack of training, fear of technology, and insufficient time to become acquainted with its application in the classroom, as reasons why they are not embracing IT in their teaching.

Wright (1993), in his research article, discusses computer perspectives from the Province of Alberta. He adds that an undergraduate course entitled, 'Introduction to Microcomputers in Education' (IME) was introduced as a compulsory course for educational students as early as 1980 at the University of Alberta, and that this course could best be viewed "as a foundation for further study of subject/age related applications"(p.46). This course offered a great deal more than computer programming, and consisted of 36 hours of lectures complemented by 36 hours of laboratory work covering topics as diverse as educational applications, and the ethics and morals of computer use. An alternative course could be taken through the Faculty of Science. In addition to the IME course, the University of Alberta's Faculty of Education has offered computer courses in educational administration,

using authoring tools to develop CAI and CMI, and various other courses integrating information technology into the curriculum. At present, the Faculty of Education, has increased its offering of IT related courses at the undergraduate level. The Department of Educational Psychology, is offering computer courses in the 'Curricular Integration of Learning Technology', 'Instructional Technology and Communication', 'Designing Technology Based Instruction', and 'Interactive Multimedia' for education students. At the graduate level, the Department of Educational Psychology is offering a Master of Education degree in IT with several of the courses being offered by alternative delivery. Several students are pursuing their PhD with a specialization in IT through the department of Educational Psychology and a formal PhD program in IT is currently in development. Other departments of the Faculty of Education at the University of Alberta offer Curriculum and Instruction courses at the undergraduate level in which information technology is integrated into the different curricula (University of Alberta, 1999).

Hirschbuhl and Faseyitan (1994) criticize teacher education programs, citing that the vast majority of faculty members do not incorporate technology in their own presentations, which results in teachers not being given the opportunity to learn from role-modeling. Lafollette (1992) points out that many faculty currently engaged in teaching teachers were not taught to teach using information technology when they were trained, and the majority have not kept up with recent innovations in technology.

Wright (1995), stresses that those involved with pre-service education for teachers should be " both advocates and role models for the use of technology" suggesting that to maximize teacher learning, teacher educators should utilize technology as a medium for the delivery of instruction, for instruction, for instructional support, communication, and professional productivity.

The University of Alberta has attempted to ameliorate this situation by developing an Academic Technologies for Learning (ATL) program through the Faculty of Extension. ATL is designed to provide faculty at the university with workshops, and assist in the development of interdisciplinary teams to improve instruction using technology. ATL is also associated with such initiatives as the Training Infrastructure and Empowerment System (TIES) for Professional Development of faculty (Szabo, 1996).

Several researchers offer suggestions to alleviate the problems of insufficient levels of teacher training. Ingram (1995) proposes that the fundamental use of technology integration should be to improve the instructional efficacy of educators and offers the following suggestions:

- Educational technology programs should be developed by teacher training colleges and universities, and consist of intensive training for faculty in the application and use of educational media.
- Existing teacher training programs should be augmented by the utilization of information technology and communication media.
- Teachers who graduate from technology enhanced programs could introduce these skills into the schools and information and ideas could be disseminated to other staff members by in-service instruction or by distance education.
- The number of graduate degree programs in information technology should increase to meet the growing needs of the educational environment.

Willis (1993) suggests that for teachers to successfully integrate technology into the classroom they should be consistently supported by administrators, and be:

- Given extensive training in a safe comfortable environment before they are permitted to use information technology in the classroom. Training should include

but not be limited to the technical aspects of hardware and software and the roles and responsibilities of educators.

- Given time to explore and experiment with information technology.

- Supplied with communication tools to enable them to discuss ideas and gain valuable advice from peers and consultants. In the Apple Classrooms of Tomorrow project, teachers are provided with a computer and a modem for their own use and are supported by a myriad of personnel drawn from universities, schools, and research agencies (Fisher et al, 1996; Means et al, 1995).

- Encouraged, on an ongoing basis, to utilize technology rather than being coerced into using it. Since "voluntary participation is correlated with successful projects" (Willis, 1993, p.29).

In the 1993 survey of microcomputer use in Alberta schools, approximately 43% of teachers surveyed identified that the level of teacher training in information technology was less than satisfactory. Alberta Education (1996a), in trying to address the issues of training, appears to have linked together the ideas of Willis (1993) and Ingram (1995) by recommending that :

- teachers are given more access to computers to facilitate and upgrade their technology skills.

- teacher certification programs should reflect the need for teachers to be competent in information and computer technology.

- schools and school boards should include a plan for upgrading teacher technology competencies in their technology plans.

In 1997, Alberta Education formed a partnership with the Alberta Teachers' Association, the Alberta School Boards Association, the College of Alberta School Superintendents, and

the TELUS Bright Futures Foundation. This partnership was called the TELUS Learning Connection (TLC). The purpose of this alliance was to provide:

- in-service to Alberta's teachers for a two year period, via the Internet.
- a website at <http://www.2learn.ca> . containing strands on Curricular Resource Links, Collaborative Learning Projects, Research Skills and Strategies, Communication Technology, and Professional Growth and Mentorship.

Because of the success rate of this program, having provided in-service to more than 10 000 teachers (reaching approximately 175 000 students) in the first eighteen months, TLC is to be extended until 2001(Alberta Learning, 1999).

In addition to the TELUS Learning Connection, which is Internet based, other technology initiatives are underway to provide Professional Development for teachers. They include, for example:

- Teaching and Learning with Technology (TLT) projects which are not meant to replace programs like TLC but to complement them (Alberta Regional Professional Development Consortia,1998a). The TLT project is available on the Internet and contains examples of Technology Integration Projects, online tutorials, a list of eMentors who are willing to mentor teachers about integrating technology, and several hypertext links to sites that may be of interest to teachers who are involved with integration of technology (Alberta Regional Professional Development Consortia,1998b).

- Local and district initiatives such as the Technology Incentive Program (TIP), in which computers and software are loaned to selected teachers (for home use. Basic training workshops are provided to the teachers on the use of this media, and subject specific workshops are provided on how to integrate IT into specific curricula (Suen, 1998).

More recently, Alberta Education (1999a) commissioned several Technology Outcome Studies: Best Practices for Alberta School Jurisdictions. Although these studies provide best practices for all aspects of the utilization of technology in schools, and are themselves teaching tools, one of the Technology Outcome Studies directly addresses the need for the development of technology skills by teachers and the need for teachers to incorporate technology into their professional development plans. Examples of workshops and mentoring programs that have occurred in Alberta are included in the appendices (Alberta Education,1999a).

Access to Technology

During the past two decades, microcomputers have become common in many Alberta schools, although despite this increase, a significant problem exists in the availability and accessibility of this medium. In a recent survey by Shwartz (1996), over 80% of the respondents thought that access to technology needed to be improved, but they were undecided in what physical location computers should be situated to maximize their use.

Milone (1989) suggests that for computers to be effectively integrated into the curriculum, teaching style needs to be considered when deciding on where to locate instructional media. If teachers use traditional methods of group instruction such as presentations and demonstrations:

> Clearly , the classroom-based computer has the greatest potential for becoming an integral part of the curriculum. It is proximate, available, and easily supervised. With proper management, the classroom-based computer can become a tool that greatly enhances student learning.(p.35)

In contrast, if computers are placed in a laboratory, and individual classes are allocated a specific period of time to use them, it is possible to maximize computer use "virtually every moment of the day" (p.40). The computer-based laboratory can provide an opportunity for

students from different classes to work on individualized projects without disturbing other students in their classrooms.

Research in the area of computer accessibility and availability seems inconclusive, since there are advantages and disadvantages to both the classroom and laboratory milieu. What must be determined is the most cost-effective (efficient) placement of computers. Simply placing one or two computers in a classroom appears to be futile, since the amount of allowable computer time that can be allocated to individual students in this situation is insignificant. On the other hand, it would be incomprehensible for educational administrators to justify allocating a computer for every student and teacher, when "schools are faced with the reality of a limited budget for equipment, telecommunications, and software, and they must make hard choices about how to get the most out of what they have" (Means et al, 1995, p.71).

Kloosterman, Ault, and Harty (1987), in their examination of school-based computer use, found that ideally teachers preferred a combination of laboratory based computers for large group work (or for when students needed to work on their individual projects), complemented by portable computers on carts which could be used for small-group work or classroom presentations. Means, Olson, and Singh (1995) concurred but suggested that some teachers frequently used several computers on carts in the form of a portable mini-laboratory to meet other teaching/learning requirements.

Implementation of Technology

For a school-based project to be successful, it is imperative that teachers are involved from the outset, and the integration of computers is no exception to this rule. However, it is obvious from the literature that this does not always occur. Computers are purchased for

schools, and decisions are made by administrators long before any thought is given to how this medium can be implemented, what type or amount of support will be provided, or what kind of training needs to be established. This type of paradigm results in teachers' attitude being identified as one of the barriers to implementation of technology. Willis (1993) is quick to suggest, " top-down projects tend to fail over time; resentment and resistance destroys projects; and, ownership is critical to success "(p.29). For technology integration to be successful, it should be part of a comprehensive, integrated plan involving all of the various stakeholders (Futrell, 1989; Dwyer, 1996).

In 1996, a framework was developed for the integration of technology in education (Alberta Education, 1996a). Input for this plan was obtained from a Technology Integration Advisory Committee (which included a representative from the Alberta Teachers' Association). Further input to the plan was obtained from a questionnaire completed by parents, teachers, business representatives, the Alberta Teachers' Association, superintendents, and other interested citizens. The Technology Integration Advisory Committee reviewed technology related initiatives that were being carried out in other provinces and other countries, and combined this information with the feedback from the questionnaires to develop a comprehensive plan for integration.

CHAPTER III

RESEARCH METHODOLOGY

Rationale for Sample Selection

Historically, funding for education has been based on the tax base of the school district and because of this it is reasonable to anticipate that large urban school districts would have a strong presence of information technology. If such is the case, it is also reasonable to anticipate that there may be a higher degree of integration of IT into the curriculum.
For these reasons, this research focussed on the four large urban school districts in the cities of Edmonton and Calgary. These four districts are Edmonton School District #7, Edmonton Catholic Regional Division No.40, Calgary School District #19, and Calgary Roman Catholic Separate School District #1.

Development, Validation, and Piloting of the Questionnaire

A literature review was carried out to examine the historical development of the use of computers in education in Alberta, and to determine the goals and objectives of Alberta Education as they relate to the integration of information technology into curricula in the future. A questionnaire (Appendix A) was constructed during the summer and fall of 1998 to reflect the problems identified in Chapter One. The questions developed for the survey were also based on the premise that the various stakeholders in education intend to integrate technology into school curricula starting in the year 2000, and on themes drawn from the literature review as presented in Chapter Two.

The survey was validated by a Professor of Education at the University of Alberta, the Projects Manager, Technology Outcomes Project, Alberta Education, a science teacher, a technology teacher, and a junior high teacher.

Each of the individuals asked to pilot the questionnaire completed the survey, and any items that were unclear were discussed and noted. Each individual was asked to suggest any revisions that might be needed and the survey was amended based on these recommendations. For example, questions 1.6 and 2.2 were expanded from being general questions on the use of productivity and communication tools to being questions on the specific use of productivity tools and communication tools. Other recommendations were made to ensure that certain questions were specific and unambiguous.

Organization of the Questionnaire

The questionnaire was divided into four parts. Part 1 identified the potential uses of information technology by the Science 10 teacher during instruction and general questions about the use of computers by the teacher. Part 2 addressed the potential uses of information technology by students during Science 10 classes. The questions in Part 3 addressed the issue of the teacher's use of information technology for instructional support and development of lesson materials. Part 4 of the questionnaire attempted to gather information from practicing teachers of Science 10 about specific ways they are implementing information technology into the curriculum.

Administration of the Questionnaire

Following the piloting of the questionnaire, letters were mailed to the superintendents of the Edmonton School District #7, Calgary School District #19, and the Calgary Roman Catholic Separate School District #1 requesting permission for their schools to participate in

the research, and for permission to contact their high school principals. From the responses received, it was determined that:

- the Edmonton Catholic Regional Division No.40 did not participate in any research projects during the 1998-99 school year.
- all research conducted in Edmonton School District #7 must first go through a Cooperative Activities Program (CAP) review. A research proposal was submitted to the CAP coordinator (who coordinates all university-initiated research) at the University of Alberta. The coordinator reviewed the research proposal for ethical guidelines and suitability, and liaised with the relevant school board official before permission to proceed with the research was granted.
- before permission is granted to carry out research in Calgary School District #19, a research proposal must be submitted to the Chief Superintendent who forwards the information to the Accountability Services Department for review.
- when attempting to carry out research with the Calgary Roman Catholic Separate School District #1 specific documentation has to be presented to the Special Projects Supervisor of the school district. This documentation consists of a copy of the University of Alberta's Ethics Review approval, a letter of support from the Graduate Student's supervisor, and a copy of the research proposal. Permission to proceed is then either given or refused.

Once permission to proceed was received from the aforementioned districts, a letter (including a copy of the questionnaire) was sent to the principal of each high school in the respective school districts requesting that they ask one of their Science 10 teachers to participate in the research. A copy of the letter of invitation to participate, which was sent to the principals, can be found in Appendix C.

Questionnaires and letters were sent to:

- Seven Calgary Roman Catholic Separate School District #1 high schools.
- Twenty Edmonton School District #7 high schools.

- Twenty Calgary School District #19 high schools (identified by Alberta Education in Alberta Education, 1997a).

CHAPTER IV

DATA ANALYSIS AND PRESENTATION OF RESULTS

Introduction

Within this chapter, a summary of the responses is provided in the form of figures and tables, to illustrate how teachers of Science 10 integrate IT into their classes.

Forty-seven high schools in the Edmonton School District #7, Calgary School District #19, and the Calgary Roman Catholic Separate School District #1 were sent questionnaires to complete. Twenty-seven questionnaires were returned. Of those returned, twenty were completed as per the directions on the front of the questionnaire giving a response rate of 42%. The seven questionnaires that were returned incomplete had comments written on the covering letters as to why they had not been completed. The reasons were as follows:

1) Some high schools declined to participate.
2) Other high schools were unable to participate in the research because they do not teach the Science 10 curriculum.
3) The remainder were not teaching Science 10 in the 1998/99 school year.

The questionnaire was divided into four major parts. Part 1 identified the potential uses of information technology by the Science 10 teacher during instruction, and posed general questions about the use of computers by the teacher. Part 2 addressed the potential uses of information technology by students during Science 10 classes. The questions in Part 3 addressed the issue of the teacher's use of information technology for instructional support and development of lesson materials. Part 4 of the questionnaire attempted to gather information from practicing teachers of Science 10 about specific ways they are integrating

information technology into the curriculum. This chapter will present the findings according to the four major sections.

Data Collection and Analysis

The focus of this research was primarily quantitative in nature and consisted of a questionnaire in which respondents answered by checking the appropriate box(es). In some questions, however, provision was made to elicit qualitative information. For example, on Part 4 of the survey respondents were asked to provide examples of how they are presently integrating IT into the curriculum, and in other questions respondents were asked to comment on their quantitative responses .

Simple descriptive statistics were used in the reporting of qualitative data. Data collected from the checked responses were totaled and tabulated. In most tables, data is reported in the form of percentage measures of the number of respondents. The number of respondents varied. For example, although twenty questionnaires were returned complete, only those who responded 'Yes' to Question 1.4 (N=16) were eligible to complete all remaining survey questions. The other respondents were asked to answer Question 1.5 then to proceed to Part 3 of the questionnaire. All percentages in the tables are rounded to the nearest whole number. The anecdotal data was recorded later in this chapter, and used to complement the data collected in the tables.

Part 1: Use of IT by the Science 10 Teacher

The first part of the questionnaire is split into two sub-parts; the first sub-part identifying general uses of information technology by the Science 10 teacher, and the second sub-part identifying the role of information technology during the teaching of Science 10. Where the

headings Rarely, Sometimes, and Frequently are used in the tables, Rarely means 1-3 times per term, Sometimes means 4-10 times per term, and Frequently means more than 10 times per term.

Question 1.0

How many Science 10 classes are you teaching this semester?

Science 10 is a five credit course which can usually be taken in either semester of a high school year. All of the respondents to the survey answered this question, and the results were as follows:

Table 1.0 Number of Science 10 Classes Taught

NUMBER OF SCIENCE 10 CLASSES TAUGHT	NUMBER OF RESPONDENTS
1	8
2	7
3	5

Note that the number of courses taught is fairly evenly distributed over the number of respondents.

Question 1.1

What is the average number of students in your Science 10 classes?

The responses to this question ranged from a low of 7 students to a high of 35, with a mean of 25 and a mode of 30. Sixty-five percent (65%) of the respondents had average

class sizes of more than twenty-seven students. All of the respondents answered this question.

Table 1.1 Average Number of Students/Science 10 Class

AVERAGE NUMBER OF STUDENTS PER CLASS	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS
7	1	5
10	1	5
18	1	5
20	1	5
24	1	5
26	1	5
27	1	5
28	2	10
29	2	10
30	6	30
35	3	15

Question 1.2

How many computers are available for teacher use during each Science 10 class?

Sixty-five percent (65%) of the teachers that responded to this question had one or more computers available for their use during the teaching of Science 10. A further five percent (5%) expected that they would have a computer for instructional use before the end of the semester. Thirty-five percent (35%) of the respondents presently had no access to computers for instructional purposes. All of the respondents answered this question.

Table 1.2 Number of Computers Available For Teacher Use

NUMBER OF COMPUTERS AVAILABLE FOR TEACHER USE DURING SCIENCE 10	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS
0	7	35
1	7	35
4	1	5
5	1	5
15	1	5
30	3	15

Question 1.3

How do you perceive that information technology should be integrated into the Science 10 curriculum?

Table 1.3 Teacher Perceptions of the Use of IT in Science 10

HOW DO YOU PERCEIVE THAT INFORMATION TECHNOLOGY SHOULD BE INTEGRATED INTO THE SCIENCE 10 CURRICULUM?	NUMBER OF RESPONSES	PERCENTAGE OF RESPONDENTS (N=20)
Not at all	0	0
Where it would be unsafe to carry out an actual experiment	10	50
To complement my lesson or delivery of my lesson	19	95
To supplement text-based information	16	80
Other (specify)	4	20

The respondents were asked to check all of the responses that applied. All of the respondents to this question felt that information technology should be integrated into the teaching of Science 10. The majority felt that it should be used to complement the teacher's lesson or delivery of the lesson. In addition, a large majority (80%) felt that IT should also be used to supplement text-based material. Respondents who checked 'Other' (response number 5) were more specific in their interpretation of what they thought integration meant. They perceived that IT should be used for "individual student research", "research on the Internet", "PowerPoint™ presentations", "analyzing data", and "remedial practice".

Question 1.4

Do either you and/or your students use IT during Science 10 classes?

Eighty percent (80%) of the respondents (N=20) identified that they or their students presently use this technology during Science 10. The respondents that answered 'No' to Question 1.4 were asked to answer Question 1.5 then to proceed to Part 3 of the questionnaire. Those who responded 'Yes' to Question 1.4 were requested to complete all remaining survey questions

Question 1.5

In the current school year, I expect to:

Decrease the level of integration of IT in Science 10
Retain the present level of integration of IT in Science 10
Slightly increase the level of integration of IT in Science 10
Greatly increase the level of integration of IT in Science 10

Nearly three-quarters of the teachers who responded to this question indicated an intent to increase their level of integration of IT in Science 10 during the current school year. Twenty-eight percent (28%) of the respondents intended to retain their existing level of use,

and none of the respondents intended to decrease the level of IT that they integrate into the curriculum. Ten percent (10%) of those eligible to answer this question spoiled their answer by checking two responses, therefore in Table 1.5, N=18.

Table 1.5 Anticipated Use of IT by Science 10 Teachers

IN THE CURRENT SCHOOL YEAR, I EXPECT TO:	PERCENTAGE OF TOTAL RESPONDENTS (N=18)
decrease the level of integration of IT	0
retain the present level of integration of IT	28
slightly increase the level of integration of IT.	50
greatly increase the level of integration of IT.	22

Question 1.6

In what way have you integrated information technology into the Science 10 curriculum?

Although twenty questionnaires were returned as complete, only sixteen teachers answered Question 1.4 in the affirmative. The remaining four were directed to Question 1.5 and then to Question 3. The sixteen respondents who responded in the affirmative were then asked to answer all remaining questions. In Question 1.6, respondents were asked to check all of the responses that applied. Thirteen teachers indicated that they used IT as a productivity tool. Ten indicated that they used IT as a communication tool, and sixteen used IT for other purposes.

The following tables illustrate how Science 10 teachers are using IT.

Table 1.6.1 Teacher Use of IT as a Productivity Tool

USE OF INFORMATION TECHNOLOGY AS A PRODUCTIVITY TOOL	PERCENTAGE OF TEACHERS INDICATING THAT THEY PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
Using word-processing software	75
Using data bases	38
Using spreadsheets	44

Table 1.6.2 Teacher Use of IT as a Communication Tool

USE OF INFORMATION TECHNOLOGY AS A COMMUNICATION TOOL	PERCENTAGE OF TEACHERS INDICATING THAT THEY PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
Using e-mail	63
Using newsgroups	6
Using chats	0

In the 'other' category of Table 1.6.3, respondents were asked to identify any other ways in which they integrated IT into the Science 10 curriculum. There was only one response to this part of the question. One teacher indicated that Microsoft PowerPoint™ (software) was being used for making scientific presentations to the class. This response could be classified under "As a means of Demonstrating Scientific Concepts/Simulations.

Table 1.6.3 Other Uses of IT by Teachers

USE OF INFORMATION TECHNOLOGY AS:	PERCENTAGE OF TEACHERS INDICATING THAT THEY PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
a means of searching for/retrieving information	100
a means of demonstrating scientific concepts/ simulations	75
a means of diagnosis and prescription	19
other	6

Question 1.7

*Where is the computer hardware that **you** use for teaching science 10 located?*

Table 1.7 Location of IT Equipment

LOCATION OF COMPUTERS USED FOR SCIENCE 10	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS (N=16)
1. Science 10 Classroom	8	50
2. Separate Computer Lab	14	88
3. Portable Carts	2	13
4. Elsewhere.	3	19

Table 1.7 shows that the majority of IT hardware (88%) is located in separate computer labs and sometimes (50%) in the Science 10 classroom. Respondents to this question were asked to check all answers that apply.

The three respondents who indicated that their computers were located "Elsewhere" identified the library (2) and science office (1) as alternate locations.

Question 1.8

Indicate the frequency with which you use the following tools to deliver instruction in Science 10.

From Table 1.8, it is apparent that eighty-one percent (81%) of Science 10 teachers who responded used a word processor to deliver instruction. Slightly less than half (49%) used a database and less than half of the respondents (43%) used a spreadsheet. There appears to be a close correlation between these responses and those of Question 1.6 which identifies the frequency with which word processors, databases, and spreadsheets are used as productivity tools.

The response to item 9 on Table 1.8 suggests that all of the teachers use the Internet at varying levels of frequency. This response correlates highly with the response on Table 1.6 which shows that the Internet is used by all of the teachers (who responded) as a means of searching for and retrieving information.

When comparing the frequency with which teachers use e-mail (from Table 1.8) to the responses to Question 1.6, it is evident that the majority of teachers prefer e-mail as a communication tool to other forms of communication tool such as using newsgroups or chats. According to the responses to Question 1.8, sixty-nine percent (69%) of the respondents used Videodiscs at least three times per term.

Table 1.8 Frequency of Use of Selected Software Tools by Teachers During Science 10

SOFTWARE TOOL	USE OF SOFTWARE: PERCENTAGE OF SCIENCE 10 TEACHERS (N=16) WHO INDICATED:					
	No Response	(Tool) Not Available	Never	Rarely (1-3 times /term)	Sometimes (3-10 times/term)	Frequently (>10 times/term)
1.Word Processor		6	12	25		56
2.Data Base	6	6	37	37	6	6
3.Videodisc	6	12	12	44	19	6
4.Spreadsheet		6	50	25	12	6
5.Simulation		6	25	50	12	6
6.Desk Top Publisher	6		63	25	6	
7.Graphics Package		6	37	25	19	12
8.E-mail			37	31	12	19
9.Internet				31	37	31
10.CD			6	63	19	12
11.Drill and Practice		6	56	25		12
12.Other	94					6

Question 1.9

Indicate the frequency with which you use the following hardware during Science 10.

The data in Table 1.9 indicates that half of the teachers who responded to this question had either no access to a Liquid Crystal Display Projection Panel (or equivalent), or had never used this type of hardware to teach Science 10. All of the respondents had used a computer and printer at least once, and fifty-six percent (56%) of the respondents had used scientific equipment interfaces in some form. The majority of respondents indicated that they had not used video equipment during Science 10, while twenty-five percent (25%) indicated that they had done so but rarely. One respondent noted that s/he had never used video equipment during Science 10 but would like the opportunity to use this equipment for instructional purposes.

From Table 1.9, it appears that half of the teachers who answered this question used modems to access the Internet and communicate through e-mail. Respondents who indicated that they used 'Other ' types of IT hardware in their schools qualified this by stating that their schools were connected directly to an Edmonton Public Schools server and, consequently, did not need a modem. Laptops and other types of portable computer were found to be rarely or never used by the majority of Science 10 teachers. Less than half (44%) of teachers had used external forms of data storage such as Zip®, Jazz®, and SyQuest® disks. One teacher indicated that s/he used a wireless mouse frequently during the semester to aid in presentations.

Table 1.9 Frequency of Use of Selected Hardware by Teachers During Science 10

TYPE OF HARDWARE	USE OF HARDWARE: PERCENTAGE OF TEACHERS (N=16) WHO INDICATED:					
	No Response	(Hardware) Not Available	Never	Rarely (1-3 times /term)	Sometimes (3-10 times/term)	Frequently (>10 times/term)
1.LCD Projection Panel (or Equivalent)	6	25	25	19	19	6
2.Computer				31	25	44
3.Scanner			38	38	19	6
4.Printer				25	6	69
5.Scientific equipment interfaces	6	19	19	56		
6.Video equipment (video-camera, video-conferencing etc)		12	63	25		
7.Modem	12		38	19	12	19
8.Laptop, notebook, or portable computer		31	50	12	6	
9.Zip®, Jazz®, SyQuest ®, etc		12	44	19	19	6
10.Other	82				12	6

Part 2: Student Use of IT During Science 10

Question 2.0

*How many computers are available for **student** use during Science 10 class?*

Ninety-four percent (94%) of the eligible teachers responded to this question. The responses ranged from zero computers being available for student use, to a high of 30 computers. Themes that were pervasive in the responses stated that, in many cases, computers had to be pre-booked for student use. Several computers were located in libraries, while others were located in computer labs which were shared by other classes. Ninety-two percent (92%) of the respondents indicated that one or more computers were available for student use during Science 10.

Table 2.0 Availability of Computers for Student Use

NUMBER OF COMPUTERS AVAILABLE FOR STUDENT USE DURING SCIENCE 10	NUMBER OF RESPONDENTS	PERCENTAGE OF RESPONDENTS
0	1	7
1	1	7
2	1	7
4	1	7
5	1	7
10	1	7
15	1	7
20	1	7
30	6	43

One respondent who answered, but is not included in Table 2.0, stated that two complete computer labs were sometimes available for students to use during Science 10, but the labs

had to be pre-booked. There was no indication of the number of computers that were located in these two labs

Question 2.1

Do you consider this number sufficient to integrate the use of IT into the Science 10 curriculum?

The responses to this question indicate that fifty-six percent (56%) of the teachers thought there were sufficient computers available for student use. Respondents identified problems with having to pre-book computers (or labs) in order to have sufficient numbers of computers available. Also, frequent problems were encountered with 'over-booking' because the demand for computers by other classes (and courses) exceeded the number of computers available. One teacher commented that at his/her school software was fairly limited.

Question 2.2

In what way(s) do students use information technology in the Science 10 classroom?

Table 2.2.1 Student Use of IT as a Productivity Tool

USE OF INFORMATION TECHNOLOGY AS A PRODUCTIVITY TOOL	PERCENTAGE OF TEACHERS WHO INDICATED THAT THEIR STUDENTS PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
Using word-processing software	69
Using data bases	25
Using spreadsheets	25

Table 2.2.2 Student Use of IT as a Communication Tool

USE OF INFORMATION TECHNOLOGY AS A COMMUNICATION TOOL	PERCENTAGE OF TEACHERS WHO INDICATED THAT THEIR STUDENTS PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
Using e-mail	31
Using newsgroups	0
Using chats	0

Table 2.2.3 Other Uses of IT by Students

USE OF INFORMATION TECHNOLOGY AS:	PERCENTAGE OF TEACHERS WHO INDICATED THAT THEIR STUDENTS PURSUE THIS ACTIVITY DURING SCIENCE 10 (N=16)
a means of searching for/retrieving information	88
a means of demonstrating scientific concepts/ simulations	44
a means of diagnosis and prescription	13

Although twenty questionnaires were returned overall, only sixteen teachers were eligible to respond to this question as per the instructions following Question 1.4. The above tables illustrate how teachers of Science 10 perceive that students are using IT in the classroom.

Question 2.3

*Indicate the frequency with which **students** use the following tools during Science 10 classes.*

Table 2.3 Frequency of Use of Selected Software Tools by Students During Science 10

SOFTWARE TOOL	USE OF SOFTWARE: PERCENTAGE OF SCIENCE 10 TEACHERS (N=16) WHO INDICATED THAT THEIR STUDENTS USE THIS TOOL					
	No Response	(Tool) Not Available	Never	Rarely (1-3 times /term)	Sometimes (3-10 times/term)	Frequently (>10 times/term)
1.Word Processor				44	38	19
2.Data Base	6		50	38	6	
3.Videodisc	6	19	56	12		6
4.Spreadsheet			63	31	6	
5.Simulation	6		38	50	6	
6.Desk Top Publisher	6	6	56	25	6	
7.Graphics Package	6	6	56	12	19	
8.E-mail	6		50	25	12	6
9.Internet			6	25	56	12
10.CD			25	50	12	12
11.Drill and Practice	12		44	38		6
12.Other	94			6		

According to Table 2.3, all of the teachers who responded indicated that students use a word processor a minimum of 1-3 times per term, whereas according to Table 1.8 only eighty-one percent (81%) of teachers reportedly use this software. However, Table 1.8

shows that the majority of teachers (56%) use a word processor frequently (more than ten times per term). In Table 2.3, only nineteen percent (19%) of the respondents indicated that their students use this software more than ten times per term.

In Table 1.8, the frequency of use of Desk Top Publishing software by teachers correlates highly with the frequency of the reported student use of this software (Table 2.3). Thirty-one percent (31%) of the respondents indicated that either teachers or students use this software between one and ten times per semester. In Table 2.3, ninety-three percent (93%) of the teachers indicated that Internet tools are used by nearly all of the students at least once per semester, whereas only forty-three percent (43%) of teachers indicated that their students use e-mail software at least once per semester.

Question 2.4

*Indicate the frequency with which **students** use the following hardware during Science 10.*

The majority of teachers indicate that their students rarely use Liquid Crystal Display (LCD) Projection Panels and external data storage devices such as Zip®, Jazz®, and Syquest® drives. The situation is similar regarding student use of scanners, scientific equipment interfaces, modems, or portable computers.

In contrast, respondents indicate that their students use a desktop computer and printer at least some of the time during their lessons. One respondent commented that some students used a network server in lieu of a modem for connecting to the Internet and for sending e-mail.

Table 2.4 Frequency of Use of Selected Hardware by Students During Science 10

TYPE OF HARDWARE	USE OF HARDWARE: PERCENTAGE OF SCIENCE 10 TEACHERS (N=16) WHO INDICATED THAT THEIR STUDENTS USE THIS HARDWARE					
	No Response	(Hardware) Not Available	Never	Rarely (1-3 times /term)	Sometimes (3-10 times/term)	Frequently (>10 times/term)
1.LCD Projection Panel (or equivalent)	6	19	69	6		
2.Computer				25	56	19
3.Scanner		6	56	25	12	
4.Printer	12			31	38	19
5.Scientific equipment interface		19	38	44		
6. Video equipment (video-camera, video-conferencing, etc)	12	12	69	6		
7.Modem	12	12	38	25	12	
8.Laptop, notebook, or portable computer	6	19	69	6		
9.Zip®, Jazz®, SyQuest ®, etc	6	19	69	6		
10.Other	82		6		12	

Part 3: Use of IT for Instructional Support

Question 3.1

Indicate the frequency with which you use the following software for developing lesson materials.

Table 3.1 Frequency With Which Teachers Use Selected Software Tools for Developing Lesson Materials

SOFTWARE TOOL	USE OF SOFTWARE: PERCENTAGE OF SCIENCE 10 TEACHERS (N=16) WHO INDICATED:					
	No Response	(Tool) Not Available	Never	Rarely (1-3 times /term)	Sometimes (3-10 times/term)	Frequently (>10 times/term)
1.Word Processor			5		10	85
2.Data Base	10		45	25	15	5
3.Videodisc	5	10	20	40	10	15
4.Spreadsheet			45	30	15	10
5.Simulation		5	40	40	5	10
6.Desk Top Publisher	5	5	55	10	20	5
7.Graphics Package		5	45	20	20	10
8.E-mail			45	10	5	40
9.Internet			5	20	20	55
10.CD			30	30	20	20
11.Drill and Practice	15		65	10		10

In previous sections of this survey teachers were asked to respond to questions about their direct use of IT in the classroom during the teaching of Science 10. This question was designed to find out the frequency with which teachers use software for developing lesson materials either in the Science 10 classroom or elsewhere.

The data presented in Table 3.1 illustrates that a large percentage of teachers (95%) use word processing software and Internet software to develop their lesson materials. Seventy percent (70%) of the respondents indicated that they use CD's and sixty-five percent (65%) use Videodiscs to provide them with information, but only a relatively small percentage of the respondents use these software tools on a frequent basis. E-mail software, on the other hand is used by fifty-five percent (55%) of the respondents and is used by forty percent (40%) of them on a frequent basis. Most of the teachers answered a large portion of this question.

Question 3.2

Do you use IT for recording or reporting marks?

This question was completed by all respondents. Ninety percent (90%) of those answering this question used IT for recording marks. One of the respondents who reported not using IT for reporting marks, also answered Question 1.4 in the negative indicating that s/he may not use IT at all for the instruction of Science 10. (Question 1.4 asked: "*Do you and/or your students use IT during science 10 classes?*").

Question 3.3

Do you use IT for recording or reporting attendance?

All of the respondents answered this question. Thirty percent (30%) of the teachers answered this question in the affirmative. One teacher noted that even though s/he does not

use IT for recording or reporting attendance, administrators and clerical staff at the school use IT for this purpose.

Question 3.4

Do you use IT for communicating with administrators?

All of the respondents answered this question. Fifty percent (50%) indicated that they use IT for communicating with administrators.

Question 3.5

Do you use IT for communicating with teachers about work-related topics?

This question was answered by all of the respondents. Forty-five percent (45%) stated that they use IT for communicating with other teachers about work-related topics.

Question 3.6

Do you use IT for any other administrative or support process?

The responses, once again, were evenly divided. Fifty percent (50%) of the respondents use IT for other administrative or support functions. Examples given, of where Science 10 teachers are using IT for administrative processes or support, are:

- using a word processor for the development of reference letters.
- e-mail exchanges with other staff regarding professional development, meetings, etc.
- contacting central office personnel via e-mail
- using e-mail to convey information to other colleagues regarding current IT advances.

- using databases to store relevant student information such as parent phone numbers (work), names of students' other teachers, and information about attendance.

- communicating with parents by e-mail.
- using the Internet for research to help students find information for science related reports.

Part 4: Exemplary Uses of IT

Question 4.1

One of the purposes of this research is to identify specific examples of where IT has been integrated into the Science 10 curriculum. Do you have a specific application of the integration of technology which you would like to describe?

Sixty percent (60%) of the respondents who completed the questionnaire chose to provide brief anecdotal examples of how and where IT was being used. They also used this section to provide personal comments about the integration of IT into their specialized field of Science 10. Although this is not a phenomenological study of the use of IT, it was decided to include the comments in this research in order to provide a better understanding of teachers' perceptions of the issues surrounding the integration of IT. Responses for Question 4.1 are divided into two sections, one describing examples of the use of IT, and the other containing constructive comments about the integration of IT into Science 10 from the respondents.

Section 1: Examples of the Use of IT

1. On the chemistry Unit of Science 10, one school uses proprietary software for

remediation and support for the students. This software is located in the computer labs. In addition, the Internet is used extensively for carrying out research during assignments.

2. In another school, information technology is used for the demonstration of anatomy during the biology unit of Science 10. Data sampling and spreadsheets are used during the instruction of the physics unit, and scientific simulations are used during the chemistry unit.

3. During the teaching of the chemistry unit, each student is assigned an element to study. The individual student then carries out research on the element using the Internet. The Internet is also used to perform an experiment on the dissection of an animal (from the biology unit), rather than dissecting certain animals in the classroom.

4. In one school, the librarian/teacher has assisted the Science 10 teachers in investigating certain strategies for using IT in the classroom. For example, the teachers have been encouraged to develop PowerPoint™ presentations, pamphlets covering aspects of the curriculum, and newsletters which cover a specific area of the curriculum. It is the intention of this school to expand the use of IT in all subjects. Teachers are reviewing the feasibility of having students produce a personal science website which includes the use of 'plug-ins' and 'hot-links' to enable others to expand their knowledge on a specific topic.

5. One school uses software obtained from the Edmonton Space and Science Centre. This program is used on the weather portion of the curriculum to demonstrate the Coriolis Effect and wind pattern variations. The Coriolis Effect "is the bending or

deflection of moving air currents in response to Earth's rotation." (Braaten et al, 1997, p.468)

6. On the physics unit, one school uses a program which has been developed by one of its district consultants, which shows "distance versus time relationships graphed for uniform/non-uniform motion", whereas at another school, the teacher has developed an application using Microsoft™ Excel™ to show similar scientific relationships.

7. Laser disks are used at one school for instructional purposes.

8. One school reported using IT in all grades of high school science. For example:

   - In Science 10, students collect data by carrying out experiments. They analyze and graph the data using a spreadsheet, and merge this information into reports using a word processor.

   - Teachers at this school also use PowerPoint™ to make unit presentations. When this software is used conjointly with a wireless mouse, the teacher is able to control presentations from anywhere in the classroom/lab.

   - Teachers at this school also use a digital camera and accompanying software for making presentations on the biology unit of Science 10. For example, a sequence of scientific events can be photographed and digitized into JPEG format (graphic images). These images can then be presented to the class in a sequence as part of the lesson, or they can be integrated into other forms of lesson material.

   - Even though data acquisition hardware is available at this school, it is used to a lesser extent than other IT equipment mainly because teachers have insufficient time to develop activities using this equipment. This particular hardware/software package consists of different sensors (e.g. temperature,

audio, and sonar probes) which are plugged into a 'probeware' box, and then connected to a computer. The probes provide digital signals to the 'probeware' box which converts the signal to data which can be analyzed by the computer and shown on the computer's monitor.

Section 2: Constructive Comments from Teachers of Science 10

1. One teacher commented positively that the donation of computers by a large company has enabled the school to place a computer in each classroom in the science department for student use.

2. Teachers from one school , who appeared to embrace IT quite extensively, found that even though they had the aspiration to use some of the software that was available to them, there was insufficient time in their teaching schedule to develop the number of activities that they would like to. These teachers also commented that they would also like to expand their use of IT by developing Authorware ® tutorials and other scientific activities using this software.

3. One respondent stated that you cannot integrate something (IT) that you do not have and that "not every science classroom has computers and even those that do, have few software programs. Use of the Internet is restricted to the computers in the library".

4. Although one of the respondents did not provide a specific example of where IT was being used in Science 10, the individual did share that there was an integrated computer technology committee at his/her school which was looking at ways to incorporate technology into its classes. The final comment from this teacher was that "IT must complement the lesson and not be all consuming when it comes to time. Time management is so crucial when it comes to teaching Science10 because there is so much

content to cover." The main focus of this teacher was to give students an in-depth understanding of the Science 10 curriculum and use IT as a tool to reach this goal.

5. The comments made by one of the teachers indicated that the individual was very receptive to the idea of using IT in the Science 10 curriculum, and valued its potential impact in the classroom. However, the respondent added that due to the high cost of technology and the current financial status of his/her school, the quality and quantity of IT hardware and software that was available was extremely poor.

CHAPTER V

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The purpose of this study is to determine the extent to which information technology is being used in the teaching/learning environment of Science 10 in selected Alberta High Schools, and the role of information technology in the teaching/learning process.

This chapter begins by discussing the findings of the research as they relate to the four problems identified in Chapter I. The discussion is followed by conclusions drawn from the research findings, and is concluded by recommendations for further study.

Problem 1

What does the integration of IT mean to Science 10 teachers?

Roblyer et al (1997) suggest that when using IT to improve teaching and learning, each integration strategy should be matched to a specific need rather than using IT just because it is available. According to the responses in Question 1.3, teachers perceive that IT should be integrated into the Science 10 curriculum, primarily as a tool to complement their lessons or as a medium to enhance the delivery of their lessons. Secondly, IT should be used as a supplement to text-based information and any other information that is given during Science 10 classes. As one respondent stated: "IT must complement the lesson and not be all consuming when it comes to time. Time management is so crucial when it comes to teaching Science10 because there is so much content to cover." The teaching of the use of IT should not take precedence over the teaching of the Science 10 curriculum. Thirdly, teachers perceive that IT should be used

on the occasions when it would be unsafe to carry out actual experiments. Finally, some teachers perceived that IT should be used as a research tool, for data manipulation, or for drill and practice by students to enhance their individual learning.

Problem 2

What role does information technology play in the teaching/learning environment of Science 10 in selected High Schools in Alberta?

From the data provided by the respondents, it appears that one of the major roles of information technology in the Science 10 classroom is that of a tool for searching for and retrieving information (Table 1.6.3) All of the teachers who responded indicated that this was one of the primary roles of IT for them, and eighty-eight percent (88%) perceived that this was also one of the primary roles of IT for their students (Table 2.2.3).

Another important role of information technology, as identified in Tables 1.6.1 and 2.2.1, is as a productivity tool. This category is sub-divided into three types of productivity tool: word processors, data bases, and spreadsheets. According to the responses in these tables, seventy-five percent (75%) of teachers appear to use word processing software as a productivity tool during Science 10, and sixty-nine percent (69%) of teachers indicated that their students use word processing software as a productivity tool during Science 10. Less than half of the teachers use databases and spreadsheets as productivity tools and only twenty-five percent (25%) of the teachers indicate that their students do. A large percentage of teachers reported using databases (as a productivity tool) for recording marks, while only thirty percent (30%) use them for reporting attendance.

According to the information provided in the research, the role of information technology as a means of demonstrating scientific concepts and/or simulations is another important role of this medium. In the Science 10 classroom, three quarters of the teachers surveyed indicated that they use information technology as a means of demonstrating scientific concepts and performing simulations. Less than half of the teachers indicated that their students use IT for this purpose.

Tables 1.6 and 2.2, indicate that sixty-three percent (63%) of teachers use e-mail as a communication tool while in the Science 10 classroom and thirty-one percent (31%) of the respondents indicated that their students do. Neither teachers nor students appear to use chats or newsgroups to any extent in the Science 10 classroom.

Use of IT for diagnostic and prescriptive purposes appears to be relatively uncommon. Less than twenty percent (20%) of teachers reported that they or their students are using IT in this role.

Problem 3

To what extent are teachers in Alberta high schools using information technology to enhance the teaching/learning process in the Science 10 curriculum?

The response to this problem can be divided into two parts: To what extent are teachers using specific tools (software) in the Science 10 environment, and to what extent are they using specific pieces of IT hardware?

Software as Tools

The responses to Question 1.4 indicate that approximately eighty percent (80%) of teachers and/or students of Science 10 are presently using information technology during classes. The number of computers available for teacher use ranges from 0 to 30 with sixty-five percent (65%) of the teachers having access to one or more computers. According to the teachers who responded to Question 2.0, the number of computers available for student use during Science 10 also ranges from 0 to 30. Ninety-two percent (92%) of the teachers who responded indicated that their students had one or more computers to use during Science 10. Forty-four percent (44%) of the respondents stated that there were insufficient computers available for student use, and cited logistical problems as the main reason.

Tables 1.8 and 2.3 illustrate the extent to which teachers and students respectively are using specific IT tools during Science 10. A large percentage of teachers (81%) indicated that they used a word processor at least one to three times per semester, and one hundred percent (100%) of the teachers who responded to Question 2.3 indicated that their students use word processors one to three times per semester. Teachers who responded that their students used this software indicated that their students used it less frequently. Fifty-six percent (56%) of teachers indicated that they used a word processor more than ten times per semester compared to nineteen percent (19%) of teachers who indicated that their students use this software with the same frequency. Ninety-five percent (95%) of teachers also use a word processor for instructional support (e.g.for developing handouts, letters, newsletters, reports, and memos).

Data bases are rarely used by teachers and students in the Science 10 learning environment. Seventy-four percent (74%) of teachers surveyed stated that they rarely or

never use data bases during Science 10. Students are reported to use data bases even less than teachers do. In Tables 1.8 and 2.3, teachers indicate that seventy-five percent (75%) of them rarely or never use spreadsheets and ninety-four percent (94%) of them report that their students do not either. Examples given by respondents of where they use data bases and spreadsheets are; for plotting and graphing experimental data, recording marks, and reporting attendance. Additionally, seventy percent (70%) of teachers rarely or never use data bases for instructional support and seldom use spreadsheets for this purpose either.

The data in Tables 1.8 and 2.3 suggest that more teachers use videodiscs than students do. Approximately sixty-nine percent (69%) of Science 10 teachers indicated that they use videodiscs compared to eighteen percent (18%) of teachers who indicated that their students do. Teachers use them more frequently in the classroom and also use them for instructional support.

Simulation software appears to be either rarely or never used by either teachers or students during Science 10. One could hypothesize that the reason for this is because few scientific applications have been developed using this medium. There may also be a lack of demand for the use of this tool in this particular teaching/learning milieu. Information provided in Table 3.2, regarding the use of simulation software for instructional support, correlates highly with its use in the classroom.

Desk Top Publishing appears to be rarely used in the Science 10 classroom, or for instructional support. Only six percent (6%) of Science 10 teachers indicate that they or their students use this software three to ten times per semester, and over eighty percent (80%) rarely or never use this medium.

Tables 1.8 and 2.3 suggest that teachers make more use of graphics software than their students do. Fifty-six percent (56%) of Science 10 teachers report that they use this software in contrast to thirty-one percent (31%) of Science 10 teachers who report that their students do. Half of the respondents indicate that they use graphics software for instructional support.

More than sixty-percent (60%) of the teachers indicated that they used e-mail at least once per semester while forty-three percent (43%) of Science 10 teachers indicated that their students also use this software. Half of the Science 10 teachers who responded indicated that their students never use e-mail during Science 10 (Table 2.3). Fifty-five percent (55%) of teachers report that they use e-mail software for instructional support with the majority using this software more than ten times per semester.

Internet software is used to a greater extent than all of the other software during Science 10. All of the respondents reported that they used this tool, and ninety-three percent (93%) of them indicated that their students do. Ninety-five percent (95%) of the teachers also made use of this tool for instructional support. This data correlates highly with Tables 1.6 and 2.2 in which the respondents identify one of the major roles of IT being as a means of searching for or retrieving information. This may also be the reason why there is a high usage of CD's by teachers and students i.e. as a means of searching for or retrieving information.

Drill and practice software does not appear to be used a great deal during Science 10. Thirty-seven percent (37%) of Science 10 teachers indicate that they use drill and practice software during Science 10. Forty-four percent (44%) of teachers indicate that their students use this software during Science 10. Twenty percent (20%) of teachers use this tool more than once per semester for instructional support

IT Hardware

Liquid Crystal Display projection panels or any other type of projection display panel appear to be rarely, if ever, used by students in the Science 10 learning environment. According to Table 2.4, only six percent (6%) of Science 10 teachers reported that their students use this hardware. In contrast, it appears that forty-four percent (44%) of teachers use this hardware. Since projection panels are specifically designed for the presentation of information, it would be reasonable to expect in the current learning environment, that teachers use this hardware to a greater extent than students.

Digital scanners are used in Science 10 by both teachers and students, and the extent that they are used differs quite radically. According to the data provided in Tables 1.9 and 2.4, sixty-three percent (63%) of the teachers surveyed indicated that they used a scanner from one to over ten times per semester. Thirty-seven percent (37%) of the teachers indicated that their students used a scanner between one and ten times per semester.

In Tables 1.9 and 2.4, the data suggests that the extent to which scientific equipment interfaces are used to enhance learning is minimal. Fifty-six percent (56%) of teachers reported that they use scientific equipment interfaces. Forty-four percent (44%) of teachers report that their students use this type of hardware but only rarely. The remainder of the respondents do not appear to use this type of hardware, or it simply is not available to them. One should use caution when interpreting this particular piece of data because there are other methods of demonstrating scientific concepts and/or simulations than by using scientific equipment interfaces. For example, presentation software, data bases, and spreadsheets can all be used to demonstrate various scientific concepts. One could hypothesize that the limited use of scientific equipment interfaces reported by the

respondents in this survey may be due to, their use of software as an alternative, the high cost of scientific interface equipment, lack of resources to develop lessons using this hardware, or too few applications in the science curriculum to justify the purchase of the hardware.

From the data presented in Tables 1.9 and 2.4, it is apparent that video equipment such as video-cameras and video conferencing equipment is seldom used by teachers or students to enhance the learning environment. The reason for this does not appear to be because this type of media is unavailable, but because teachers and students, for whatever reason(s), simply choose not to use this hardware. Sixty-three percent (63%) of teachers indicated that they never use this hardware and sixty-nine percent (69%) of teachers indicate that their students never use this hardware during Science 10.

Questions 1.9.7 and 2.4.7 attempted to find out to what extent modems are being used in Science 10. These parts of the questions should have been divided into two separate categories. One covering the use of modems, and the other covering the use of network servers (e.g., the Edmonton Public Schools Servers). The purpose of these questions, however, was to provide additional information to support the premise that teachers and students are (or are not) using the Internet. Fifty percent (50%) of the teachers reported that they used modems, while thirty-seven percent (37%) reported that their students do. Twelve percent (12%) of teachers indicated that they used a direct connection to a network server and the same percentage of teachers indicated that their students do. A higher percentage of teachers than students appear to use modems, and with greater frequency. It could be hypothesized that some of the respondents were not sure whether their schools used dial-up connections or not. This would depend on the teacher's expertise in using IT or knowledge of it.

The extent to which laptop, notebook, and portable computers are used in Science 10 to enhance the learning environment appears to be minimal. This majority of respondents reported that they or their students never used this hardware or it was not available at the time of reporting. The reason for this may be that schools cannot afford such equipment, or that this type of media is not required to enhance the teaching/learning environment of Science 10.

The intent of Questions 1.9 and 2.4 was to determine the extent to which several types of hardware are being used during Science 10, and the part of the questions dealing with Zip® drives, Jazz® drives, and Syquest® drives, etc., was intended to find out to what extent data storage devices are being used by teachers. It appears that these types of storage device are either never used or not available to over fifty percent (50%) of the teachers, and over ninety percent (90%) of the teachers reported that their students do not use this hardware.

The extent to which other IT hardware is used during Science 10 to enhance the teaching/learning environment appears to be minimal. Only one respondent noted that s/he used a wireless mouse a great deal of the time. No other teachers responded to this part of the question.

Part 3 of the survey was intended to identify to what extent teachers use IT for instructional support. Nearly all of the respondents use IT for recording marks, whereas less than one third use IT for recording attendance. One half of the teachers who responded, indicated that they use IT for communicating with administrators, but slightly less than half use it for communicating with others about work-related topics. The final question in Part 3 of the survey attempted to find out to what extent teachers use IT for any other type of administrative or support purpose. Fifty percent (50%) of the teachers responded to this question and although several examples were given, they fell into already covered

categories of use, namely, the use of e-mail for communication, using databases for storing students' personal data, using word processors for developing letters, and using the Internet for academic research.

Problem 4

Do teachers in Science 10 intend to decrease, maintain, or increase the integration of information technology during this school year?

Forty-three percent (43%) of the schools surveyed responded to the questionnaire and of those that responded ninety percent (90%) answered Question 1.5 regarding their future use of IT. All of the teachers either intend to retain their present level of integration of IT or to increase it. The data in Question 1.5 suggests that the trend is for teachers to slightly increase their use of IT during the current year with twenty-two percent (22%) opting to greatly increase their use of IT.

From an analysis of the questionnaires, twenty percent (20%) answered Question 1.4 in the negative suggesting that neither they nor their students used IT during Science 10. Ninety percent (90%) of the respondents who answered Question 1.4 answered Question 1.5. Of these respondents, seventeen percent (17%) answered that they expected to retain the present level of use of IT (to not use IT), and six percent (6%) stated that they expected to greatly increase the level of integration of IT.

Conclusions

Alberta Education (1995a), identifies several challenges and recommendations that need to be addressed in order to maximize the integration of technology into education. Some of the recommendations are relevant to this research. For example, students should "routinely

create, analyze and critically interpret information and data . . . using the tools and skills of information retrieval and processing (e.g. word processing, graphics, spreadsheet, database applications) " (Alberta Education, 1995a, p.4).

The data provided in this research suggests that the majority of Science 10 students and teachers presently use IT with varying frequencies for searching, accessing and retrieving information. Approximately three quarters of the respondents reported that they and their students use word processors. Both teachers and students appear to use this software quite frequently, even though they use it at varying levels of frequency.

In contrast, databases and spreadsheets are used by less than half of the teachers surveyed. The reason for this may be because there is very little need to use databases and spreadsheets in the Science 10 curriculum. The information provided by the research suggests that other IT tools are used in the Science 10 classroom, with varying frequency.

Overall, teachers who responded to this survey appeared to be positive about using IT , and the potential use of it in the teaching/learning environment. Several respondents identified specific hurdles that still need to be overcome for IT to be integrated to a greater extent in the Science 10 curriculum. For example, better use must be made of existing IT hardware and software. Adequate funding must be put in place to ensure equitable access to technology regardless of where a school is located, and improved teacher training must be carried out so that beginning teachers will be confident and competent with using IT. This will permit teachers to focus more on the content of the curriculum, and increase the integration of IT where it meets the educational needs of their students.

The results from this study can not be generalized to all schools in Alberta since urban schools were historically funded differently than rural schools and it has only been within

the last few years that funding equitability has been addressed. The level of hardware and software (both in quantity and quality) that is available to high schools may vary significantly between urban schools and rural schools. One could also question whether the results of this study could be generalized to other urban school districts since each has a certain level of autonomy to develop and implement its own Three-Year Technology Plan.

Recommendations for Further Study

This research focussed on school districts encompassed by the two largest urban areas of Alberta. It was designed to identify the use of IT, during Science 10, from the teacher's perspective. A further study should be carried out to identify the use of IT from the student's standpoint. This would give a broader perspective of how IT is being used, for Science 10, outside of the classroom/laboratory setting, and identify if students are transferring IT skills to different learning environments.

Presently in Alberta, a large number of cost-saving measures are being implemented, for example, staffing levels are being reduced, teacher preparation time is being reduced, and class sizes are being increased. Further research should be carried out to determine the effects of these measures on the integration of IT into the curriculum and whether these measures are affecting professional development initiatives.

Finally, future funding initiatives for IT integration will be 'blended' with the funding for regular programs, therefore a longitudinal study should be carried out to see if available funding is able to keep pace with the advancement of hardware and software, and whether the quality of technology at that time still adequately meets the needs of the students.

APPENDIX A
QUESTIONNAIRE

A SURVEY OF THE USE OF INFORMATION TECHNOLOGY IN SCIENCE 10 IN SELECTED ALBERTA SCHOOLS

The completion and return of this survey is interpreted as consent to participate. Information provided will be kept confidential.

The code number at the top right hand side of the survey is the only way your school can be identified. This number will be removed, by a neutral third party, once the survey is received, and the name of your school will be deleted from the list of schools that were sent questionnaires.

Should a large number of schools not respond to the survey, a reminder letter may be sent to those schools, in an attempt to encourage them to respond, and make the research more meaningful. Your anonymity and that of your school will be respected.

For the purpose of this survey, **Information Technology** (IT) is defined as the use of computers and related communication technologies.

The following survey is divided into four parts:

Part 1: Use of IT by the Science 10 teacher
- In General.
- During Instruction.

Part 2: Student use of IT during Science 10

Part 3: Use of IT for Instructional Support

Part 4: Exemplary uses of IT

Please complete all parts.

Instructions:

1. For each item requiring a check(√), decide which response applies and check(√) the appropriate box(es).

2. For each item requiring you to circle the most appropriate number, circle **one** response only.

3. For the purpose of this survey **Rarely** is defined as 1-3 times/term, **Sometimes** is defined as 4-10 times/term, and **Frequently** is defined as more than 10 times /term.

4. Please do not place any marks on your survey that will identify you or your school.

Part 1:Use of IT by the Science 10 Teacher.

Use of IT in General

1.0 How many Science 10 classes are you teaching this semester? _____

1.1 What is the average number of students in your Science 10 classes?_____

1.2 How many computers are available for teacher use during each Science 10 class?_____

1.3 How do you perceive that information technology should be integrated into the Science 10 curriculum? **Please check (√) all that apply.**

- ❒ Not at all
- ❒ Where it would be unsafe to carry out an actual experiment.
- ❒ To complement my lesson or delivery of my lesson.
- ❒ To supplement text-based information.
- ❒ Other (specify)_____

_____

1.4 Do either you and/or your students use IT during Science 10 classes?

Please check (√) your response:

❒ Yes ❒ No

If you answered **Yes** to Question 1.4, answer all remaining questions. If you answered **No,** answer **Question 1.5** and then proceed to **Question 3.**

1.5 In the current school year, I expect to:

- ❒ Decrease the level of integration of IT in Science 10.
- ❒ Retain the present level of integration of IT in Science 10.
- ❒ Slightly increase the level of integration of IT in Science 10.
- ❒ Greatly increase the level of integration of IT in Science 10.

Use of IT During Instruction

1.6 In what way have **you** integrated information technology into the Science 10 curriculum? **Please check (√) all that apply.**

As a productivity tool :

- ❒ Using word processing software
- ❒ Using data bases
- ❒ Using spreadsheets

As a communication tool:

- ❒ Using e-mail,
- ❒ Using newsgroups
- ❒ Using chats

- ❒ As a means of searching for/retrieving, information (e.g. Internet).
- ❒ For demonstrating scientific concepts and/or simulations.
- ❒ Diagnosis and prescriptive assessment of knowledge and skills.
- ❒ Other (please specify)_____

1.7 Where is the computer hardware that **you** use for teaching Science 10 located? Please check (√) all that apply.

- ❒ In the Science 10 classroom.
- ❒ In a separate computer lab.
- ❒ On portable carts.
- ❒ Elsewhere (please specify)_____

1.8 Indicate the frequency with which you use the following tools to deliver instruction in Science 10. **Circle the appropriate response:**

	Not Available	Never	Rarely (1-3/term)	Sometimes (4-10/term)	Frequently (>10/term)
1.Word Processor	1	2	3	4	5
2. Data Base	1	2	3	4	5
3. Videodisc	1	2	3	4	5
4. Spreadsheet	1	2	3	4	5
5. Simulation	1	2	3	4	5
6. Desk Top Publisher	1	2	3	4	5
7. Graphics Packages	1	2	3	4	5
8. E-mail	1	2	3	4	5
9. Internet	1	2	3	4	5
10. CD	1	2	3	4	5
11. Drill and Practice	1	2	3	4	5
12. Other (specify)_____	1	2	3	4	5
13. Other (specify)_____	1	2	3	4	5

1.9 Indicate the frequency with which you use the following hardware during Science 10. **Circle the appropriate response:**

	Not Available	Never	Rarely (1-3/term)	Sometimes (4-10/term)	Frequently (>10/term)
1. LCD projection panel (or equivalent)	1	2	3	4	5
2. Computer	1	2	3	4	5
3. Scanner	1	2	3	4	5
4. Printer	1	2	3	4	5
5. Scientific equipment interfaces	1	2	3	4	5
6. Video equipment (video-camera, video conferencing, etc.)	1	2	3	4	5
7. Modem	1	2	3	4	5
8. Laptop, notebook, or portable computer.	1	2	3	4	5
9. Zip®, Jazz®, Syquest®, etc	1	2	3	4	5
10. Other (specify)_____	1	2	3	4	5
11. Other (specify)_____	1	2	3	4	5

Part 2: Student Use of IT During Science 10.

2.0 How many computers are available for **student** use during Science 10 class?_____

2.1 Do you consider this number sufficient to integrate the use of IT into the Science 10 curriculum? **Please check (√) your response:**

❒ Yes ❒ No

Comments?_____

_____

2.2 In what way(s) do **students** use information technology in the Science 10 classroom? **Please check (√) all that apply.**

As a productivity tool :

❒ Using word processing software

❒ Using data bases

❒ Using spreadsheets

As a communication tool:

❒ Using e-mail,

❒ Using newsgroups

❒ Using chats

❒ As a means of searching for/retrieving, information (e.g. Internet).

❒ For demonstrating scientific concepts and/or simulations.

❒ Diagnosis and prescriptive assessment of knowledge and skills.

❒ Other (please specify)_____

2.3 Indicate the frequency with which <u>students</u> use the following tools during Science 10 classes. **Circle the appropriate response :**

	Not Available	Never	Rarely (1-3/term)	Sometimes (4-10 /term)	Frequently (>10/term)
1.Word Processor	1	2	3	4	5
2. Data Base	1	2	3	4	5
3. Videodisc	1	2	3	4	5
4. Spreadsheet	1	2	3	4	5
5. Simulation	1	2	3	4	5
6. Desk Top Publisher	1	2	3	4	5
7. Graphics Packages	1	2	3	4	5
8. E-mail	1	2	3	4	5
9. Internet	1	2	3	4	5
10. CD	1	2	3	4	5
11. Drill and Practice	1	2	3	4	5
12. Other (specify)_____	1	2	3	4	5
13. Other (specify)_____	1	2	3	4	5

2.4 Indicate the frequency with which <u>students</u> use the following hardware during Science 10. **Circle the appropriate response:**

	Not Available	Never	Rarely (1-3/term)	Sometimes (4-10/term)	Frequently (>10/term)
1. LCD projection panel (or equivalent)	1	2	3	4	5
2. Computer	1	2	3	4	5
3. Scanner	1	2	3	4	5
4. Printer	1	2	3	4	5
5. Scientific equipment interfaces	1	2	3	4	5
6. Video equipment (video-camera, video conferencing, etc.)	1	2	3	4	5
7. Modem	1	2	3	4	5
8. Laptop, notebook, or portable computer.	1	2	3	4	5
9. Zip®, Jazz®, Syquest®, etc	1	2	3	4	5
10. Other (specify)_____	1	2	3	4	5
11. Other (specify)_____	1	2	3	4	5

Part 3: Use of IT for Instructional Support.

3.1 Indicate the frequency with which <u>you</u> use the following software for developing lesson materials. **Circle the appropriate response:**

	Not Available	Never	Rarely (1-3/term)	Sometimes (4-10 /term)	Frequently (>10/term)
1.Word Processor	1	2	3	4	5
2. Data Base	1	2	3	4	5
3. Videodisc	1	2	3	4	5
4. Spreadsheet	1	2	3	4	5
5. Simulation	1	2	3	4	5
6. Desk Top Publisher	1	2	3	4	5
7. Graphics Packages	1	2	3	4	5
8. E-mail	1	2	3	4	5
9. Internet	1	2	3	4	5
10. CD	1	2	3	4	5
11. Drill and Practice	1	2	3	4	5
12. Other (specify)_____	1	2	3	4	5
13.Other (specify)_____	1	2	3	4	5

Please check (√) your response to the following questions:

3.2 Do you use IT for recording or reporting marks?

❒ Yes ❒ No

3.3 Do you use IT for recording or reporting attendance?

❒ Yes ❒ No

3.4 Do you use IT for communicating with administrators?

❒ Yes ❒ No

3.5 Do you use IT for communicating with teachers about work-related topics?

❒ Yes ❒ No

3.6 Do you use IT for any other administrative or support process?

❒ Yes ❒ No

If Yes, please give examples._____

_____

_____

Part 4: Exemplary Uses of IT.

4.1 One of the purposes of this research is to identify specific examples of where technology has been integrated into the Science 10 curriculum. Do you have a specific application of the integration of technology which you would like to describe?

_____

_____

_____

_____

_____

_____

Thank you for your cooperation.

APPENDIX B

EXAMPLE OF LETTER TO SCHOOL SUPERINTENDENTS

Department of Educational Psychology
University of Alberta
Edmonton, AB
T6G 2G5

Superintendent of Schools
XXXXXX School District
etc.

Dear Superintendent :

I am conducting research for my thesis as part of a Master of Education degree at the University of Alberta . The purpose of my study is to find out to what extent Science 10 teachers are integrating computer technology into their curriculum and what role computer technology is playing in the teaching/learning environment. I am writing to request permission to invite schools in your district to participate in the study.

While teachers are under no obligation to participate in the study, their involvement will maximize the relevance of the research and therefore will be greatly appreciated. Completion of the survey will require approximately 20 minutes of each participating teacher's time. Any information resulting from this research will be reported in aggregate form and will not identify individual teachers or schools. A summary of the study's findings will be provided to all participating school districts.

If you require further information regarding this study please feel free to contact me at 432-7442. I look forward to your response and thank you in advance for your cooperation.

Sincerely,

Graham Jones

APPPENDIX C

EXAMPLE OF LETTER TO SCHOOL PRINCIPALS

Department of Educational Psychology
University of Alberta
Edmonton, AB
T6G 2G5

Principal
xxxxxxxxx School
etc,

Dear Sir/Madam :

I am conducting research for my thesis as part of a Master of Education degree at the University of Alberta. The purpose of my study is to find out to what extent Science 10 teachers are integrating computer technology into their curriculum and what role computer technology is playing in the teaching/learning environment. The Superintendent of your School District has granted permission for its schools to participate in this study.

Since your School has been selected to participate in this research, I am requesting that you ask your Science 10 teachers to complete one of the enclosed questionnaires and return them to me in the enclosed stamped addressed envelope provided by .....

The teachers will be under no obligation to complete the questionnaire, but should they choose to do so, I envisage that it will take 15-20 minutes of their time. Any information resulting from this research will be reported in aggregate form and will not identify individual teachers or schools. A summary of the study's findings will be provided to all participating school districts

If you require further information regarding this study please feel free to contact me at 432-7442. I look forward to your response and thank you for your cooperation.

Sincerely,

Graham Jones

APPENDIX D
SAMPLE OF LETTER ATTACHED TO SURVEY INSTRUMENT

Department of Educational
Psychology
University of Alberta
Edmonton, AB
T6G 2G5

Dear Colleague:

The enclosed survey is being conducted as part of a Master of Education degree at the University of Alberta. The purpose of this study is to find out to what extent Science 10 teachers are integrating computer technology into their curriculum and what role computer technology is playing in the teaching/learning environment. It is also hoped that information gathered from your responses will provide ways of improving the teaching learning environment by identifying specific examples of the way information technology is being integrated into the curriculum.

The Superintendent of your School District has granted permission for its schools to participate in this study, and since your School has been selected to participate in this research, I am requesting that you, as a Science 10 teacher, complete one of the enclosed questionnaires and return it to me in the enclosed stamped addressed envelope provided by .....

You are under no obligation to complete the questionnaire, but should you choose to do so, I envisage that it will take 15-20 minutes of your time. Your anonymity and that of your school will be respected.

If you have any questions about this study please feel free to contact me at 432-7442. I appreciate your willingness to participate in this research and assist me with my studies, and thank you for your cooperation.

Sincerely,

Graham Jones

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