FACILITIATING THE INTEGRATION OF COMPUTERS INTO THE ELEMENTARY SCHOOL CURRICULUM

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ABSTRACT

A study involving a questionnaire and interview format was undertaken at an independent elementary school in British Columbia, Canada to investigate the factors that affect the integration of computer technology into the curriculum and to determine whether Personal Computers (PCs) or Macs in a computer laboratory or classroom setting would provide the best the learning opportunities for the students. Focus groups were used to discuss results from the questionnaires and interviews to develop a plan to integrate computers into classroom curricula. Nineteen subjects (teachers as well as administrators) took part in the study with an 83% response rate to questionnaires. Six subjects were randomly chosen to take part in in-depth interviews and all 23 teachers/administrators took part in the first focus group. Six teachers took part in the second focus group. Factors that were found to affect statistically ($p \leq 0.05$) the integration of computers in elementary curricula were age and experience of the teacher, teacher confidence, and perceived emphasis of computers in the school. It was agreed upon that integrating PCs into the classrooms would provide the best learning opportunities for the students by allowing easy access to computers. Following focus group discussions, a three-year plan involving a mentorship program was developed, accepted by the administration, and implemented where 24 PC wireless internet-connected refurbished computers would be purchased and integrated into 6 or 7 classrooms per year. The most confident teachers volunteered to integrate the computers in their classrooms the first year. These teachers then would act as mentors to the teachers integrating the computers in subsequent years, thereby providing guidance and assistance to the less-confident teachers.

TABLE OF CONTENTS

LIST OF CHARTS

Page

LIST OF TABLES

Page

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During this study I had many life changes; our first son was born, I received my first principal position, and am now eagerly awaiting the birth of our baby daughter. Throughout all of this Dr. Belanger has continued to provide support, encouragement and expert guidance. Whenever I needed assistance Dr. Belanger was always able to make time for me. Thank you for all of your help.

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CHAPTER I

INTRODUCTION

> Since the Industrial Revolution, few developments match or exceed the computer in its revolutionary impact on the world. Its influence has been tremendous. From the child's playroom to shuttle flights to the outer space, the computer is omnipresent. At all levels of education there is continued increase in use of the computer. Computing proficiencies are increasingly being expected among the members of the teaching profession; but the challenge to the educators is to learn how to effectively use it in the classroom... (Guha, 2001, pp. 275-276)

However, Guha quotes Jordan and Follman "...systematic curricular integration of computers is still more of a promise than a reality...many students and educators remain technologically illiterate" (Guha, 2001, p. 276).

The British Columbia Ministry of Education states that computers should be integrated into classroom curricula in Kindergarten through to grade ten (1996). Integrating computers into classroom curricula and using them as a teaching/learning tool does pose some challenges. Cradler, Freeman, Cradler and McNabb (2002) theororize that a "growing challenge in education is establishing and implementing strategies to develop the skills and knowledge necessary for teachers to use technology as a tool" (p. 50). The purpose of this study is to examine the factors that affect the integration of computer technology in an elementary school and to develop ways to facilitate the integration of computers into the elementary curriculum.

Background Information

"Students need access to technology and opportunities to use it as part of their educational process" (Gallagher, 2001, p. 34). As an administrator in an independent elementary school, I was presented with the challenge of evaluating our elementary school computer technology program and providing guidance to a local school board (Parish Education Committee) in regards to upgrading its computer program. As an independent school we operate on the principle of site-based management and therefore make decisions based on the needs of the school. At the time of the study, the school had a student population of approximately 375 students and ran from kindergarten to grade seven. The teaching staff was comprised of 16 classroom teachers, three non-enrolling teachers (two French teachers and one Physical Education teacher), three teacher assistants and two school administrators. At the time of the study, the school had a computer lab that consisted of 15 Mac computers and Mac compatible software. These 15 computers were linked to one printer. The lab did not have Internet access but the adjacent library did. All children in the school had 30 minutes per week of computer instruction in the lab guided by a computer teacher. Due to the limited number of computers, half of a class would access the lab at one time, while the other half remained in the classroom working with the classroom teacher. The number of computers in individual classrooms varied from zero to five computers. The classroom computers consisted of an assortment of donated computers, both PC and Mac operating platforms. None of the classroom computers was networked. As an independent school we were in a position to examine the needs of the stakeholders in our particular school and to develop a plan to meet these needs. An extensive evaluation of the Information and

Communication Technology (ICT) program was completed in order to prepare a plan for the future use of computers in the school.

A review of the current literature suggests that computer technology has changed the way teachers teach and students learn. Teachers can use computers as a teaching tool, which can be used to engage the students and to make learning authentic. (Becker, 1994; Dexter, Evans & Becker, 1999; Dias, 1999; Smeets and Mooij, 2001; Tienne & Luft, 2001-2002;). In the *Conditions for Success Report...* (1999) to the British Columbia Ministry of Education, the Teaching, Learning and Education Technology Advisory Committee recommended that technology "be integrated into curriculum rather than having technology as a separate course" (p. 6). With this recommended direction of technology integration across the curriculum lays the debate of teaching children about computers or teaching children with computers:

> Integrating technology is not about technology—it is primarily about content and effective instructional practices. Technology involves the tools with which we deliver content and implement practices in better ways. Its focus must be on curriculum and learning. Integration is defined not by the amount or type of technology used, but by how and why it is used. (Earle, 2002, p. 7)

Howard, McGee, Schwartz and Purcell (2000) describe the constructive learning model as the "creation of active learning environments—environments that permit critical thinking, discovery, and collaboration" (p. 456). Jarvela (2001) theorizes that the

integration of computer technology can be used to create these active learning environments:

> Preparing children for a rapidly changing world is an exacting challenge. Students who enter the information-centered world of this century must be prepared to learn on their own. Learning skills and motivation for lifelong growth are crucial for coping with the continuous challenge of information flow. Technology can play an important role in restructuring teaching and learning practices to match the needs of an information society better. (p. 43)

Clouse and Nelson (2000) theorized that "In a constructed learning environment, several important things occur: Students can create their own knowledge, and technology can re-align the process of teaching with the realities of the students' world and move from a teacher-centered to learner-controlled environment." Glennan and Melmed (2000) support that notion:

> ...current technology-rich schools tend to place a good deal of emphasis on project-based learning using communications, word-processing, and spreadsheet software...this reflects the lessons of modern cognitive science concerning constructivist and situated learning...individual teachers normally design the projects and must ensure that these projects produce the skills that students need to acquire. (p. 71)

Niess developed a set of guidelines that could be applicable to all teachers for integrating computer-assisted instruction into the curriculum:

1. Fit the computer to the curriculum rather than the curriculum to the computer.
2. Use the computer as a personal and professional tool.
3. Use the computer in the learning of subject matter. (Niess in Halpin, 1999, p. 129).

Kromhout and Butzin (1993) conducted a longitudinal study of nine schools involved in Project CHILD (Computers Helping Instruction and Learning Development) to investigate the effects of computer technology in the classroom. Project CHILD was a five-year research and development project in Florida that facilitated the integration of computers into the classroom by providing each classroom with a "computer station with three to six computers, a teacher station for small-group instruction, and textbook and writing stations as well as stations for hands-on activities" (p. 56). They concluded that:

> The effect was positive and statistically significant, across grades and schools, for the three areas measured: reading, mathematics, and total battery scores on standardized tests. The effects were largest for students who had been in the program for more than one year... (p. 55)

Middleton and Murray (1999) conducted a study to examine "the relationship between levels of technology implementation in the classroom and standardized test scores in

reading and mathematics in grades four and five" (p. 109). Standardized test scores in reading and mathematics were collected from 2574 students in a large South Carolina school district. The results of the study showed that "student achievement was affected by the level of technology used by the classroom teacher" (p. 114). A study in West Virginia of 950 fifth grade students from 18 schools showed an increase in test scores in student achievement tests. These increases appeared to be a result of "integrating curriculum objectives for basic skill development in reading and writing with instructional software" (Mann, Shakeshaft, Becker & Kottkamp in Cradler, McNabb, Freeman & Burchett, 2002, p. 47).

While evidence exists to support the integration of computer technology, not all teachers are integrating computer technology. Ertmer, Addison, Lane, Ross and Woods (1999) report that "integrating technology into classroom curricula is not easily accomplished" (p. 54). van Braak (2001) noted that despite the efforts by governments to make computer technology part of the regular school routine there is a small number of teachers who look at computers as an invaluable teaching tool. "...successful implementation of technology depends on the classroom teacher" (Johnson & Johnson in Middleton and Murray, 1999, p. 114).

The questions thus remain, why are or why aren't teachers integrating computer technology into the curriculum? And if they are not integrating computer technology into the curriculum what can we, as a school, do to help them integrate computer technology? In order to create and more importantly implement a new vision for the school ICT

program, teacher input is crucial. Blase and Kirby (2000) theorize that in order to bring out the best in teachers they must be involved in the decision making process:

> Teachers and school administrators, as professionals, are best qualified to make decisions affecting their unique student population. Collective decisions that draw on the expertise of many teacher-professionals in a given school are superior to individual decisions made by an administrator. (p. 42)

There are several ways to train teachers on how to use computers. Collier (2001) identifies four teacher-training methods: technology mentors; student involvement; teacher leadership, and student involvement, technology competencies; and inquiry and action research for technology integration. Dexter, Anderson and Ronnkvist (2002) operationalized quality technology support as consisting of:

1) access to one-on-one personal guidance and help;
2) frequent teacher participation in technology-oriented professional support among teacher peers;
3) professional development content focussed on instruction and integration;
4) access to resources. (p. 265)

An Introduction to the Study

> When it comes to the integration of technology into our schools, you can create it, you can legislate it, you can order it, you can supply it, you can give it standards,

> and you can write outcomes for it. But the bottom line is that if it is going to happen in substantial ways, it is the classroom teachers who will make it happen. (Goodlore in Barrell, 2001, p. 17)

The purpose of the current study was to investigate the factors affecting the integration of computer technology at the school and to develop methods to facilitate the integration of computers into the elementary curriculum, based on the written and verbal opinions of enrolling and nonenrolling teachers at the school. The objectives of the study were as follows:

1. To determine if teachers felt that computer instruction would be best served in a computer lab or classroom.
2. To determine what teacher barriers exist to the integration of computers into the classroom/curriculum.
3. To determine what computer skills the teachers feel should be taught.
4. To determine which academic subjects the teachers feel should have computer technology integrated into the curriculum to enhance learning opportunities.
5. To determine what kind of operating platform to use in the school, PC or Mac.
6. To determine the type of teacher training needed for successful technology integration.
7. To determine what changes need to be made to the current information and communication technology program at the school to enhance the learning opportunities of the students.

Each objective is expanded on below:

Objective 1: *To determine if teachers felt that computer instruction would be best served in a computer lab or classroom.* The location of the computers was an area of interest. It needed to be determined whether or not the computers would be put back into the existing lab or if the teachers would prefer them in their classrooms. Whitehead (1994) writes that putting computers into classrooms where the teachers are prepared to use them would put an end to the scheduling issues that arise when using a lab and would also ensure that expensive equipment is not sitting in a large room not being used or is used infrequently. Would having computer technology in the classroom allow the teachers to take advantage of the teachable moment, rather than waiting for their scheduled time in the computer lab?

Objective 2: *To determine what teacher barriers exist to the integration of computers into the classroom/ curriculum.* Several barriers were identified as potentially preventing the integration of computers: resistance to change, teacher attitudes towards computers, professional development issues, access to computers, and the perceived cost of computers" (Fabry & Higgs, 1997).

Objective 3: *To determine what computer skills the teachers feel should be taught.* Since the majority of the families in the school have a computer at home, computer literacy was not a concern. The students at the school were at a stage where they were

ready to learn with computers. "Teachers, in general, have less need to teach about computers and a greater need to use technology as a learning tool that is integrated routinely into classroom instruction" (Scheffler & Logan, 1999, p. 319).

Objective 4: *To determine which academic subjects the teachers feel should have computer technology integrated into the curriculum to enhance learning opportunities.* Teachers may feel that computer technology may be incorporated more easily into one subject than another. I was interested in finding out where the majority of teachers felt that computer technology would best be integrated to enhance the learning opportunities of the students.

Objective 5: *To determine what kind of operating platform to use in the school, PC or Mac.* The existing computer lab had Macs but the lab was in great need of an upgrade. The majority of the teachers had PC's at home and unofficially reported during staff meetings that they were not as knowledgeable about Macs as they were about PC's. In an unofficial survey of families in the school the majority of them reported that they had a PC in their home. This made it difficult for the children to complete work at home on their PC that they had begun at school on a Mac.

Objective 6: *To determine the type of teacher training needed for successful technology integration.* It was important to investigate the type of training the teachers needed to feel comfortable integrating computers into their planning, teaching and student learning. While Scheffler and Logan (1999) addressed the issue of the teachers having less need to

teach the students about how to use the computer this may be a potential point of conflict. Haymore, Sandholtz, Ringstaf and Dwyer (2000) theorize that "Teachers enter the profession with deeply held notions about how to conduct school—they teach as they were taught" (p. 257). The majority of computer technology available to our students today was not available to most of their teachers while they were being educated. Therefore, computer technology takes many teachers out of their comfort zone in the classroom.

Objective 7: *To determine what changes need to be made to the current information and communication technology program at the school to enhance the learning opportunities of the students.* The school was interested in upgrading the existing Information and Communications Technology (ICT) program. The results of the study will be used to help school administration develop a plan to determine the new direction for the ICT program at the school. After an extensive review of Ministry documents it was discovered that the school was not integrating computers into the curriculum as outlined by the Ministry of Education. The debate of learning about computers versus learning with computers was at the forefront of the investigation.

The study was prompted by the Parish Education Committee's (PEC) desire to determine a direction for the computer program. It was acknowledged that new computers were needed but the Committee was hesitant to decide on a new direction without having a clear understanding of the current program, the needs of the students or a clear understanding of the requirements as outlined by the Ministry of Education.

An Overview of the Experimental Procedures

In order to determine how to effectively integrate computers into the curriculum, the study looked at what computer skills the teachers felt the students should be taught, the attitudes of the teachers towards computers at the school, how teachers are currently using computers, the teachers' ideal use of computers, the ideal location of computers in the school, and the ideal operating platform for computers. Teachers were divided into groups according to the chart below:

Chart 1. Teacher Groupings for the Purpose of Comparing Clusters

Age of teacher	1. Under 40 years of age 2. Over 40 years of age
Years of teaching experience	1. 0 to 10 years 2. 11 plus years
Teacher confidence using computers	1. Using computers and/or able to integrate them 2. Ranging from awareness of computers but have not used them to beginning to gain a sense of confidence
Perceived emphasis, by teachers, of computers in the school	1. Computers are underemphasized 2. Highly overemphasized, overemphasized, or correctly emphasized
Teacher computer use at home	1. Often or very often 2. Sometimes, seldom or never

A Likert Scale Questionnaire was used to survey classroom teachers, non-enrolling teachers (French, Physical Education, Learning Assistance, Teacher-Librarian), administration, and teacher aides (Appendix C).

A sample of teachers was also interviewed with structured and open-ended questions (Appendix E). The stratified sample consisted of primary teachers, intermediate teachers, non-enrolling teachers. The interviews were used to allow teachers to clarify and expand

on responses from the questionnaire. The interviews also served to allow expression of attitudes/perceptions of computers in the school as they relate to curriculum. Following an analysis of the questionnaires and interviews it was determined that the computers would meet the needs of the children best if PC computers were placed in the classroom. The information/analysis was presented to the PEC (Appendix G). It was decided that the information should be presented to the staff and discussed. A focus group, made up of the entire staff, was presented the information from the first part of the study (study of the ICT Integrated Resource Package, questionnaires, and interviews). Following the presentation of the findings, the group took part in a discussion of the issues that arose from this presentation.

Our school had available funds to enable us to purchase computers for some, but not all, of the classrooms. At this point we had to make a decision about which classes would get the computers. We chose to follow a model found in the literature. At Hellsgate Elementary School (Whitehead, Cain & Graves, 1994) funding prevented the school from putting computers into all of the classrooms. Computers were put into classrooms where the teachers were enthusiastic about using computers and were ready to use them in their classrooms. Using this model, teachers who were interested in having computers in their classrooms for the upcoming year were asked to respond, in writing, expressing this desire to administration. Once the number of teachers interested in using computers in the classroom was determined, another focus group made up of these interested teachers was conducted in order to determine how to facilitate the integration of the computers into the classroom. At this meeting the teacher group discussed the type of training and also

support they felt they would need in order to make the shift from the computer lab to the classroom a success. These teachers agreed to be part of a pilot project for using a networked Internet system in their classroom.

Definition of Terms

- *Technology:* Electronic or digital products. (This term is used interchangeably with computers for the purpose of this paper.)
- *Curriculum:* All the courses of study offered by an educational institution

  Source: *The American Heritage® Dictionary of the English Language, Fourth Edition*

- *Technology Integration:* Moulding computers into subject areas.
- *Peer Coaching:* Tutoring a peer/colleague about a subject that the coach is educated about.
- *Constructivism:* "...the constructivist learning model emphasizes the creation of active learning environments—environments that permit critical thinking, discovery, and collaboration. Such environments typically engage students in real-life problems, collaborating on group projects, writing articles or stories, developing models or diagrams, journaling, and investigating solutions to research questions" (Howard, McGee, Schwartz & Purcell, 2000, p. 456).
- *Parish Education Committee (PEC):* A committee composed of seven members of the parish community, and the Pastor, who meet monthly to ensure that

educational policy of the Superintendent's Office is being followed. They are also responsible for preparing the budget for the operation and maintenance of the school.

- *ICT:* Information and Communication Technology

Research Questions

This study examines the following questions:

1. How can the school being studied use computers to enhance the learning opportunities of the students?
2. How can the school integrate computers into the curriculum as outlined in the Ministry Documents?
3. What do the teachers at the school think is the best way of integrating computers into the curriculum?
4. How can school administration support the teachers in their efforts to integrate computers into the curriculum?
5. What is the existing comfort level of teachers working with computers?
6. What training do teachers feel that they will need in order to feel competent integrating computers into the curriculum?
7. Based on the results of the questionnaire and initial focus group, did teachers feel that integration of computers was best accomplished by having computers in the classroom or computers in the lab? How would the school facilitate a move of computers away from the lab and into the classroom?

Assumptions

The following assumptions underlie the study:

1. That the teachers responding to the questionnaire, interview and focus group(s) will participate in the study as it is intended: a study to investigate ways to improve the existing ICT program at the school. That they will not look at the study as a form of teacher evaluation where there is the potential to answer the questions in a way that would be a positive reflection on their teaching as opposed to responding in a way that would allow the school to develop an improved ICT model.

2. All students at the school have a computer in their home and have a basic knowledge and working skill of computers. This assumption moves the primary focus of ICT education away from computer literacy training towards learning with computers.

Limitations

Formal generalizability of the results of this study must not be extended to all schools and their attempts to integrate computers into the curriculum. This study was a delimited study, limited to the context of this particular school. The students came from homes where a significant portion of them had computers with Internet access. The school had the desire and the financial means to improve the ICT program; the PEC was waiting for direction and an ICT plan before moving forward and spending capital. The school was

also in a unique position, as an educational Internet company was interested in using the school as a pilot school and approached them to take part in a new program using the Internet in schools. As part of the pilot program the school was supplied with computers and wireless technology at a reasonable price. The company also offered to provide training for the teachers so they would be able to use the internet software to be used in the project.

As previously outlined, independent schools operate on the principle of site-based management and thus are able to make decisions locally that address the issues that are relevant to their school. Therefore, other independent schools or schools that have site based management and are able to make decisions that are particular to their school may find that the methods and/or conclusions of this study can apply to their situation as well.

Significance of the Study

By examining the existing computer program at the school the administration would then be provided with information needed to facilitate the development a plan, in conjunction with the teachers, on how to improve the learning opportunities for the students, with computers, at the school. LeBaron (2001) theorizes that collaborative planning is key to the effective design and implementation of an educational program:

> Purposeful collective action depends on planning. Planning establishes goals and sets the evaluation criteria by which they are measured. It drives activities, shapes relationships, and provides a scaffold for a shared vision of how curriculum

> should promote learning. The systemic improvement of learning, teaching, and curriculum depends not only on the presence of an effective plan, but also on the participation of many stakeholders in the design and execution of the plan...Both strategic and operational planning contribute to the cause of effective technology integration in a school's teaching and learning environment. (pp. 17-18)

It is important, therefore, to determine how the teachers at the school, to enhance the learning opportunities of the students, are currently using computer technology. It is vital to examine not only the teachers who are using computer technology but also the teachers who are not using computer technology. With the data we can then begin to plan how to facilitate the integration of computer technology by all the teachers in the school. Weikart and Marrapodi (1999) conducted a two-year study of a large urban school district examining the effective use of computer technology in elementary and middle schools. They concluded that each school must develop its own school-wide plan. "Each school's plan should detail the site's vision for technology and address short- and long-term needs for hardware, software, on-going and coherent professional development, and strategies for enhancing teaching and learning through technology" (p. 58).

At the conclusion of the study we will drew up a plan that was used to improve the ICT program at the school. The plan was based primarily on the feedback offered by the teaching staff. This plan included the optimum location of computer technology in the school to ensure integration of technology; the preferred operating platform; and forms of

teacher training that need to be established in order to ensure that teachers are capable of integrating computer technology into the curriculum.

The role of computer technology continues to evolve. Numerous factors affect the successful integration of computers into elementary curricula. It is essential that we study the attitudes of teachers about the use of computers, and the factors that affect the integration of computers into the curriculum, so that we can develop plans to use technology more effectively in education. Each school will encounter different factors and will need to undertake an analysis of their factors in order to address them. I have developed a questionnaire, based on literature and my own thoughts to investigate teacher attitudes and factors affecting the integration of computers into the curriculum. I followed the findings from the questionnaire with interviews and focus groups to analyse these factors and to investigate ways to encourage teachers to integrate the technology. The study that I developed can be replicated in other elementary schools or modified as necessary to examine factors that affect the successful integration of computer technology into the elementary curricula. The opportunities to research of the effect of technology integration are plentiful. Professional development models that educate teachers on how to support student learning through technology need to be investigated for efficacy and then implemented. An area of further investigation is the impact of computer technology on student achievement.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The use of computer technology in education is an area of interest for researchers, educators and software developers alike. There has been a great deal of discussion about the use of computers: to learn about computers or learn with computers, to put computers in the classroom or put them in a lab, what kind of computer technology training do the children need? Current research has studied the role of the teacher in the integration of technology, looking at the effects of teacher attitude on the integration of computers as well as forms of training used to facilitate the integration of computer technology into the curriculum. The following is a review of the literature regarding the factors affecting and ways to facilitate the integration of computer technology into the curriculum and ways to facilitate the integration of computer technology into the curriculum.

Research on Using Computer Technology in Schools

The introduction of technology into schools is becoming more prevalent (Fabry & Higgs, 1997; Fisher, 1996; Liu, Macmillan & Timons, 1998). Researchers have found that technology improves learning and/or has a positive effect on it (Becker, 1994; Fabry & Higgs, 1997; Hadley, 1993; Hinostroza & Mellar, 2000; Schacter & Fagnano, 1999; Smith-Gratto & Blackburn, 1997). Furthermore, learning in computer-based classrooms accommodates students' individual learning styles (Becker, 1994; Hadley & Sheingold, 1993; Schacter & Fagnano, 1999; Swan & Mitrani, 1993; Tiene & Luft 2001-2002).

Educational Reform

Educational reform is not a new concept. Cuban (2001) noted that school reform has been going on for the last two hundred years. "If any aspect of schooling in the past two centuries has escaped the reformers' passion for improvement, I have not found it" (p. 1). Presently, education reformers are looking at ways education can be improved with the use of computer technology. Education is being reformed by computer integration (Liu et al., 1998). Liu et al. report that, "Recent reforms in various content areas, such as science and mathematics, explicitly require teachers to make full use of computer resources for student learning—integrating computers into the curriculum" (p. 189). The British Columbia Ministry of Education encourages the integration of computers into all areas of the curriculum. The Ministry recommends not reporting on computers as a separate course since they are to be integrated into subject areas between Kindergarten and Grade Ten (Ministry of Education Skills and Training, 1996). In 2001 the BC Ministry of Education published a number of documents outlining how ICT could be integrated.

Computer Integration and Constructed Learning

A change in the role of the teacher is necessary as the focus shifts from teacher-centred learning to a student-centred learning environment (Becker, 1994; Smeets & Mooij, 2001; Swan & Mitrani, 1993). These studies include: Clouse and Nelson (2000), who used current studies related to school reform, constructivist pedagogy and educational technology; Becker (1994), who used data from a national survey; Smeets and Mooij (2001) who studied "teaching-learning characteristics and the role of the teacher in ICT

learning environments" (p. 403); and Tiene and Luft (2001-2002) who found that in a "technology rich environment" children were encouraged to work together to seek and construct knowledge, and teachers were able to individualize student learning.

> To integrate technology into classroom practice in the manner envisioned by ardent proponents, teachers must make two radical changes—not only must they learn how to use technology, but they must also fundamentally change how they teach. Teachers are being asked to move away from relying on a teacher-centred classroom to a more student-centred classroom. (Fabry & Higgs, 1997, p. 388)

Tiene and Luft (2001-2002) noted "a shift in teaching style from 'sage on the stage' to 'guide on the side'" (p. 13). Higgins, Mosely, and Tse (2001) found "that teachers who were the most positive about computers had better computer skills, a stronger inclination to use ICT, a preference for having children learn through open-ended activities, and a willingness to question their own approach to teaching" (p. 45).

In 1997 Dexter, Evans and Becker conducted a study to examine "the use of computers in teachers' instructional practices and teachers' perceptions of the impact of computers on changes made in their classrooms" (Dexter, Evans & Becker, 1999, p. 224). The study consisted of a questionnaire, three interviews and three classroom observations. In the study the researchers gathered data from 47 grade 4-12 teachers at 20 K-12 schools. The experience of the teachers ranged from one year to over 20 years. The teaching style of the teachers ranged from traditional to innovative; participation in the study was

voluntary. Dexter et al. concluded "In construction or student-centred classrooms, teachers use tool software and information technology to allow students to work in active ways. The technology supports learning; it becomes a tool with which the students may construct knowledge" (pp. 221-222). Dias (1999) theorizes that when technology is truly being integrated "Teachers begin to see knowledge as something children must construct rather than being transferred" (p. 21). Educators point out that meaningful learning can be supported by technology when it is active, constructive, collaborative, intentional, conversational, contextualized, and reflective (Jonassen in Dias, 2001; Norton & Sprague, 2001). Clouse and Nelson (2000) conducted a study investigating this type of learning environment concluding that "technology can realign the process of teaching with the realities of the students' world..." (p. 297). Fullan (2000) noted that although "Technology generates a glut of information... it has no particular pedagogical wisdom—especially regarding new breakthroughs in cognitive science about how learners must construct their own meaning for deep understanding to occur" (p. 582). He concluded that as technology improves, the teacher will be expected to become more of a pedagogical expert. In his paper studying the integration of instructional technology into public schools, Earle (2002) theorized that there is a need for an improved pedagogy when integrating technology:

> Technologies must be pedagogically sound. They must go beyond information retrieval to problem solving; allow new instructional and learning experiences not possible without them; promote deep processing of ideas; increase student interaction with subject matter; promote faculty and student enthusiasm for

teaching and learning; and free up time for quality integration—in sum, improve pedagogy. (p. 7)

In Berg, Benz, Lasley and Raisch's (1998) descriptive study of how "exemplary technology-using teachers in southern Ohio are using technology in their elementary classrooms" (p. 111), they address the issue that teachers are being asked "to change to something different without presenting a clear picture of what this classroom of the future should look like" (p. 111). In these classrooms teachers are no longer looked at as the expert, "The teacher becomes a facilitator/coach as opposed to an all-knowing wizard" (Clouse & Nelson., 2000, p. 297).

Students often bring a wealth of experience and expertise that is of value in the classroom (Dias, 1999). Teachers are now able to utilize the concept of peer helping (Gilmore, 1995). Barrell (2001), Collier (2001), and Marcovitz et al. (2000) found that students could be used to answer questions or to teach classmates to which they have been assigned. Barrell states "Teachers need to see themselves as partners with students in the integration of technology" (p. 21).

Location of Computers

There are a variety of instructional options for integrating computers and technology into the curriculum. An examination of the literature reveals that not a great deal of research has been done regarding the most effective location for computers. An examination of current practice gives an indication of the locations of computers for teaching. Computer

instruction can be provided exclusively in a computer lab with a computer instructor. Computer labs are often equipped with the latest technology (Hiede & Henderson, 2001) and are capable of producing a large number of interesting opportunities for the students. However, labs require teachers with a great deal of technological expertise in order to provide meaningful learning opportunities for the students and have them experience success (Cliford & Friesen, 2001). Evans-Andris (1995) found that limited communication between the classroom teacher and the computer lab teacher led to minimal integration between classroom activities and the computer lab. Hiede and Henderson (2001) identified the following drawbacks to using a computer lab:

- ICT cannot be viewed as a tool to accomplish many specific tasks, because it is not available whenever the student needs it.
- The teacher cannot naturally integrate ICT into the daily experience of each student. It becomes a special event.
- The teacher doesn't have easy access to ICT for previewing resources or for personal use.
- Neither student nor teacher learns to take responsibility for the care and appropriate use of the equipment.
- Time-lines for the use of the room are artificial, arbitrary, and determined by administrative needs rather than student and teacher needs. (p. 23)

Provenzo, Brett and McCloskey (1999) theorized that when computer instruction is based in a computer lab, there is "less of a tendency to integrate the machines with everyday

instruction... and then machines are likely to become a part of a separate activity, typically involving drill and instruction exercises" (p. 8). Clifford and Friesen (2001) state that advocates of the lab operate with the assumption that "All students need to be doing the same thing at the same time, computers are the point" (p. 36). Perry and Areglado (2001) claimed that "the technology lab was usually the last place on the tour a visitor will actually see technology teaching and learning taking place" (p. 87). They also noted that "Computers are often located far from classrooms, where most teaching takes place" (p. 87).

Whitehead, Cain and Graves (1994) described the move of computers from the lab to the classroom at Hellsgate Elementary School in Missoula, Montana. Hellsgate Elementary School is a K-8 school with over 1000 students. Whitehead et al. noted that with a lab comes the difficulty of scheduling and often expensive equipment sits in a room with no one using it. "Having the computers in the classroom makes it easier to individualize instruction in a variety of subjects" (p. 19).

Scheefler and Logan (1999) in their study of computer competencies relevant to teachers sent surveys to 596 teachers: 120 technology coordinators (64%), 228 secondary teachers (82%) and 132 university teacher educators (66%) responded. All of the technology coordinators and teachers came from Kentucky and all but 21 of the teacher educators came from Kentucky. The study consisted of 5-point Likert scale measuring 67 competencies that were divided into ten groups. They concluded "Teachers, in general, have less need to teach about computers and a greater need to use technology as a

learning tool that is integrated routinely into classroom instruction" (p. 319). Computer labs, often equipped with the latest technology, provide a great number of unique learning experiences for the students. However, these experiences are not always related to, and therefore do not always support, the learning that is happening in the classroom.

Alternatively, computer instruction can occur in the classroom mediated by the classroom teacher. With the goal to integrate computers into all areas of the curriculum, classroom-based computer instruction has benefits over lab-based computer instruction (Hinostroza, 2000; Provenzo, Brett & McCloskey, 1999; Maddux, Johnson & Willis, 2001; Whitehead, 1994).

Arguing for computers in classrooms rather than labs, Clifford and Friesen (2001) advise that students should have access to computers when they need them. Lamont Johnson (1997) theorizes "The full potential of the computer as a teaching and learning tool will not be realized unless the computer is in the classroom and is an integral part of the learning and teaching process" (1997, p. 4). Clifford and Friesen (2001) theorize "the work students are doing should guide their decisions about which technology tools they need. Scheduled access to machines should never determine what they get to think about" (p. 37). Computers in the classroom allow teachers to individualize instruction in an attempt to meet the needs of the students (Vockell & Schwartz, 1992; Whitehead, 1994).

Barriers to Classroom Use of Computers

Niederhauser and Stoddard (2001) examined the relationships between "teachers' instructional perspectives and their use of technology in instruction" (p. 15). They were interested in exploring the argument that "technology will promote the use of constructivist approaches to learning" (p. 15). Niederhauser and Stoddard surveyed 1093 elementary school teachers from a western state that was "recognized as a leader in educational technology" (p. 18). They found that "teachers' perspectives about effective computer-based pedagogy are related to the types of software they use with their students" (p. 29). Niederhauser and Stoddard concluded that barriers exist with educational reform initiatives such as introducing computer technology into classroom curricula. Although technology improves learning and/or has a positive effect on it (Hadley, 1993; Hinostroza & Mellar, 2000; Schacter & Fagnano, 1999), there appear to be a number of barriers that impede the use of technology. Fabry and Higgs (1997) identified resistance to change, teacher attitudes, professional development, access, and cost, as the key barriers to integration of technology.

Teacher Experience/Age of Teachers

After an extensive review of an ERIC search, little research was found on the effect that teacher experience or age had on integrating computers into the classroom. "The literature about beginning teachers reveals that most new teachers are concerned about managing their classrooms and tend to see computer integration as ancillary" (Novak & Knowles in McGee, 2000, p. 198).

Resistance to Change

Fabry and Higgs (1997) in their study of the barriers to the educational use of technology claim that "an innate dislike for change (especially change mandated from above) is the most basic and significant barrier to technology integration" (p. 388). However, Fullen and Miles (1992) caution against using the word resistance:

> ...it is usually unproductive to label an attitude or action as "resistance." It diverts attention from real problems of implementation, such as diffuse objectives, lack of technical skills, or insufficient resources for change. In effect, the label also individualizes issues of change and converts everything into a matter of "attitude." (p. 748)

Most teachers teach as their teachers did when they were students. At that time, computers were not often used in schools (Cuban, 1986; Vockell & Schwartz, 1992). Cuban (1986) speculates that many teachers go into the profession because they are conservative by nature; they enjoyed their own experiences in school as students, and would like to maintain the nature of schools. Research indicates that teachers are less inclined to use technology than other professionals (Yildirim, 2001). Miller and Olsen (1994) state "The history of innovation in education teaches us to be cautious about predictions associated with new technologies" (p. 121).

Davidson and Ritchie (1994) conducted a study investigating the attitudes of students, teachers and parents towards integrating computers into the classroom. The study was

conducted at Highland Park Elementary School in Austin, Texas. Approximately 475 K-Gr. 5 students, 34 teachers, and 231 parents participated in the study. Davidson and Ritchie gathered data by having the participants complete a questionnaire relevant to their position in the school. The three groups completed the questionnaire prior to the integration of the computers and one year later to "determine whether any changes in those attitudes had occurred after the implementation of the computers" (p. 5). The researchers also used "Informal observation and conversations with teachers and parents ...to verify the documented survey responses" (p. 5) to create anecdotal comments. At the conclusion of their study Davidson and Ritchie noted that with the advent of computer integration, there is a feeling among teachers that their role would dramatically change and more demands would be put on them. Fabry and Higgs (1997) claim:

> To integrate technology into the classroom teachers must make two radical changes—not only must they learn to use technology, but they must also fundamentally change how they teach. Teachers are being asked to move away from relying on a teacher-centered classroom to a more student-centered classroom. (p. 388)

Along with a pedagogical change, the teacher is being asked to step out of the role as classroom expert. "...few teachers are as comfortable with computers as their students are. This puts the teacher, who is supposed to be the expert, at a disadvantage" (Nicol & Butler, 2001, p. 26). Jacobsen and Goldman (2001) note that a conflict arises out of the fact that students seem to have better a understanding of technology than their teachers.

Dufour (1998) emphasizes the notion that "change is difficult" (p. 50). There are preconceived notions about use of technology and how it influences the role of teachers (McGee, 2000). The attitude or concern that technology is irrelevant to educational instruction also hinders the acceptance and use of technology (Ertmer et al, 1999; Schofield, 1995). The belief or attitude that student outcomes will not improve through the use of technology hinders the integration of computers into the classroom by lowering the teacher's incentive to use computers. If teachers do not feel that the computer helps them teach, they will not value the technology and will be hesitant to use the available technology (Ertmer et. al., 1999; Schofield, 1995). Bird, in George and Camarata (1996), identified three reasons for resisting technological change: "(1) perceiving oneself as incompetent, (2) rationalizing that adapting is not necessary, or (3) feeling incompetent" (p. 49). Fullan and Miles (1992) question whether this is resistance to change or simply part of the change process:

> Change does involve individual attitudes and behaviours, but they need to be framed as natural responses to transition, not misunderstood as "resistance." During transitions from a familiar to a new state of affairs, individuals must normally confront the loss of the old and commit themselves to the new, unlearn old beliefs and learn new ones, and move from anxiousness and uncertainty to stabilization and coherence. Any significant change involves a period of intense personal and organizational learning and problem solving. People need support for such work, not displays of impatience. (p. 748)

Teacher Attitude Toward Computers

Ertmer, Addison, Lane, Ross and Woods (1999) completed a study at Midland Elementary School, a K-5 school of 281 lower and middle socio-economic class students. Seven K-2 teachers participated in the study that consisted of a survey, three semistructured interviews and classroom observations made over a six-week period. The study was conducted to "examine teachers' uses of technology and explore perceptions regarding how and why they use technology" (Ertmer et al., 1999, p. 57). They concluded that "researchers and educators alike still report that integrating technology into classroom curricula is not easily accomplished" (p. 54). Success of integration relies on the attitudes of the teachers involved in the process of integrating computers into the curricula. It is important to look at these attitudes and determine how they affect this process (Khine, 2001).

Published research studies stress the importance of teacher attitude when aiming to integrate computers and technology into classroom curriculum (Hunt & Bolin, 1993; Marcinkiewicz, 1993-4; Ertmer et al., 1999). Davidson and Ritchie (1994), Fabry and Higgs (1997), and Hinostroza and Mellar (2000) have shown that teacher attitude can positively or negatively affect the integration of computers and technology into the elementary school classroom.

Marcinkiewicz (1993-94) conducted a study of 170 elementary school teachers from four schools in the eastern United States of differing size and location. The teachers answered questionnaires that looked at "innovativeness, teacher locus of control, perceived self-

confidence in computer use, perceived relevance of computers to teaching, and three demographic variables-age, gender, and years of computer experience" (p. 224). The purpose of the study was to determine "whether any of the selected variables were related to teachers' computer use" (p. 229). To be eligible for the study teachers needed to have access to computers for their teaching, be working with a ratio of one computer per 44 pupils; and "computers had to have been available at the schools for at least three years" (p. 224). The researcher believed that after three years the computers would then be considered part of the school culture; elementary school teachers were chosen because "they typically teach a variety of subjects and are therefore less likely to be influenced to use computers by their specialization in a subject area that emphasizes computer use" (p. 225). Marcinkiewicz theorized that by studying elementary school teachers the study would reflect the internal motivation of teachers for using computers. Marcinkiewcz found that "teachers were largely underutilizing computers even though computers were available in their school" (p. 233). Following his study Marcinkiewcz concluded that "To understand how to achieve integration, we need to study teachers and what makes them use computers, and we need to study computers and what makes teachers want to—or need to—use them" (p. 234).

Williams, Coles, Wilson, Richarson and Tuson (2000) studied how teachers are currently using ICT (Information and Communications Technology), "how competent teachers feel themselves to be" (p. 308), what kind of training they would need to continue to develop their ICT skills, and "the factors which tend to encourage or hinder the take-up of ICT in the classroom" (p. 308) in both primary and secondary schools. In their study they

surveyed teachers from randomly selected schools and interviewed teachers. Eighteen percent (352) of the questionnaires distributed to primary schools were completed and returned and 37% (329) of the questionnaires distributed to secondary schools were returned. The researchers also interviewed 23 secondary teachers and 13 primary teachers; these interviews highlighted the teachers' "current knowledge of ICT" and "their perception of the facts which help or hinder them from using ICT." (p. 309). Williams et al. found a:

> ...significant correlation between levels of use of ICT and teachers' attitudes. Those who are more inclined to identify with the positive benefits to themselves and their pupils also tend to use ICT more often. Those for whom the problems and worries they encounter appear to outweigh the potential benefits, tend to use ICT less often. (p. 311)

Ertmer et al. (1999) concluded integrating computers into classroom curriculum is a challenge, and it is therefore "important to examine how current classroom practices and beliefs support or inhibit classroom technology use" (p. 55). "Teachers' existing attitudes, skills, and work habits have a great deal of influence on their acceptance, style of implementation, and integration of educational computing into the curriculum and their teaching" (Knupfer, 1993, as cited in Hardy, 1988, p. 131).

Saveyne, Davidson, and Orr (1992) conducted a study of 68 preservice teachers enrolled in summer sessions of "a required course on computer applications in education" (p. 33) to see "whether their attitudes and feelings of anxiety are influenced by participation in a

computer course" (p. 31). All of the students completed a survey prior to beginning the course and 58 completed a survey after the course was completed. Savenye et al concluded that in order for computers to be successfully integrated in the classroom, both teacher and administrator must display positive attitudes. These positive attitudes can influence the students' attitudes about computers.

Yildirim (2000) "examined the changes in preservice and inservice teachers' attitudes towards computers following their participation in an educational computing class, and explored the factors that contributed to their computer use" (p. 479). One hundred fourteen preservice and inservice teachers who were enrolled in a computer class designed to increase computer literacy of teachers took part in a Likert-type scale survey designed to measure the perceived competency of the participants. Of this group 20 students volunteered to take part in the follow-up survey and interviews. Yildirim (2000) concluded "One way to encourage teachers to use computers in the classroom is to increase their level of computer literacy. This can be achieved by providing several computer literacy courses tailored to specific levels of anxiety, and competency" (p. 492).

Jaber and Moore (1999) conducted a study of 1017 K-12 teachers in rural West Virginia and rural south-western Virginia. The investigators devised a survey to investigate the "factors which influence teachers' use of computer-based technology" (p. 253). They concluded that teachers needed access to computers that were not obsolete. They also found that teachers "preferred a continuous type of computer training...defined as training conducted on an ongoing basis throughout the year to provide the teachers with

the necessary competencies for employing computer-based technology in instruction" (p. 265). Gilmore (1995) studied a "teacher development program designed to introduce educational uses of computers and to facilitate their integration into classroom activities" (p. 251). The program was made up of: "(a) classroom-based action research project, (b) supplementary workshops, (c) dissemination of information through newsletters, and (d) access to computers" (p. 255). The training program was conducted by seven "experienced classroom teachers with the appropriate skills and knowledge to implement classroom-based training in the use of computers in the curriculum" (p. 254). Gilmore concluded that this model of professional development served as an effective confidence builder for teachers who are using new technology. One of the teachers who took part in the program stated "the program is an important and valuable one in that it targets and can give confidence to those who would normally think of reasons why they can't work with computers" (p. 265).

Cost

The cost of technology is a concern for both administrators and teachers alike. Fabry and Higgs (1997) point out that concerns about funds for computer technology is one significant barrier to the effective use of computers. Although the cost of computer technology is decreasing, the cost to meet the needs of a school can still be quite high. "Despite the increasing affordability of technology, costs of this magnitude represent a significant barrier to technology integration" (Fabry & Higgs, 1997, p. 392).

Vockell and Schwartz (1992) note that the purchase of computers and/or software often takes financial resources away from other projects. They go on to write that although computers are expensive they are actually quite cost effective: "...if a $1700 microcomputer is used constantly during the school day, its real cost drops to about a dollar an hour during the first year" (p. 172). Rogers (2000) points out that while cost and funding can act as barriers to the integration of technology, it is often a refection of priority of technology in the school. Middleton and Murray (1999) concluded that the fact that technology has a positive effect on student achievement requires that they should be of high priority.

Wiekart and Marrapodi (1999) studied 25 "average" urban neighbourhood elementary and middle schools to determine how computer technology was being integrated into the schools. The researchers observed how technology was being used in the classroom, interviewed the technology teacher, classroom teachers and the principal of each school, and used a survey where the staff answered questions about funding, staff qualifications, wiring and number and types of computers being used. Weikart and Marrapodi (1999) observed that "Repair and upkeep of existing technology was an elusive goal for school principals and technology teachers alike" (p. 54). They concluded that "well-planned technology efforts were hampered by the absence of fund allocations for necessary repairs and upgrading of computers.

Access to Computers

"Access" is a term used by Fabry and Higgs (1997) to describe the "availability of technology... locating the proper amount and right types of technology... connectivity, ubiquity, and interconnectivity" (p. 390). Student to computer ratio, which can vary amongst schools, is another barrier negatively affecting teacher attitude defined under the term "access" (Fabry & Higgs, 1997). Limited "access" has a negative affect on the empowerment of teachers to make a positive decision about technology integration (Fabry & Higgs, 1997).

Ross, Hogaboam-Gray and Hannay (1999) conducted a study to look at "what factors influence teacher confidence in their ability to implement computer-based instruction before and after an infusion of information technology" (p. 77). They found that "when teachers had greater access to information technology (more computers, training and software) their opportunities for successful teaching experiences increased, thereby contributing to greater confidence in their instructional ability" (p. 87).

Dupagne and Krendl (1992), in their review of literature relating to teachers' attitudes toward computers, claimed that teachers who have regular access to a computer display positive attitudes towards their use in the classroom (1992). Hadley and Sheingold (1993) analyzed data from a survey sent to teachers who were competent in computer technology integration, and "taught grades 4-12 in urban, suburban and rural public schools in all fifty states" (p. 266). Hadley and Sheingold concluded that teachers and

students were able to feel a greater sense of achievement when they had access to technology.

Teacher Training

Teachers' lack of formal training in computers has resulted in a lack of confidence when dealing with technology in the classroom (Fabry & Higgs, 1997; Hardy, 1998; Ertmer et al., 1999; Yildirim, 2001). Lack of confidence in using or teaching computers "may cause some people to avoid using them" (Hardy, 1998, p. 126). Many teachers feel inadequately prepared to integrate technology into their classes, which prevents them from using the technology as a teaching/learning tool (Hardy, 1998; Ertmer et al., 1999; Yildirim, 2000).

Hunt and Bolin (1993, as cited in Fabry & Higgs, 1997), claim "The educational potential computers possess will not be fully realized unless teachers embrace and understand how to effectively use them" (p. 385). Computer training is a key factor in confidence (Fabry & Higgs, 1997; Hardy, 1998; Okinaka, in Hardy, 1998; Hickey, 1993; van Braak, 2001; Marcinkiewcz, 1993-94, Zeitz, 1995; Guha, 2001;Yilidrim, 2000) and knowledge (Guha, 2001; Williams, Coles & Wilson, 2000; Yilidrim, 2000) in teaching and willingness to integrate computers into the curriculum within the elementary classroom (Dias, 1999). The need for training has been referred to as "essential to facilitate change" (Fabry & Higgs, 1997, p. 388). Dexter, Anderson and Becker (1998) note "for teachers to implement any new instructional strategy, they must acquire new knowledge about it and then weave this together with the demands of the curriculum, classroom management,

and existing instructional skills" (p. 223). For example they "must be given time, training and support to have the skills to make technology transformational" (Fabry & Higgs, p. 390). Johan van Braak (2001) conducted a questionnaire study of 236 randomly selected secondary school teachers "familiar with computer use" (p. 141). He concluded:

> It would be advisable for teachers be to [sic] exposed to examples of good practice during in-service training. This would help them getting familiarized with computers, with their use in the classroom, and with their value as a pedagogical tool. This is likely to decrease the degree of resistance among teachers. (p. 151)

Many practicing teachers do not feel that they received adequate computer training during their pre-service training but are still required to teach computers ('Yaghi, 1996; Glenn & Carrier, 1989). Teachers can build their confidence with computers through workshops such as in-services to prepare them for teaching computers in the classroom (Hardy, 1998; Marcinkiewcz, 1993-4). In-service training should be planned in a way that meets the needs of the teachers (Hardy, 1998; Collier, 2001; Williams & Cole, 2000).

Zeitz (1995) speculates that while traditional in-service courses provide teachers with a satisfactory amount of training for integration of technology, it is frequently in the form of a one-day workshop where the teachers are expected to expand on what they have learned after the workshop. Sparks argues that these forms of in-service is seldom effective and typically "produce little lasting change in the classroom" (p. 52).

Gilmore (1995) studied a "teacher development program designed to introduce educational uses of computers and to facilitate their integration into classroom activities" (p. 251). The program was made up of: "(a) classroom-based action research project, (b) supplementary workshops, (c) dissemination of information through newsletters, and (d) access to computers" (p. 255). The training program was conducted by seven "experienced classroom teachers with the appropriate skills and knowledge to implement classroom-based training in the use of computers in the curriculum" (p. 254). She concluded that one day training sessions do not always allow teachers to immediately apply skills learned to the classroom (Gilmore, 1995). MacArthur, Pilato, Kercher, Peterson, Malouf and Jamison (1995) studied a mentoring program to provide support for teachers using computers. Data from the program were collected from 75 participants, 21 mentors and 54 participants in the second year of the program. Data collection consisted of course evaluations completed at the end of each semester; a Computer Use questionnaire completed at the beginning and at the end of each semester by both the mentors and protégés; and computer logs that were used for two weeks at the beginning and two weeks at the end of each semester. Following the study MacArthur et al. concluded "Traditional inservice education, time limited and decontextualized, cannot offer the on-site support that computer users require" (p. 60).

A review of the literature concludes that there are more effective methods of training teachers, such as weekly seminars, coaching, technology mentors, and peers (Zeitz, 1995; Gilmore, 1995; Weikart & Marrapodi, 1999; Collier, 2001; Hadley & Sheingold, 1993; Sandholtz & Ringstaff, 1996). Hadley & Shiengold found that "onsite support and

colleagueship are critical ingredients to successful technology use" (p. 299). Lockard, Abrams, and Many (1997) state "the identified needs of the teachers committed to technology must be addressed, needs that will vary greatly from one school to the next" (p. 378). Teachers feel that on-going training and support is critical for integration of technology into the classroom (Williams, et al., 2000; Lebaron & Collier, 2001; Weikart & Marrapodi, 1999). One technology resource teacher felt that teachers would use their classroom computers more if they knew they had support when it was needed (Pearson, 1994). Gilmore (1995) states:

> Although inservice courses were seen as adequate, there frequently was subsequent fading or nonuse of skills developed in the course. School-based training, on the other hand, allowed teachers to work with colleagues whom they knew, on equipment with which they wanted to become familiar, and with software actually available to them in the school. It was described as professional development over which teachers had a considerable amount of control. (p. 254)

Johan van Braak (2001) conducted a questionnaire study of 236 randomly selected secondary school teachers "familiar with computer use" (p. 141). The purpose of the study was to investigate "the relationship between computer use in the classroom and influencing factors on an individual level" (p. 141). He concluded that in order to decrease resistance to technology in the classroom, teachers should be "exposed to examples of good practice during in-service training. This would help them getting

familiarized with computers, with their use in the classroom, and their value as a pedagogical tool" (p. 151).

Holohan, Jurkat, and Friedman (2000) conducted a study of a three-year mentor teacher model developed to teach mathematics with computer technology. The program consisted of 39 middle and high school teachers in various New Jersey school districts trained to use computers effectively in computer technology to teach mathematics and act as mentor teachers to "diffuse and institutionalize the use of these new technologies to other classrooms" (p. 337). The mentor teachers' "computer skills, confidence using computers, and attitudes toward computers" (p. 340) were assessed during the first two years of the program. In year three of the program, the degree to which the mentor teachers "had integrated computer technology into their curricula" (p. 341) was evaluated. At the end of the project the 39 mentor teachers and the 212 mentee teachers were surveyed and interviewed to assess the success of the project. Holahan et al. concluded that while mentoring activities take place in several different ways the key to the program is "sufficient support and time to plan mentoring activities and work with mentees" (p. 348). MacArthur et al. (1995) identified the need to focus on the individual needs of the learner/protégé as a key to the mentoring process. Wildman et al. (1992) caution that a mentoring program must be locally developed and designed to meet the needs of those involved.

David Welton described how the teachers at Ramirez Elementary School, a school of over 700 students, learned to use the technology to facilitate student learning in social

studies and literacy skills. He noted the importance of a computer resource person:

> Having a computer resource person who is always available, and who can stand by a teacher's side and demonstrate what to do, was a key component in helping teachers learn how to use computers. Even when teachers began striking out on their own, they were comforted by the fact that they had someone to call on if they ran into problems... (p. 29)

Sandholtz and Ringstaff (1995) working on the Apple Classrooms of Tomorrow project worked with a database that included 32 teachers. Through personal narratives from the teachers Sandholtz and Ringstaff identified the need for teachers to implement their training into their practice:

> ...teachers who are learning to use new technological tools want to use their new skills as soon as they return to their classrooms. Too often, new skills become rusty while teachers wait for new equipment to arrive. The project stipulated that participating teachers should have access to technology as soon as they are finished their training. (p. 292)

Catherine Collier (2001) in her examination of approaches to staff development for technology, theorizes that for successful integration of technology into the classroom teachers learn the following:

- Hands-on exercises, focused on the curriculum, with tools such as an office package, multimedia, and Internet browser and e-mail
- Interaction with software packages and a forum to consider their use in the curriculum
- Examples of well-designed lessons, units, and projects that use technology in an integrated fashion
- Instruction in finding and evaluating resources
- Instruction in techniques and technologies for student inquiry, such as probeware, WebQuests, simulations, modeling tools, and design tools
- Instruction in the creation of new resources, such as those produced with video, hypermedia, and authorware. (p. 62)

Hardy (1998), in a review of teacher attitudes toward and knowledge of computer technology, identified the following concerns that teachers have about technology:

- lack of hardware and software (availability and quality)
- not having enough time for computer activities in the classroom
- how to effectively integrate computers into the classroom
- lack of adequate training to build their confidence and computer skills to use computer technology effectively. (p. 66)

Having administrative support, adequate funding, time, and training are some factors noted by Fabry and Higgs (1997) that facilitate the implementation of technology. Confidence (Ertmer et al., 1999), lack of anxiety (Dupagne & Krendl, 1992), "motivation

and commitment to student learning" (Hadley & Sheingold, 1993, p. 298), and "support for integration and collegiality" (Hadley & Sheingold, 1993, p. 298) are attitudes that facilitate integration. Fullan (1992) notes the importance of recognizing the reasons for people not wanting change and claims that although it often has negative connotations this is not always the case. Any change involves a move away from something that is comfortable to something that is new and unfamiliar. In order to address "resistance to change" teachers must have a clear picture of where the change is going to take them.

Teacher training on how to use and integrate technology is as important as buying the technology (Middleton & Murray; 1999, Smith-Gratto & Blackburn, 1997). Hardy (1998) notes that teachers who obtain knowledge about technology are more likely to use technology in their teaching. Honeyman and White (1987 as cited in Dupagne & Krendl, 1992) found that "...educators with previous computer skills tend to show lower levels of anxiety toward computers than do other educators" (p. 443). Hardy (1998) found that as teachers become more familiar with computers, and their capabilities, they become more enthusiastic about using them. Teacher attitudes toward computer use can be affected favourably, if they have an understanding of how computers can be used most effectively (Okinaka in Hardy, 1998). Hardy (1998) found that "...the teacher is the central figure who essentially decides whether to utilize computer technology in the classroom and therefore needs to be aware of or have a basic understanding of how the technology can be integrated and effectively used in the classroom" (p. 119). Hickey (1993) completed a qualitative study (narrative) using classroom observation and interviews to describe through narrative detail how computers were used in the classroom. "Over a two year

period, eighty-three teacher education interns in a social studies methods course served as participant-observers in elementary classrooms" (p. 220). Each intern was assigned an elementary classroom. The participant-observers completed the "observation instrument using personal narrative" (p. 221) followed by the interviews of the classroom teacher. "The interviews did not take place until after all other data had been collected, in order to avoid possible bias in either participant-observer reports or teachers' normal curriculum planning" (p. 221). Hickey felt that the participant-observer method of observation would be most effective since the interns were expected to be involved in the daily administration of the classroom. Hickey concludes that providing teachers with "training in curriculum integration so that computers are viewed as an integral part of curriculum planning" (p. 219). Informed and educated teachers are "more likely to set higher goals for students and themselves, persist through obstacles, and be more successful" (Ertmer et al., 1999, p. 76).

Conclusion

A review of the literature indicates that computers can be looked at as an educational tool to enhance the learning experiences of students. Recent research supports the integration of computers in elementary curricula. The integration of computers into the curriculum has caused a paradigm shift in the way teachers are now expected to use computers. When teachers create learning opportunities where their students are able to use computer technology learning has the opportunity to become more individualized providing a constructivist learning environment. Experts support the use of computers in the classroom versus in a laboratory, however, little research has been conducted on

education comparing location (lab versus classroom). There are several barriers that need to be addressed before the integration of computers into the curriculum can be considered a success. Budget constraints are an issue that must be addressed when looking at purchasing new computers. Novice teachers tend to focus their energy on managing their classroom and may have little energy to spend on computer integration. Teachers teach as they were taught. This teaching model is often not compatible with the constructivist teaching model that is supported for computer integration. Space is another issue that needs to be examined. A school might have the finances for the computers but location of these computers is also important. Computers in the classroom, integrated into the curriculum, represent a paradigm shift for many teachers. If computers are put into classrooms as opposed to labs the classroom teacher is asked to take on a new role, the role of facilitator and often times the computer expert. However in the role of facilitator the teacher has to be willing, in a sense, to "give up control" of the class and let the students take ownership of their learning.

It is possible to have the financing in place, have space in every room for the computers but have a staff that balks at using them. Teacher attitudes must be examined carefully before successful integration can take place. Teachers display a wide range of attitudes towards technology that impact the way computers are used in educational settings. These attitudes have been formed by a multitude of factors such as confidence in working with computers, past experience and training with computers, funding, access, and administrative support.

In order to increase computer use in classrooms and the integration of technology, we need to examine teacher attitudes and the factors that affect the attitudes. It is apparent that many teachers do not feel that they are adequately trained to have computers used in the classroom. This issue needs to be addressed for both pre-service teachers and practicing teachers. In-service courses must be designed to address the following issues: working knowledge of computers; competence working with computers; a feeling of being able to facilitate their students' learning; and strategies for integrating computers into the curriculum. Once these factors have been addressed and attitudes reformed, we can expect a smoother transition of integrating technology into the elementary curricula. However, Earle (2002) cautions:

> ...the focus of integration is on pedagogy—effective practices for teaching and learning. Teachers need to make choices about technology integration without becoming technocentric by placing undue emphasis on the technology for its own sake without connections to learning and the curriculum. (p. 10).

Sanholtz, Ringstaff and Dwyer concluded that:

> Technology is a catalyst for change processes because it provides a distinct departure, a change in context that suggests alternative ways of operating. It can drive a shift from a transitional instructional approach toward a more eclectic set of learning activities that include knowledge-building situations for students...Underlying this model is our view that such changes will occur only if there is a concomitant change in teachers' beliefs about their practice. However,

instructional evolution is not simply a matter of abandoning beliefs but one of gradually replacing them with more relevant ones shaped by experiences in an altered context. Beliefs are a source of guidance in times of uncertainty; they are important in defining teaching tasks and organizing relevant information. They are an irreplaceable element in the process of imagining alternative futures… (2000, p. 268).

CHAPTER III

METHODOLOGY

Overview

The purpose of this study is to examine the factors that affect the integration of computer technology in an elementary school and to develop ways to facilitate the integration of computers into the elementary curriculum. The method of inquiry chosen for this study consisted of questionnaires, interviews and focus group discussions.

Ethics Approval

Application was made to the University of British Columbia (UBC) Ethics Committee in September of 2001, to conduct the study for the dual purpose of a Master of Arts thesis and a self-initiated project to improve the existing ICT program at the school where I was vice-principal. A certificate of approval was issued once the ethical review committee had approved the study. This certificate can be found in Appendix A of this paper.

Characteristics of Subject Population

The subjects for the study were part-time and full-time teachers, regardless of whether they were enrolling teachers or non-enrolling teachers, and teacher assistants. The subjects taught at an independent elementary school in British Columbia that serves 375 students. The students (grades 1-7) in the school had access to the computer lab with the computer specialist, for 30 minutes per week, and were also able to book the lab when it was not in use by the computer teacher. However, because the lab only had 15 computers,

it was only able to accommodate 15 students at one time. Kindergarten students had 30 minutes per week of computer time in the lab with a teacher's aide. Access, number of computers, and operating platforms in each individual classroom varied depending on the class.

Planning Retreat

At a planning retreat in October 2001, the study was introduced to, and approved by, the Parish Education Committee, school administration and teacher representatives who attended the retreat. At this retreat I gave a Power Point presentation (Appendix B) explaining the evaluation of our existing ICT program. I outlined my plans to survey teachers using a questionnaire and interview format, and by conducting focus group discussions in the months of January 2002 to June 2002.

Staff/Subjects

After receiving approval from the UBC Ethics Committee, the study was explained to the staff (potential subjects) by the investigator. It was made clear to the staff that the purpose of the study was to improve our existing ICT program, and in order to fulfill that purpose, teachers' thoughts, experiences and attitudes about computers were needed.

Recruitment and Consent for Questionnaire

The study was formally introduced to the staff during a staff meeting in January of 2002. All enrolling and non-enrolling teachers, teacher assistants and principal in the school (23 in total) were invited to take part in the questionnaire. One day following the introduction

of the study, a questionnaire (Appendix C), and cover letter (explaining instruction and ensuring anonymity) (Appendix D) were enclosed in a manila envelope and placed in each of the teacher's mailboxes. No identifying marks were placed on the questionnaires, and teachers were asked not to put their names on the questionnaires to ensure anonymity. Participation in the study was voluntary and consent was assumed if the questionnaire was completed and returned to the secretary.

Purpose/Development

The purpose of the questionnaire was to gain information about teacher attitudes towards computers, teacher experience with computers, teacher use of computers at home and in the classroom, access to computers, teacher training in computers, preference for location of computers, preference for skills to be taught using computers, and demographics. Questionnaires in the literature were reviewed and relevant questions were chosen to include in the questionnaire; other questions I created myself. The questionnaire consisted of a variety of appropriate questions using a Likert-scale. No written information was allowed, only circling the most correct answer. The polarity was changed on a percentage of questions (13%) to ensure that teachers were answering the questions thoughtfully.

Literature Resources

Below I have listed the literature/resources in which I found the following questions. Following the return of the questionnaires, I divided the questionnaires into two sections, Part 1 and Part 2 for clarity.

In the demographic portion of the questionnaire:

Survey of Teachers' Attitudes Towards Computers (1997)

Questions 2, 3, 6, 7, 8, 9 and 10.

Delta School District Teacher Information and Communication Technology Survey

Question 5.

Parent, Teacher, and Student Attitudes Toward Computers at Highland Park Elementary School by Dr. Gayle Davidson and Scott Ritchie

Questions 13 and 14.

In the second part of the questionnaire:

Survey of Teachers' Attitudes Toward Computers (1997)

Questions 1, 3, 4 and the question that required the teachers to identify where they are in the adoption of computers.

Parent, Teacher and Student Attitudes Towards Computers at Highland Park Elementary School

Questions 5, 6, 7, 34 and 35.

Teachers' View of Technology and Teaching

Questions 14 and 15.

Validity

The questionnaire was tested for validity by number of experts in the field of both education and information technology. The list of people who verified the study included an IT professor in the Faculty of Education at UBC, a computer programmer, the former ICT coordinator at the school where the study was completed, the former principal of the

school and a classroom teacher with a specialization in ICT. It was noted that the survey was weighted with statements/questions addressing teacher attitudes towards computers and not enough focus on pedagogy and how computers were being used in the school. More questions were added to address the issue of how computers were being used in the school and how teachers wanted to see them used in the school. Two classroom teachers and one computer teacher then piloted the questionnaire. The respondents did not indicate any problems or concerns regarding the questions or questionnaire with the exception of one spelling mistake and a change in the in the order of questions in Part 1.

Initially there was concern about how the teachers on staff would respond to the questionnaire knowing that their anonymous responses as a group would be reviewed by the school administration. Along with assuring anonymity of each teacher, I felt that it would be important to reassure the staff that their responses would be used to make an informed decision to improve the ICT program at school. The purpose of the questionnaire was discussed at a staff meeting prior to its distribution. At the meeting I assured the staff that participation in the study was voluntary and their responses would not be used for anything else but the stated purpose which was to measure the factors that affect the integration of computers and how we can facilitate the integration of computers into the curriculum more effectively. The study began in January of 2002. Because of a timeline established by the Parish Education Committee it was critical that a significant portion of the study be completed by the deadline of February 2002 in order to make recommendations that could be included in the budget for the upcoming school year.

Data Analysis

The initial stage of data analysis involved calculating the percentage of each person's response for each question using a calculator. Individual responses were then added together to create percentages responding to each Likert answer as a group. These data were entered into an Excel spreadsheet and bar graphs were created using the graphing program on Excel (Appendix G). The information from the graphs was also summarized in text form and prepared on Power Point slides for the purpose of presenting the information to the Parish Education Committee (PEC). After the information was presented to the PEC and the findings were discussed, the same information was presented to the teaching staff.

In the second stage of analysis, items on the survey were clustered together and tested for reliability using SPSS. The following items made up the cluster "Computer Skills Should be Taught": word processing, graphing, presentation of work, internet search. When tested for reliability, the cluster had an alpha of 0.77. The following items made up the cluster "Positive Teacher Attitudes Towards Computers": acknowledgement that computers provide irreplaceable alternatives in teaching, acknowledgement that computers are not a waste of time, the value of teaching with computers, incorporation of available computer technology into the classroom, positive attitude about internet, a positive feeling that computers would improve the performance of the teacher, a positive feeling that computers would improve the quality of student work, a positive feeling that computers would motivate students, and acknowledging the fact that with guidance teachers could see computers playing a larger role in their class. When tested for

reliability, the cluster had an alpha of 0.86. The following items made up the cluster "Current Use of Computers to Enhance Student Learning": students complete assignments on the computer, teacher uses computer to individualize learning, teachers plan units with integration of computers in mind. When tested for reliability the alpha was 0.81. The following items made up the cluster "How Teachers See the Use of Technology Enhancing Learning": teachers see the use of computers enhancing students' math skills, teachers see computers enhancing students' reading skills, teachers see computers enhancing students' writing skills, teachers see computers enhancing students' problem solving skills, teachers would use computers more if they had more access to computers, teachers envision computers being used to reinforce concepts studied in other subject areas. When tested for reliability, the alpha was 0.75. Once the clusters proved reliable they were then used to look for statistical significance, using the non-parametric test, the Mann-Whitney U Test, between different groups of teachers: for example, experience of teachers, age of teachers, level of computer confidence of teachers, perceived emphasis of computer use in the school, and teacher use of computers at home. The Mann-Whitney U Test was used because of the of the very small sample sizes used in the study.

Recruitment and Consent for Interviews

A stratified random sample consisting of primary and intermediate teachers was used to recruit subjects for the interview process. The subjects were given a cover letter explaining the study and interview process and consent form (see Appendix F). All

teachers who were approached to participate in an interview consented and took part in an interview. The interviews took place during February, March and April of 2002.

Purpose/Development

Following a simple analysis of the group answers from the questionnaire using Excel, questions where the majority of teachers strongly agreed or strongly disagreed were highlighted. The purpose of the interview was to clarify or expand on the answers to these close-ended questions and to allow an open-ended discussion about teacher attitudes/perceptions, experience and thoughts about computers in the school (Appendix E). The style of interview I chose allowed open discussion about topics that arose that were unique to each interview. I took a passive approach attempting not to influence subjects' answers/discussions during the interview and acted only as a facilitator to encourage free expression. The interview lasted in the range of 20-30 minutes. The responses to the questions during the interview were hand written by the interviewer.

Data Analysis

The hand written information from the questionnaires was reviewed and patterns were looked for in responses. Unique or important points were transcribed to Word.

Recruitment and Consent for First Focus Group

All staff members (enrolling and non-enrolling teachers and teacher assistants) were asked to participate in a focus group to discuss the data from the questionnaires. All teachers were present at the focus group where data from the questionnaire were

presented in Power Point and lecture format prior to discussion. The focus group took place in April 2002. Consent was obtained via letter with subject and witness signature. Subjects who already signed a consent form for the interview did not need to sign a second consent form for the focus group. All other subjects who participated in the focus group by speaking but were not interviewed signed a consent form (see Appendix F).

Purpose/Development

The purpose of the first focus group was to review and discuss the results of the questionnaires and interviews and to review the upcoming year's plans for integrating computers into the curriculum. Following the presentation of the preliminary questionnaire and interview results to the PEC, it was decided that funding would be provided for the purchase of 24 new computers. The existing computer lab would remain intact. The new computers would be placed in six classrooms.

Recruitment and Consent for Second Focus Group

At a staff meeting in May 2002, teachers were presented the opportunity to take part in a pilot project where four to six computers (with wireless Internet connection), would be placed in some classrooms, with the goal to integrate computer technology into the curriculum. All teachers willing to take part in the pilot project were asked to meet with the investigator within the next week to discuss the next phase of the project. Six intermediate teachers volunteered to be part of the pilot project. These teachers verbally agreed to take part in a second focus group, which was carried out in June 2002. Consent was obtained via letter with subject and witness signature; during the initial focus group

subjects that did not participate in the initial focus group by speaking but participated in the second focus group signed a consent form (see Appendix F).

Purpose/Development

The purpose of the second focus group was to discuss what support would be required to ensure successful integration of computers. This group comprised the second part of my study: facilitating the integration of computers. The main objective of this part of the study was to investigate what training and support the classroom teachers would need in order to integrate technology into their classrooms. From the responses during the second focus group, a staff development model was created that would provide the teachers with initial training so they would feel comfortable using the computers in the classroom and also provide continued support for the teachers as the school year progressed. Responses from the second focus group were tape-recorded and notes were carefully transcribed from the meeting by the investigator. The duration of the second focus group was 60 minutes.

Data Analysis

Because a preliminary professional development model for integrating computers was created during the second focus group, no further analysis was performed. The premises for the model were transcribed onto Word in Microsoft Works and were presented and discussed with school administration and the incoming ICT coordinator (Appendix I). Permission was given, by the school principal, to present those recommendations in this paper (Appendix J).

Concluding Comments on Methods

Two methods were used to investigate teacher attitudes towards integration of computers—a questionnaire and interview. Focus groups were used to discuss the findings from the questionnaires and interviews and to develop strategies to integrate computers into the elementary curriculum. The final focus group developed a model to initiate teacher training on new computers being integrated in some of the classrooms and continued support throughout the 2002-2003 school year (Appendix I).

CHAPTER IV

DATA

The purpose of the study was to investigate the factors, from the point of view of the teacher, affecting the integration of computer technology at the school and to develop methods to facilitate the integration of computers into the elementary curriculum, based on the written and verbal opinions of enrolling and non-enrolling teachers at the school. The objectives of the study were as follows:

1. To determine if teachers felt that computer instruction would be best served in a computer lab or classroom.
2. To determine what teacher barriers exist to the integration of computers into the classroom/curriculum.
3. To determine what computer skills the teachers feel should be taught.
4. To determine which academic subjects the teachers feel should have computer technology integrated into the curriculum to enhance learning opportunities.
5. To determine what kind of operating platform to use in the school, PC or Mac.
6. To determine the type of teacher training needed for successful technology integration.
7. To determine what changes needed to be made to the current information and communication technology program at the school to enhance the learning opportunities of the students.

All subjects who participated in the study completed a questionnaire consisting primarily of five-point Likert scale questions. A sample of five teachers who completed the questionnaire participated in one-on-one interviews with the investigator to:

1. clarify issues that arose following an analysis of the questionnaires,
2. openly express their opinions on a number of topics regarding computers at the school.

The teachers have been given pseudonyms to protect their anonymity. Teachers also participated in a second focus group to discuss the findings of the survey and interviews and to discuss the preliminary plans of direction that our computer program would take over a three-year period commencing the next school year.

Further analysis of the survey revealed that the following factors were important when determining how computers were being used by the students and integrated into the curriculum:

- age of the teacher
- years of experience of the teacher
- teacher confidence with computers
- perceived emphasis of computers in the school by the teacher
- the extent of teacher computer use at home.

Each factor was compared to opinions/statements about computers that were clustered together following an analysis of responses from the questionnaire. The opinions/statements were:

- Computer Skills to be Taught
- Computer Skills That Should be Taught
- Positive Teacher Attitudes Towards Computers
- Current Use of Computers to Enhance Student Learning
- Ideal Use of Computers to Enhance Student Learning
- The Best Place for Computers is in the Classroom
- The Best Place for Computers is in the Computer Lab
- Student Learning Would be Best Served Using PC Computers
- Student Learning Would be Best Served Using Mac Computers.

The Mann-Whitney U Test was chosen to compare factors to each cluster. The Mann-Whitney U Test is commonly used for non-parametric data with small subject pools. Because this study was undertaken at one school with a total n value of 19 and comparative factor groups with n's as small as 6, the Mann-Whitney U Test was chosen.

Each factor and opinion/statement was compared to one another using the Mann-Whitney U Test to calculate a p. value. Statistical differences between the two factor categories were then determined (setting the p value at ≤ 0.05) and presented in table format. A written review of the Mann-Whitney U Test follows each test. A breakdown of the cluster compared to the factor categories in table and written form further explains the basis for the calculated p value. Table headings of cluster breakdown include the number of subjects, mean value in each cluster category, and standard deviation. At the end of each cluster (following Tables 10, 20, 30, 42, 44, 46, and 48), quotations from the

interviews and the first focus group that support or disagree with the findings of the questionnaire, with regards to that particular cluster, can be found.

Computer Skills Should be Taught

The following ten tables (Tables 1-10) describe which computer skills teachers felt students should be taught. The cluster "Computer Skills to be Taught" was compared to: age (Tables 1& 2); teaching experience Tables (3 & 4); computer confidence of teacher (Tables 5 & 6); the amount of emphasis, as perceived by the teacher, of computer use in the school (Tables 7 & 8); and use of computers at home by the teacher (Tables 9 & 10).

Table 1. Mann-Whitney U Test Results of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Two Teacher Age Groups

Variable	Age 1 n	Mean Rank	Age 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Computer Skills to be Taught	8	12.19	11	8.41	26.50	0.14

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers 40 years of age and over.

As Table 1 shows, when compared by age, the cluster "Computer Skills to be Taught" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 12.19 for the under 40 group and 8.41 for the over 40 group are substantial. The younger teachers more strongly agreed that computer skills should be taught to their students. Because the numbers of subjects are so small (8, 11),

the findings might reflect a Type II Error, and the mean difference between the two teacher age groups may be real.

Table 2. Mean Likert Scores of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Two Teacher Age Groups

	Age 1			Age 2			
Computer Skills to be Taught	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Keyboarding	8	4.50	0.54	11	4.36	0.51	0.14
Word Processing	8	4.63	0.52	11	4.18	0.60	0.45
Graphing	8	4.13	0.99	11	4.09	0.70	0.04
Presentation	8	4.50	0.54	11	4.18	0.60	0.32
Internet Search	8	4.63	0.52	11	4.27	0.65	0.36

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers 40 years of age and older.

Further analysis of the data (Table 2) reveals that for each of the components of the "Computer Skills to be Taught" cluster, the differences between the two teacher age groups were between 0.04 and 0.45 on the five-point scale. The differences were not statistically significant. When breaking down the computer skills that should be taught into individual components it was found that the under 40 group more strongly agreed that each computer skill should be taught compared to the over 40 group. All of these differences are very small with word processing showing the largest difference for the two age groups. This finding is consistent with findings for experience (Table 4). The standard deviation of 0.99 in the graphing category of Group 1 can be attributed to one subject's responses of 2 on the five-point Likert scale. All of the other subjects' responses ranged from 4-5.

Table 3. Mann-Whitney U Test Results of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Two Teacher Experience Groups

Variable	Experience 1 n	Mean Rank	Experience 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Computer Skills to be Taught	8	11.94	11	8.59	28.50	0.20

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

As Table 3 shows, when compared by years of teaching experience, the cluster "Computer Skills to be Taught" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.94 for the less experienced group and 8.59 for the more experienced group are substantial. The less experienced teachers more strongly agreed that computer skills should be taught to their students. Because the numbers of subjects are so small (8, 11), the findings might reflect a Type II Error, and the mean difference between the two experience groups may be real.

Further analysis of the data (Table 4) reveals that for each of the components of the "Computer skills should be taught" cluster, the differences between the two experience groups were between 0.04 and 0.44 on the five-point scale. The largest difference between the two groups was found in the "Word Processing" category. The differences between the two groups were not statistically significant. When breaking down the computer skills that should be taught into individual components it was found that the less experienced group more strongly agreed that each computer skill should be taught

compared to the more experienced group. The standard deviation of 0.99 in the graphing category for the less experienced group can be attributed to one subject's response of 2 on the 5-point Likert scale. All of the other subjects' responses ranged from 4-5.

Table 4. Mean Likert Scores of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Two Categories of Teacher Experience

	Experience 1			Experience 2			
Computer Skills to be Taught	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Keyboarding	8	4.62	0.52	11	4.27	0.47	0.35
Word Processing	8	4.62	0.52	11	4.18	0.60	0.44
Graphing	8	4.13	0.99	11	4.09	0.70	0.04
Presentation	8	4.50	0.54	11	4.18	0.60	0.32
Internet Search	8	4.63	0.52	11	4.27	0.65	0.36

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

As Table 5 shows, when compared by the teacher's level of confidence, the cluster "Computer Skills to be Taught" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.50 for the more confident group and 8.23 for the less confident group are substantial. The more confident group of teachers more strongly agreed that computer skills should be taught to their students. Because the numbers of subjects are so small (7, 11), the findings might reflect a Type II Error, and the mean difference between the two groups may be real.

Table 5. Mann-Whitney U Test Results of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Teachers with Different Levels of Computer Confidence

Variable	Confidence 1 n	Mean Rank	Confidence 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Computer Skills to be Taught	7	11.50	11	8.23	24.50	0.20

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

Further analysis of the data (Table 6) reveals that for each of the components of the "Computer Skills to be Taught" cluster, the differences between the groups based on the confidence level of teachers were between 0.07 and 0.62 on the five-point scale. The largest difference between the two groups was found in the "Presentation" category. The differences between the two groups were not statistically significant. When breaking down the computer skills that should be taught into individual components it was found that the more confident group more strongly agreed that each computer skill should be taught compared to the less confident group. The standard deviation of 1.11 in the graphing category of the more confident group can be attributed to one subject's response of 2 on the five-point Likert scale. All of the other subjects' responses ranged from 4-5.

Table 6. Mean Likert Scores of Teacher Beliefs of Which Computer Skills Should be Taught to Students in Teachers with Different Levels of Computer Confidence

	Confidence 1			Confidence 2			
Computer Skills Should be Taught	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Keyboarding	7	4.43	0.54	11	4.36	0.51	0.07
Word Processing	7	4.71	0.49	11	4.18	0.16	0.53
Graphing	7	4.29	1.11	11	4.00	0.63	0.29
Presentation	7	4.71	0.45	11	4.09	0.54	0.62
Internet Search	7	4.43	0.79	11	4.36	0.51	0.07

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

Table 7. Mann-Whitney U Test Results of Responses of Which Computer Skills Teachers Believe Should be Taught to Students in Terms of Teacher Perception of Emphasis of Computers in the School

Variable	Emphasis 1 n	Mean Rank	Emphasis 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Computer Skills to be Taught	12	12.33	7	6.00	14.00	0.02*

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. *p. $\leq$ 0.05

As Table 7 shows, when compared by teacher perception of emphasis on computer use at school, the cluster "Computer Skills to be Taught" revealed statistically significant differences between the two groups. This significant difference may be because teachers who feel that computers are underemphasized at the school also believe more strongly that computer skills should be taught. The differences between the mean ranks of 12.33 for the teacher group that felt computers are underemphasized in the school and 6.00 for teacher group that felt computers are highly overemphasized, overemphasized or correctly emphasized in the school are substantial. Because the numbers of subjects are so small (12, 7), the findings might reflect a Type I Error.

Table 8. Mean Likert Scores of Responses of Which Computer Skills Teachers Believe Should be Taught to Students in Terms of Teacher Perception of Emphasis of Computers in the School

	Emphasis 1			Emphasis 2			
Computer Skills to be Taught	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Keyboarding	12	4.50	0.52	7	4.29	0.49	0.21
Word Processing	12	4.58	0.52	7	4.00	0.58	0.58
Graphing	12	4.42	0.52	7	3.57	0.98	0.85
Presentation	12	4.50	0.52	7	4.00	0.58	0.50
Internet Search	12	4.58	0.52	7	4.14	0.70	0.44

Note. Emphasis 1 computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized.

Further analysis of the data (Table 8) reveals that for each of the components of the "Computer Skills to be Taught" cluster, the differences between the two groups of

teacher perceived emphasis on computers in the school were between 0.21 and 0.85. The largest difference between the two groups was found in the "Graphing" category. The differences between the two groups were statistically significant. When breaking down the computer skills that should be taught into individual components it was found that the teacher group who feel computers are underemphasized in the school more strongly agreed that each computer skill should be taught compared to the teacher group who feel computers are highly overemphasized, overemphasized or correctly emphasized at the school. The standard deviation of 0.98 in the "Graphing" category for the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized can be attributed to one subject's response of 2 on the five-point Likert scale. All of the other subjects' responses ranged from 4-5.

Table 9. Mann-Whitney U Test Results of Responses of Which Computer Skills Teachers Believe Should be Taught to Students Based on Teacher Computer Use at Home

Variable	Computer Use at Home 1 n	Mean Rank	Computer Use at Home 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Computer Skills to be Taught	11	11.55	8	7.88	27.00	0.16

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

As Table 9 shows, when compared by teacher use of a computer at home the cluster "Computer Skills to be Taught" revealed no statistically significant differences between

the two groups. However, the mean ranks of 11.55 for the group of teachers who used a computer at home often or very often and 7.88 for the group of teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home are substantial. Because the numbers of subjects are so small (11 and 8), the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Table 10. Mean Likert Scores of Responses of Which Computer Skills Teachers Believe Should be Taught to Students Based on Teacher Computer Use at Home

	Computer at Home 1			Computer at Home 2			
Computer Skills to be Taught	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Keyboarding	11	4.45	0.52	8	4.38	0.52	0.07
Word Processing	11	4.45	0.52	8	4.25	0.71	0.20
Graphing	11	4.36	0.51	8	3.75	1.03	0.61
Presentation Skills	11	4.45	0.52	8	4.13	0.64	0.32
Internet Search	11	4.55	0.52	8	4.25	0.71	0.30

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Further analysis of the data (Table 10) reveals that for each of the components of the "Computer Skills to be Taught" cluster, the differences between the two Computer Use at Home groups were between 0.07 and 0.61 on the five-point scale. The largest difference between the two groups was found in the "Graphing" category. The differences between the two groups were not statistically significant. When breaking down the computer skills that should be taught into individual components it was found that the group of teachers

who use a computer at home often or very often more strongly agreed that each computer skill should be taught compared to the group of teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home. The standard deviation of 1.03 in the "Graphing" category for the group of teachers that never use a computer at home, seldom use a computer at home or sometimes use a computer at home can be attributed to one subject's response of 2 on the five-point scale. All of the other subjects' responses ranged from 3-5.

Following interviews and focus group discussions, quotes of interest to the findings of Tables 1-10 were chosen.

Bonney, a primary teacher with less than 10 years experience and under 40 years of age, said that she would use computers to "teach the children to explore a variety of ways to represent an idea."

Leslie, a teacher who has taught as a primary and intermediate classroom teacher, with over 10 years experience and under 40 years of age, stated that "keyboarding, typing, word processing, how to open and save on a disk, how to find work saved on a disk, how to eject a disk, and to know what the computer is telling you" are skills that the students need to acquire. She also felt that in regards to Ministry requirements, "computers are a minor part, presentation is the key."

Positive Teacher Attitudes Towards Integrating Computers

The following ten tables (Tables 11-20) describe the attitudes that teachers displayed towards integrating computers into the curriculum. The cluster of "Positive Teacher Attitudes Towards Integrating Computers" was compared using age (Tables 11 & 12); teaching experience (Tables 13 & 14); computer confidence of teacher (Tables 15 & 16); the amount of emphasis, as perceived by the teacher, of computer use in the school (Tables 17 & 18); use of computers at home by the teacher (Tables 19 & 20).

Table 11. Mann-Whitney U Test Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Age Groups

Variable	Age 1 n	Mean Rank	Age 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Positive Teacher Attitudes Towards Computers	8	12.88	11	7.91	21.00	0.06

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age.

As Table 11 shows, when compared by age (under or over 40), the cluster "Positive Teacher Attitudes Towards Computers" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 12.88 for the under 40 group and 7.91 for those over 40 are substantial. Because the numbers of subjects are so small (8 and 11), the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Table 12. Mean Likert Scores of Teacher Responses of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Age Groups

	Age 1			Age 2			
Positive Teacher Attitudes Towards Computers	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
There is no Alternative to Computers	8	3.70	0.46	11	3.73	1.01	0.03
Using Computers is not a Waste of Time	8	4.63	0.52	11	4.55	0.52	0.11
I Value Teaching with Computers	8	4.25	0.71	11	4.36	0.50	0.11
I Would Incorporate Computer Technology if it was Available	8	4.63	0.52	11	4.09	0.83	0.54
Internet is not a Waste of Time	8	4.50	0.53	11	4.09	0.94	0.41
Computers Would Improve Teacher Performance	8	3.75	1.04	10	2.20	0.92	1.55
Computers Would Improve Student Work	8	3.88	0.99	10	3.00	1.25	0.88
Students are Motivated when using Computers	8	4.38	0.52	10	3.45	0.50	0.93
With Guidance Would I Would use a Computer	8	4.63	0.52	10	3.80	0.92	0.83

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age.

Further analysis of the data (Table 12) reveals that for each of the components of the "Positive Teacher Attitudes Towards Computers" cluster, the differences between the two teacher age groups were between 0.03 and 1.55. The differences were not statistically significant. The largest difference was found in the category "Computers Would Improve Teacher Performance", as was also found in Table 14. The categories in Table 12 and Table 14 were almost identical. With the exception of the "Students are Motivated when

using Computers" category, where the difference was 0.34, the greatest difference between the two variables (under 40 years of age and over 40 years of age; 0-10 years experience and over 10 years experience) in each category was less than 0.05. The similarities between Tables 12 and 14 can be attributed to the fact that the subject pool for the under 40 years of age teachers and the 0-10 years experience teachers; and the over 40 years of age teachers and the teachers with over 10 years of experience was identical, with the exception of two teachers. All of the teachers in the under 40 years of age category were in the teachers with 0-10 years of teaching experience category and all of the teachers in the over 40 years of age category were in the over 10 years of teaching experience category, with the exception of two teachers. One of these teachers was in the under 40 years of age category and in the over 10 years of teaching experience category, and one of the teachers was in the over 40 years of age category and in the 0-10 years of teaching experience category. When breaking down the computer skills that should be taught into individual components, with the exception of the "There is no Alternative to Computers" and the "I Value Teaching with Computers" categories, the under 40 group displayed a more positive attitude towards computers compared to the over 40 group.

The standard deviation of 1.01 in the "There is no Alternative to Computers" category in the over 40 group can be attributed to one subject's response of 1 on the five-point scale, one subject's response of 3 on the five-point scale and one subject's response of 5 on the five-point scale. The remaining 8 subjects' responses were 4 on the five-point scale. The standard deviation of 1.25 in the "Computers Would Improve Student Work" category in the over 40 group can be attributed to one subject's response of 1 on the five-point scale.

All of the other subjects responded in the 2-4 range. Similar ranges in responses for the over 40 group were found in the "Internet is a Waste of Time", "Computers Would Improve Teacher Performance", and "With Guidance I Would use a Computer" categories. Similar ranges in responses were found for the younger teachers in the "Computers Would Improve Teacher Performance" and "Computers Would Improve Student Work" categories.

Table 13. Mann-Whitney U Test Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Experience Groups

Variable	Experience 1 n	Mean Rank	Experience 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p value)
Positive Teacher Attitudes Towards Computers	8	12.50	11	8.18	24.00	0.10

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

As Table 13 shows, when compared by years of teaching experience (ten years and under; eleven or more years), the cluster "Positive Teacher Attitudes Towards Computers" revealed no statistically significant differences between the two groups. However, the differences between the mean rank of 12.50 for the teachers with 10 or fewer years of experience group and 8.18 for those teachers with 11 or more years of experience group are substantial. Because the numbers of subjects are so small (8, 11),

the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Table 14. Mean Likert Scores of Teacher Responses of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Experience Groups

	Experience 1			Experience 2			
Positive Teacher Attitudes Towards Computers	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
There is no Alternative to Computers	8	3.75	0.46	11	3.73	1.00	0.02
Using Computers is not a Waste of Time	8	4.62	0.52	11	4.55	0.52	0.07
I Value Teaching with Computers	8	4.25	0.71	11	4.36	0.50	0.11
I would Incorporate Computer Technology if it was Available	8	4.62	0.52	11	4.09	0.83	0.53
Internet is not a Waste of Time	8	4.50	0.53	11	4.09	0.94	0.41
Computers Would Improve Teacher Performance	8	3.75	1.04	10	2.20	0.92	1.55
Computers Would Improve Student Work	8	3.88	0.99	10	3.00	1.25	0.88
Students are Motivated when using Computers	8	4.19	0.53	10	3.60	0.70	0.59
With Guidance I Would use a Computer	8	4.63	0.52	10	3.80	0.92	0.83

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

Further analysis of the data (Table 14) reveals that for each of the components of the "Positive Attitudes Towards Computers" cluster, the differences between the two experience groups were between 0.11 and 1.5 on the five-point scale. The largest difference between the two groups was found in the "Computers Would Improve Teacher Performance" category. The differences were not statistically significant. When breaking down the computer skills that should be taught into individual components, with the exception of the "I Value Teaching with Computers" category, the less experienced group displayed a more positive attitude towards computers.

The standard deviation of 1.25 in the "Computers Would Improve Student Work" category in the more experienced group can be attributed to one subject's response of 1 on the five-point scale and one subject's response of 5 on the five-point scale. All the other subjects responded in the 2-4 range. Similar ranges in responses were found for the more experienced teachers in the "Computers Would Improve Teacher Performance", Computers Would Improve Student Work", and "With Guidance I Would Use a Computer" categories.

The standard deviation of 1.04 in the "Computers Would Improve Teacher Performance" for the less experienced group can be attributed to one subject's response of 2 on the five-point scale. All the other subjects responded in the 3-5 range. Similar ranges in responses were found for the less experienced teachers in the "Computers Would Improve Student Work" variable.

Table 15. Mann-Whitney U Test Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum With Different Levels of Teacher Computer Confidence

Variable	Computer Confidence 1 n	Mean Rank	Computer Confidence 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p value)
Positive Teacher Attitudes Towards Computers	7	11.79	11	8.05	22.50	0.15

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

As Table 15 shows, when compared by confidence level, the cluster "Positive Teacher Attitudes Towards Computers" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.79 for the more confident group of teachers and 8.05 for the less confident group of teachers are substantial. Because the numbers of subjects are so small (7 and11), the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Table 16. Mean Likert Scores of Teacher Responses of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Computer Confidence Groups

	Computer Confidence 1			Computer Confidence 2			
Positive Attitudes	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
There is no Alternative to Computers	7	3.43	1.13	11	3.81	0.40	0.38
Using Computers is not a Waste of Time	7	4.86	0.38	11	4.36	0.50	0.50
I Value Teaching with Computers	7	4.71	0.49	11	4.00	0.45	0.71
I Would Incorporate Computer Technology if it was Available	7	4.57	0.79	11	4.09	0.70	0.48
Internet is not a Waste of Time	7	4.43	1.13	11	4.09	0.54	0.34
Computers Would Improve Teacher Performance	7	2.71	1.60	11	3.00	1.00	0.29
Computers Would Improve Student Work	7	3.57	1.51	11	3.27	1.01	0.30
Students are Motivated when using Computers	7	3.93	0.61	11	3.82	0.75	0.11
With Guidance I Would use a Computer	7	4.57	0.79	11	3.91	0.83	0.66

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

Further analysis of the data (Table 16) reveals that for each of the components of the "Positive Teacher Computer Attitudes" cluster, the differences between the confidence level groups was between 0.38 and 0.71 on the five-point scale. The largest difference was found in the "I Value Teaching with Computers" category. The differences were not statistically significant. When breaking down the attitudes into individual components it was found that the teachers who expressed a higher confidence level in computers also expressed a more positive attitude towards computers with the exception of "There is no Alternative to Computers" and "Computers can Improve Teacher Performance" items where the teachers with less confidence expressed more positive attitudes.

The standard deviation of 1.60 in the "Computers Would Improve Teacher Performance" category in the more confident teacher group can be attributed to two subjects' responses of 1 on the five-point Likert scale, two subjects' responses of 2 on the five-point scale, two subjects' responses of 4 on the five-point Likert scale, and one subject's response of 5 on the five-point Likert scale. Similar ranges in responses were found for the younger teachers on the "There is no Alternative to Computers", "Internet is not a Waste of Time", and "Computers Would Improve Student Work" variables. The standard deviation of 1.01 in the "Computers Would Improve Student Work" category in the less confident teacher group can be attributed to on subject's response of 5 on the five-point Likert scale. All of the other subjects' responses were in the 2-4 range. Similar ranges in responses were found for the less confident teachers in the "Computers Would Improve Student Work" variable.

Table 17. Mann-Whitney U Test Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in terms of Teacher Perception Towards the use of Computers in the School

Variable	Emphasis 1 n	Mean Rank	Emphasis 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Positive Teacher Attitudes Towards Computers	12	11.38	7	7.64	25.50	0.16

Note. The Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. The Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized.

As Table 17 shows, when compared by teacher perception of emphasis on computer use at school, the cluster "Positive Teacher Attitudes Towards Computers" revealed no statistically significant differences between the two groups. The differences between the mean ranks of 11.38 for the group that felt that computers were underemphasized and 7.64 for the group that felt that computers in the school are highly overemphasized, overemphasized, or correctly emphasized are substantial. Because the numbers of subjects are so small (12,7), the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Table 18. Mean Likert Scores of Teacher Responses of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Perceived Computer Emphasis Groups

	Emphasis 1			Emphasis 2			
Positive Teacher Attitudes Towards Computers	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
There is no Alternative to Computers	12	3.83	0.39	7	3.57	1.27	0.26
Using Computers is not a Waste of Time	12	4.58	0.51	7	4.57	0.51	0.01
I Value Teaching with Computers	12	4.33	0.65	7	4.29	0.49	0.04
I Would Incorporate Computer Technology if it was Available	12	4.58	0.51	7	3.86	0.90	0.72
Internet is not a Waste of Time	12	4.50	0.52	7	3.86	1.07	0.64
Computers Would Improve Teacher Performance	12	3.17	1.27	6	2.33	1.03	0.84
Computers Would Improve Student Work	12	3.83	1.03	6	2.50	1.05	1.33
Students are Motivated when Using Computers	12	4.04	0.69	6	3.50	0.49	0.54
With Guidance I Would use a Computer	12	4.42	0.80	6	3.67	0.82	0.75

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized.

Further analysis of the data (Table 18) reveals that for each of the components of the "Positive Teacher Attitudes Towards Computers" cluster, the differences between the perceived emphasis groups were between 0.01 and 1.33 on the five-point Likert scale. The largest difference was found in the "Computers Would Improve Student Work"

category. The differences were not statistically significant. When breaking down the attitudes into individual components it was found that the teacher group that felt that computers were underemphasized in the school more strongly agreed for each positive attitude item compared to the teacher group that felt that computers were highly overemphasized, overemphasized, or correctly emphasized.

The standard deviation of 1.27 in the "Internet is not a Waste of Time" category for the teacher group who feel that computers are underemphasized at the school can be attributed to one subject's response of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point scale, three subjects' responses of 3 on the five-point Likert scale, three subjects' responses of 4 on the five-point scale and two subjects' responses of 5 on the five-point Likert scale. Similar ranges in responses were found for the teacher group who feel that computers were underemphasized at the school on the "Computers Would Improve Student Work" variable. The standard deviation of 1.27 in the "There is no Alternative to Computers" category for the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school can be attributed to one subject's response of 1 on the five-point scale, one subject's response of 3 on the five-point scale and one subject's response of 5 on the five-point Likert scale. All the rest of the subjects' responses were 4. Similar ranges of responses for the teacher group who feel that computers were highly overemphasized, overemphasized, or correctly emphasized on the "I Would Incorporate Computer Technology if it was Available", "Internet is not a Waste of Time", "Computers Would

Improve Teacher Performance" and "Computers Would Improve Student Work" variable.

Table 19. Mann-Whitney U Test Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Categories of Computer Use at Home by Teachers

Variable	Computer at Home 1 n	Mean Rank	Computer at Home 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Positive Attitudes Towards Computers	11	11.64	8	7.75	26.00	0.14

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

As Table 19 shows, when compared by teacher use of a computer at home, the cluster "Positive Teacher Attitudes Towards Computers" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.64 for the group of teachers that use computers at home often or very often and 7.75 for the group of teachers that never use computers at home, seldom use computers at home, or sometimes use computers at home are substantial. Because the numbers of subjects are so small (11, 8), the findings might reflect a Type II Error and the mean differences between groups may be real.

Table 20. Mean Likert Scores of Teacher Responses Results of Positive Teacher Attitudes Towards the Integration of Computers into the Curriculum in Two Teacher Categories of Computer Use at Home

	Computer at Home 1			Computer at Home 2			
Positive Teacher Attitudes Towards Computers	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
There is no Alternative to Computers	11	4.00	0.45	8	3.38	1.06	0.62
Computers are not a Waste of Time	11	4.64	0.50	8	4.50	0.53	0.14
I Value Teaching with Computers	11	4.45	0.52	8	4.13	0.64	0.32
I Incorporate Computer Technology if it was Available	11	4.46	0.69	8	4.13	0.83	0.33
Internet is not a Waste of Time	11	4.63	0.50	8	3.75	0.89	0.88
Computers Would Improve Student Work	10	3.80	1.14	8	2.88	1.13	0.92
Computers Would Improve Teacher Performance	10	3.10	1.37	8	2.63	1.06	0.47
Computers Motivate Students	10	3.95	0.69	8	3.75	0.71	0.20
With Guidance I Would use Computers More	10	4.20	0.92	8	4.13	0.84	0.07

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Further analysis of the data (Table 20) reveals that for each of the components of the "Positive Teacher Attitudes Towards Computers" cluster, the differences between the two teacher groups were between 0.07 and 0.92 on the five- point scale. The greatest difference between the two groups was found in the "Computers Would Improve Student

Work" category. The differences were not statistically significant. When breaking down the positive attitudes into individual components it was found that the teacher group who use a computer at home often or very often more strongly agreed that each computer skill should be taught compared to teacher group that never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

The standard deviation of 1.37 for the "Computers Would Improve Teacher Performance" category in the teacher group that used a computer at home often or very often can be attributed to one subject's response of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 3 on the five-point Likert scale, two subjects' responses of 4 on the five- point Likert scale and 2 subjects' responses of 5 on the five-point Likert scale. Similar ranges in responses were found for the teacher group that used a computer at home often or very often on the "Computers Would Improve Student Work" and "With Guidance I Would use Computers More" variables. The standard deviation of 1.13 for the "Computers Would Improve Student Work" category in the teacher group that never used a computer at home, seldom used a computer at home or sometimes used a computer at home can be attributed to one subject's response of 1 on the five-point Likert scale, two subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 3 on the five-point Likert scale, and three subjects' responses of 4 on the five-point Likert scale. Similar ranges in responses were found for the teacher group that never used a computer at home, seldom used a computer at home or sometimes used a computer at home on the "There is no Alternative to Computers" and "Computers Would Improve Teacher Performance" variables.

From the interviews and focus group discussions, quotes of interest to the findings of Tables 11-20 were chosen.

Bonney claimed that integrating computers into the classroom would be "fantastic. The kids already have computer skills and we would be able to build on these skills. Kids would be excited about school. We would be addressing a variety of learning skills. It would let us be open to different ways of representing a concept."

Paula, a teacher with more that 10 years experience and over 40 years of age felt that there were barriers into integrating computers into the curriculum. "The computers do not always work. There is often a problem with the printing; there is no finished product. There is not enough time in the day. If I was more familiar with computers I might do more. It is a personal view. Other things are more important."

Jackie, a teacher with more than 10 years of teaching experience and over 40 years of age felt that in order to integrate computer technology and enable the students to feel comfortable operating a computer, the school would need to "provide teachers with computers for their classrooms and training. Teachers need confidence and need to feel comfortable when working with computers."

Current Use of Computers

The following ten tables (Tables 21-30) describe how teachers are currently using computers in their classroom to enhance student learning. The cluster of how teachers are

currently using computers to enhance student learning was compared to: age; teaching experience; computer confidence of the teacher; the amount of emphasis, as perceived by the teacher, of computer use in the school; use of computers at home by the teacher.

Table 21. Mann-Whitney U Test Results of How Teachers are Currently Using Computers to Enhance Student Learning in Two Teacher Age Groups

Variable	Age 1 n	Mean Rank	Age 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers Are Currently Using Computers to Student Enhance Learning	8	9.69	11	10.23	41.50	0.83

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age.

As Table 21 shows, when compared by age, the cluster "How Teachers Are Currently Using Computers to Enhance Student Learning" revealed no statistically significant differences between the two groups. The older group of teachers more strongly agreed that they are currently using computers to enhance student learning. The differences between the mean ranks of 9.69 for the younger teacher group and 10.23 for the older teacher are similar.

Further analysis of the data (Table 22) reveals that for each of the components of the "How Teachers Are Currently Using Computers to Enhance Student Learning" cluster, the differences between the two teacher age groups were between 0.10 and 0.25 on the five-point scale. The largest difference was found in the category "Teacher Uses

Computer To Individualize Work", similar results were found in tables 24, 26, and 28. The largest difference between categories in Table 30 was "Students Complete Assignments on Computer". The differences between the two age groups are not statistically significant. When breaking down how teachers are currently using computers into individual components it was found that the older teacher group more strongly agreed that their students were using computers to complete assignments and that they planned units with computers in mind compared to the younger teacher group. However the younger teacher group more strongly agreed that they were using computers to individualize learning.

The standard deviation of 1.38 in the "Students Complete Assignments on the Computer" for the senior group of teachers can be attributed to two subjects' responses of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point Likert scale, one subjects response of 3 on the five-point scale, four subjects' responses of 4 on the five-point scale and one subject's response of 5 on the five-point Likert scale. The standard deviation of 1.35 in the "Teacher Uses Computer to Individualize Student Learning" category for the older teacher group can be attributed to two subjects' responses of 1 on the five point Likert scale, five subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 4 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. Similar ranges in responses in the younger group of teachers were found in the "Students Complete Assignments on Computer" and "Teacher Uses Computer to Individualize Learning" variables. Similar ranges in responses in the senior

group of teachers were found in the "Teacher Plans Integration of Computers Into Unit" variable.

Table 22. Mean Likert Scores of How Teachers are Currently Using Computers to Enhance Student Learning in Two Teacher Age Groups

	Age 1			Age 2			
How Teachers Are Currently Using Computers to Enhance Student Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Students Complete Assignments on Computer	7	2.43	1.17	11	2.91	1.38	0.21
Teacher Plans Integration of Computers Into Unit	8	2.50	0.76	10	2.60	1.17	0.10
Teacher Uses Computer to Individualize Learning	8	2.75	1.17	10	2.50	1.35	0.25

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age.

Table 23. Mann-Whitney U Test Results of How Teachers are Currently Using Computers to Enhance Student Learning in Two Groups of Teacher Experience

Variable	Experience 1 n	Mean Rank	Experience 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers Are Currently Using Computers to Enhance Student Learning	8	10.38	11	9.73	41.00	0.80

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

As Table 23 shows, when compared by years of teaching experience, the cluster "How Teachers Are Currently Using Computers to Enhance Learning" revealed no statistically significant differences between the two groups. The differences between the mean ranks of 10.38 for the less experienced teacher group and 9.73 for the more experienced teacher group are similar. The less experienced group of teachers more strongly agreed that they are using computers to enhance student learning.

Table 24. Mean Likert Scores of How Teachers are Currently Using Computers to Enhance Student Learning in Two Groups of Teacher Experience

	Experience 1			Experience 2			
How Teachers Are Currently Using Computers to Enhance Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Students Complete Assignments on Computer	7	2.43	1.51	11	2.91	1.38	0.48
Teacher Plans Integration of Computers Into Unit Planning	8	2.88	1.13	10	2.30	0.82	0.58
Teacher Uses Computer to Individualize Learning	8	4.50	0.54	10	3.50	0.85	1.00

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

Further analysis of the data (Table 24) reveals that for each of the components of the "How Teachers Are Currently Using Computers to Enhance Learning" cluster, the differences between the two experience groups were between 0.48 and 1.00 on the five-point Likert scale. The largest difference between the two groups is found in the "Teacher Uses Computer to Individualize Learning" category. When breaking down how teachers are currently using computers into individual components it was found that the more

experienced group of teachers more strongly agreed that their students complete assignments on the computer. The less experienced group of teachers more strongly agreed that they plan with computers in mind and they use computers to individualize learning compared to the more experienced group of teachers.

The standard deviation of 1.51 in the "Students Complete Assignments on the Computer" category for the less experienced group of teachers can be attributed to two subjects' responses of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point scale, one subject's response of 4 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. The standard deviation of 1.38 for the "Students Complete Assignments on Computer" category in the more experienced group of teachers can be attributed to two subjects' responses of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point Likert scale, one subject's response of 3 on the five-point Likert scale, four subjects' responses of 4 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. The standard deviation of 1.13 for the "Teacher Plans Integration of Computers Into Unit Planning" category in the less experienced group of teachers can be attributed to one subject's response of 4 on the five-point Likert scale and one subject's response of 5 on the five-point scale. All of the other subjects' responses were in the 2-3 range.

As Table 25 shows, when compared by confidence level, the cluster "How Teachers Are Currently Using Computers to Enhance Learning" revealed statistically significant differences between the two groups. The more confident group of teachers more strongly

agreed that they are using computers to enhance student learning. The differences between the mean ranks of 12.86 for the more confident teacher group and 7.36 for the less confident teacher group are substantial. However, because the numbers of subjects are so small (11 and 7), the findings might reflect a Type I error.

Table 25. Mann-Whitney U Test Results of How Teachers are Currently Using Computers to Enhance Student Learning in Two Groups of Teachers With Different Levels of Computer Confidence

Variable	Confidence 1 n	Mean Rank	Confidence 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers Are Currently Using Computers to Enhance Learning	7	12.86	11	7.36	15.00	0.03*

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. *p. $\leq$ 0.05

Further analysis of the data (Table 26) reveals that for each of the components of the "How Teachers Are Currently Using Computers to Enhance Learning" cluster, the differences between the confidence level groups were between 0.66 and 1.57 on the five-

point Likert scale. These differences are statistically significant. The largest difference between the two groups was in the "Teacher Uses Computer to Individualize Learning" category. When breaking how teachers are currently using computers to enhance learning into individual components it was found that the teachers who expressed a higher confidence level in computers more strongly agreed that they are currently using computers to enhance student learning compared to the less confident group.

Table 26. Mean Likert Scores of How Teachers are Currently Using Computers to Enhance Student Learning in Two Teacher Groups With Different Levels of Computer Confidence

	Confidence 1			Confidence 2			
How Teachers Are Currently Using Computers to Enhance Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Students Complete Assignments on Computer	6	3.50	1.64	11	2.18	1.08	1.32
Teacher Plans Integration of Computers Into Unit Planning	7	2.86	1.22	10	2.20	0.63	0.66
Teacher Uses Computer to Individualize Learning	7	3.57	1.13	11	2.00	0.89	1.57

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

The standard deviation of 1.64 in the "Students Complete Assignments on Computer" category in the more confident group can be attributed to one subject's response of 1 on the five-point Likert scale and one subject's response of 2 on the five-point Likert scale. All of the other subjects' responses were in the 4-5 range. The standard deviation of 1.08 in the "Students Complete Assignments on Computer" category in the less confident group can be attributed to one subject's response of 3 on the five-point Likert scale and two subjects' responses of 4 on the five-point Likert scale. All of the other subjects' responses were in the 1-2 range. The standard deviation of 1.22 for the "Teacher Plans Integration of Computers into Unit Planning" category for the more confident teacher group can be attributed to one subject's response of 3 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. All of the other subjects' response was 2 on the five-point Likert scale. The standard deviation of 1.13 for the "Teacher Uses Computer to Individualize Learning" category can be attributed to two subjects' response of 2 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. The remaining four subjects' response was four on the five-point Likert scale.

As Table 27 shows, when compared by teacher perception of emphasis on computer use at school, the cluster "How Teachers Are Currently Using Computers to Enhance Learning" revealed no statistically significant differences between the two groups. The differences between the mean ranks of 10.21 for the group of teachers that felt that computers are underemphasized at the school and 9.64 for the group of teachers that felt

that computers are highly overemphasized, overemphasized ore correctly emphasized are similar.

Table 27. Mann-Whitney U Test Results of How Teachers are Currently Using Computers to Enhance Student Learning in Two Groups of Teachers in Terms of Perceived Emphasis of Computers in the School

Variable	Emphasis 1 n	Mean Rank	Emphasis 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers Are Currently Using Computers to Enhance Learning	12	10.21	7	9.64	39.50	0.83

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school.

Further analysis of the data (Table 28) reveals that for each of the components of the "How Teachers Are Currently Using Computers to Enhance Learning" cluster, the differences between the two teacher groups were generally between 0.26 and 0.66 on the five-point Likert scale. The differences were not statistically significant. The largest difference between the two groups was in the "Teacher Uses Computers to Individualize Learning" category. When breaking down how teachers are currently using computers into individual components it was found that the group of teachers who felt that computers are underemphasized at the school more strongly agreed that their students were using computers to complete assignments and that they were using computers to

individualize learning compared to the group of teachers who felt that computers are highly overemphasized, overemphasized or correctly emphasized. The group of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school more strongly agreed that they were planning units with integrating computers in mind.

The standard deviation of 1.52 in the "Students Complete Assignments on the Computer" category in the group of teachers who felt that computers are underemphasized at the school can be attributed to a wide variety of responses from the subjects. Three subjects' responses were 1 on the five-point Likert scale, three subjects' responses were 2 on the five-point Likert scale, one subject's response was 3 on the five-point Likert scale, three subjects' responses were 4 on the five-point Likert scale and two subjects' responses were 5 on the five-point Likert scale. The standard deviation of 1.34 in the "Teacher Uses Computer to Individualize Learning" for the group of teachers who felt that computers are underemphasized in the school can be attributed to the subjects giving a variety of responses. Two subjects' responses were 1 on the five-point Likert scale, four subjects' responses were 2 on the five-point Likert scale, one subject's response was 3 on the five-point Likert scale, four subjects' responses were 4 on the five-point Likert scale and one subject's response was 5 on the five-point Likert scale. Similar ranges in responses were found in for the teachers who felt that computers were underemphasized in the school in the "Teacher Plans Integration of Computers Into Unit Planning" category. Similar ranges in responses were found in the teachers who felt that computers are highly overemphasized, overemphasized or correctly emphasized at the school in the "Students

Complete Assignments on the Computer", "Teacher Plans Integration of Computers Into Unit Planning", and "Teacher Uses Computer to Individualize Learning" categories.

Table 28. Mean Likert Scores of How Teachers are Currently Using Computers to Enhance Student Learning in Two Teacher Groups in Terms of Perceived Emphasis of Computers in the School

	Emphasis 1			Emphasis 2			
How Teachers Are Currently Using Computers to Enhance Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Students Complete Assignments on Computer	12	2.83	1.52	6	2.50	1.22	0.53
Teacher Plans Integration of Computers Into Unit Planning	11	2.45	1.04	7	2.71	1.23	0.26
Teacher Uses Computer to Individualize Learning	12	2.83	1.34	6	2.17	0.98	0.66

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school.

As Table 29 shows, when compared by teacher use of a computer at home, the cluster "How Teachers Are Currently Using Computers to Enhance Learning" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.50 for the group of teachers that uses computers at home often or very often and 7.94 for the teacher group that never or seldom uses a computer at home are substantial. The teachers who often or very often used a computer at home more strongly agreed that they are using computers to enhance student learning. Because the numbers of subjects are so small (11, 8), the findings might reflect a Type II Error and the differences between the two groups may be real.

Table 29. Mann-Whitney U Test Results of How Teachers are Currently Using Computers to Enhance Student Learning in Two Teacher Groups Based on Computer Use at Home

Variable	Computer at Home 1 n	Mean Rank	Computer at Home 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers Are Currently Using Computers to Enhance Learning	11	11.50	8	7.94	27.50	0.17

Note. Computer at Home 1 use a computer at home often or very often. Computer at Home 2 never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Table 30. Mean Likert Scores of How Teachers are Currently Using Computers to Enhance Student Learning in Two Groups Based on Computer Use at Home

	Computer at Home 1			Computer at Home 2			
How Teachers Are Currently Using Computers to Enhance Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Students Complete Assignments on Computer	11	3.18	1.60	7	2.00	0.58	1.18
Teacher Plans Integration of Computers Into Unit Planning	10	2.70	1.17	8	2.38	0.74	0.32
Teacher Uses Computer to Individualize Learning	10	2.90	1.29	8	2.25	1.17	0.65

Note. Computer at Home 1 use a computer at home often or very often. Computer at Home 2 never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Further analysis of the data (Table 30) reveals that for each of the components of the "How Teachers Are Currently Using Computers to Enhance Learning" cluster, the

differences between the two groups were between 0.32 and 1.18 on the five-point Likert scale. The differences between the groups were not statistically significant. The largest difference between the two groups was in the "Students Complete Assignment on Computer" category. When breaking down how teachers are currently using computers to enhance learning into individual components it was found that the group of teachers that use computers at home often or very often more strongly agreed that they are currently using computers to enhance learning compared to the group of teachers that never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

The standard deviation of 1.60 in the "Students Complete Assignments on the Computer" category for the group of teachers that often or very often used a computer at home can be attributed to three subjects' response of 1 and one subject's responses of 2 on the 5-point Likert scale. All of the other subjects' responses ranged from 4-5. The standard deviation of 1.29 in the "Teacher Uses Computer to Individualize Learning" category for the group of teachers that often or very often used a computer at home can be attributed to one subject's response of 1 on the five-point Likert scale, five subjects' responses of 2 on the five-point Likert scale, one subject's response of 3 on the five-point Likert scale, two subjects' responses of 4 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. Similar ranges in responses for the teachers that often or very often use a computer at home were found in the "Teacher Plans Integration of Computers Into Unit Planning" category. Similar ranges in responses for the teachers that never use a computer at home, seldom use a computer at home or sometimes use a

computer at home were found in the "Teacher Uses Computer to Individualize Learning" category.

Following interviews and focus group discussions, quotes of interest to the findings of Tables 21-30 were chosen.

During the focus group discussion the issue of not being able to trouble shoot problems was discussed. Jackie, who has four computers in her classroom responded that "the teacher doesn't have to do maintenance. Let the kids do it. I haven't had to touch a computer all year."

Sally, an intermediate teacher with less than 10 years of experience and under 40 years of age, reported that her students "used the computer to complete their project on Egypt."

How Teachers See the Use of Computers Enhancing Student Learning

The following ten tables (Tables 31-40) describe how teachers see computers enhancing student learning. The cluster of how teachers see computers enhancing student learning was compared to: age (Tables 31 & 32); teaching experience (Tables 33 & 34); computer confidence of the teacher (Tables 35 & 36); the amount of emphasis, as perceived by the teacher, of computer use in the school (Tables 37 & 38); use of computers at home by the teacher (Tables 39 & 40).

As Table 31 shows, when compared by age, the cluster "How Teachers See the Use of Computers Enhancing Learning" revealed statistically significant differences between the two groups. The younger teachers more strongly agreed that computers could be used to enhance student learning compared to the senior teachers. As will be seen in Table 32, the responses of each group in the components of the cluster were consistent: the scores for the younger teachers were four and above while the scores for the senior teachers were in the mid-threes, with the exception of "Computers Should be Used to Reinforce Student Learning" which was a four. The differences between the mean ranks of 13.06 for the group of younger teachers and 7.77 for the senior teacher group are substantial. Because the numbers of subjects are so small (8, 11), the findings might reflect a Type I Error.

Table 31. Mann-Whitney U Test Results of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Age Groups

Variable	Age 1 n	Mean Rank	Age 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers See the Use of Computers Enhancing Learning	8	13.06	11	7.77	19.50	0.04*

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. *p. $\leq$ 0.05

Further analysis of the data (Table 32) reveals that for each of the components of the "How Teachers See the Use of Computers Enhancing Learning" cluster, the differences between the two teacher age groups were between 0.31 and 0.85 on the five-point Likert

scale. The differences between the two groups were statistically significant. The largest difference between the two groups was for the "Computers Would Enhance My Students' Problem Solving Skills" category. When breaking down how teachers felt computers could be used to enhance learning into individual components it was found that the group of younger teachers more strongly agreed that computers could be used to enhance learning compared to the senior group of teachers.

Table 32. Mean Likert Scores of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Age Groups in Two Teacher Age Groups

	Age 1			Age 2			
How Teachers See the Use of Computers Enhancing Student Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Computers Should Enhance My Students' Math Skills	8	4.13	0.34	9	3.67	0.71	0.46
Computers Would Enhance My Students' Reading Skills	8	4.00	0.76	11	3.55	0.93	0.45
Computers Would Enhance My Students' Writing Skills	8	4.13	0.84	11	3.82	0.87	0.31
Computers Would Enhance My Students' Problem Solving Skills	8	4.25	0.71	10	3.40	0.70	0.85
I would Plan to use Computers More if I had More Access	8	4.38	0.52	10	3.60	0.97	0.78
Computers Should be Used to Reinforce Student Learning	8	4.38	0.52	10	4.00	0.94	0.38

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age.

The standard deviation of 0.93 in the "Computers Would Enhance my Students' Reading Skills" for the senior group of teachers can be attributed to two subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 3 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. All of the rest of the

subjects' responses were 4 on the five-point Likert scale. The standard deviation of 0.97 in the "I Would Plan to use Computers More if I had More Access" category for the senior group of teachers can be attributed to one subject's response of 2 on the five-point Likert scale, four subjects' responses of 3 on the five-point Likert scale, three subjects' responses of 4 on the five-point Likert scale and two subjects' responses of 5 on the five-point Likert scale. The standard deviation of 0.94 in the "Computers Should be used to Reinforce Student Learning" category for the senior group of teachers can be attributed to one subject's response of 2 on the five-point Likert scale and one subject's response of 3 on the five-point Likert scale. All the rest of the subjects' responses were in the 4-5 range.

Table 33. Mann-Whitney U Test Results of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Experience Groups

Variable	Experience 1 n	Mean Rank	Experience 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers See the Use of Computers Enhancing Learning	8	13.06	11	7.77	19.50	0.04*

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. *p. $\leq$ 0.05

As Table 33 shows, when compared by years of teaching experience, the cluster "How Teachers See the Use of Computers Enhancing Learning" revealed statistically significant differences between the two groups. The differences between the mean ranks

of 13.06 for the less experienced teacher group and 7.77 for the more experienced teacher group are substantial. The less experienced teachers more strongly agreed that computers could be used to enhance student learning compared to the more experienced teachers. As will be seen in Table 34, the responses of each of the components of the cluster were consistent: the scores for the less experienced teachers were above four and above while the scores for the more experienced teachers were in the mid to high three range. Because the numbers of subjects are so small (8, 11), the findings might reflect a Type I Error.

Table 34. Mean Likert Scores of How Teachers See the Use of Computers Enhancing Student Learning in Two Experience Groups

	Experience 1			Experience 2			
How Teachers See the Use of Computers Enhancing Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Computers Would Enhance My Students' Math Skills	8	4.13	0.35	9	3.67	0.71	0.46
Computers Would Enhance My Students' Reading Skills	8	4.00	0.76	11	3.55	0.93	0.45
Computers Would Enhance My Students' Writing Skills	8	4.13	0.84	11	3.82	0.87	0.31
Computers Would Enhance My Students' Problem Solving Skills	8	4.00	0.76	10	3.60	0.83	0.40
I would Plan to use Computers More if I had More Access	8	4.50	0.53	10	3.50	0.85	1.00
Computers Should be Used to Reinforce Student Learning	8	4.50	0.54	10	3.90	0.88	0.60

Note. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience.

Further analysis of the data (Table 34) reveals that for each of the components of the "How Teachers See the Use of Computers to Enhance Learning" cluster, the differences

between the two experience groups were between 0.31 and 1.00 on the five-point Likert scale. These differences were statistically significant. The largest difference between the two groups was in the "I Would Plan to use Computers More if I had More Access" category. When breaking down how teachers felt computers could be used to enhance learning into individual components it was found that the less experienced teacher group more strongly agreed that computers could be used to enhance student learning compared to the more experienced teacher group.

The standard deviation of 0.93 in the "Computers Would Enhance my Students' Reading Skills" category in the more experienced group can be attributed to two subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 3 on the five-point Likert scale and one subject's response of 5 on the 5-point Likert scale. All the rest of the subjects' responses were 4 on the five-point Likert scale.

As Table 35 shows, when compared by confidence level, the more confident teacher group more strongly agreed that computers could be used to enhance student learning. The cluster "How Teachers See the Use of Technology Enhancing Learning" revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.71 for the more confident group and 8.09 for the less confident group are substantial. Because the numbers of subjects are so small (7 and 11), the findings might reflect a Type II Error and the differences between the two groups may be real.

Table 35. Mann-Whitney U Test Results of How Teachers See the Use of Computers Enhancing Student Learning in Two Groups of Teachers With Different Levels of Computer Confidence

Variable	Confidence 1 n	Mean Rank	Confidence 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers See the Use of Computers Enhancing Learning	7	11.71	11	8.09	23.00	0.16

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

Further analysis of the data (Table 36) reveals that for each of the components of the "How Teachers See the Use of Technology Enhancing Learning" cluster, the differences between the confidence level groups were between 0.04 and 0.70 on the five-point Likert scale. The largest difference between the two groups was for the "Computers Would Enhance My Students Writing Skills" category. When breaking down how teachers felt computers could be used to enhance learning into individual components it was found that the more confident teacher group more strongly agreed that if they had more access to computers they would plan to use them and that computers should be used to reinforce

concepts learned in the classroom than the less confident teacher group. The more confident teacher group also agreed more strongly than the less confident teacher group that computers would enhance their students' writing and problem solving skills. However, the less confident teacher group agreed more strongly that computers would enhance their students' math and reading skills. The differences between the two groups were not statistically significant.

The standard deviation of 0.95 in the "Computers Could be Used to Enhance Reading Skills" category for the more confident teacher group can be attributed to two subjects' responses of 3 on the 5-point Likert scale and one subject's response of 5 on the five-point Likert scale. All the rest of the responses were 4. The standard deviation of 0.90 in the "Computers Would Enhance my Students' Problem Solving Skills" category for the more confident teacher group can be attributed to two subjects' responses of 3 on the five-point Likert scale. All the rest of the responses ranged from 4-5. The standard deviation of 1.11 in the "I Would Plan to Use Computers More if I had More Access" category for the more confident teacher group can be attributed to four subjects' responses of 4 on the five-point Likert scale and three subjects' responses of 5 on the five-point Likert scale.

Table 36. Mean Likert Scores of How Teacher See Computers Enhancing Student Learning in Two Teacher Groups With Different Levels of Computer Confidence

	Confidence 1			Confidence 2			
How Teachers See the Use of Computers Enhancing Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. In $\bar{x}$
Computers Would Enhance My Students' Math Skills	7	3.86	0.38	11	3.90	0.74	0.04
Computers Would Enhance My Students' Reading Skills	7	3.71	0.95	11	3.91	0.70	0.20
Computers Would Enhance My Students' Writing Skills	7	4.43	0.79	11	3.73	0.79	0.70
Computers Would Enhance My Students' Problem Solving Skills	7	3.86	0.90	10	3.70	0.82	0.16
I would Plan to use Computers More if I had More Access	7	4.29	1.11	10	3.70	0.68	0.59
Computers Should be Used to Reinforce Student Learning	7	4.57	0.54	11	3.91	0.83	0.66

Note. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer.

As Table 37 shows, when compared by teacher perception of emphasis on computer use at school, the cluster "How Teachers See the Use of Technology Enhancing Learning" revealed statistically significant differences between the two groups. The teachers who feel that computers are underemphasized at the school more strongly agreed that computers could be used to enhance student learning. As will be seen in table 38, the responses of each group in the components of the cluster were consistent: the scores for

the group of teachers who felt that computers are underemphasized at the school were four and above, with the exception of "Computers Would Enhance My Students' Problem Solving Skills" which was in the high threes. The scores for the teachers who felt that computers are highly overemphasized, overemphasized or correctly emphasized at the school were in the low to mid threes with the exception of "Computers Should be Used to Reinforce Student Learning" which was in the low fours. The differences between the mean ranks of 12.67 for the group of teachers who feel that computers are underemphasized at the school and 5.43 for the group of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized are substantial. Because the numbers of subjects are so small (12 and 7), the findings might reflect a Type I Error.

Table 37. Mann-Whitney U Test Results of How Teachers See the Use of Computers Enhancing Student Learning in terms of Teacher Perception Towards the Use of Computers in the School in Two Groups

Variable	Emphasis 1 n	Mean Rank	Emphasis 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers See the Use of Computers Enhancing Learning	12	12.67	7	5.43	10.00	0.01*

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. *p. $\leq$ 0.05

Table 38. Mean Likert Scores of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Groups in Terms of Perceived Emphasis of Computers in the School

	Emphasis 1			Emphasis 2			
How Teachers See the Use of Computers Enhancing Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Computers Would Enhance my Students' Math Skills	11	4.18	0.41	6	3.33	0.60	0.85
Computers Would Enhance My Students' Reading Skills	12	4.17	0.58	7	3.00	0.82	1.17
Computers Would Enhance my Students' Writing Skills	12	4.25	0.87	7	3.43	0.54	0.82
Computers Would Enhance my Students' Problem Solving Skills	11	3.91	0.83	7	3.57	0.79	0.34
I would Plan to use Computers More if I had More Access	11	4.36	0.51	7	3.29	0.95	1.07
Computers Should be Used to Reinforce Student Learning	12	4.17	0.84	6	4.17	0.75	0.0

Note. Emphasis 1 is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized.

Further analysis of the data (Table 38) reveals that for each of the components of the "How Teachers See the Use of Technology Enhancing Learning" cluster, the differences between the two teacher age groups were between 0.0 and 1.17 on the five-point Likert scale. The largest difference between the two groups was for the "Computers Would Enhance My Students' Reading Skills" category. When breaking how teachers saw the use of technology enhancing learning into individual components it was found that the group of teachers who feel that computers are underemphasized at the school more

strongly agreed that computers would enhance learning compared to the group of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school in all areas except the idea of using computers to reinforce concepts studied in class. In this area both groups agreed equally about the use of computers to reinforce learning. The differences between the two teacher groups were not statistically significant.

The standard deviation of 0.95 in the "I Would Plan to Use Computers More if I had More Access" category in the group of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school can be attributed to one subject's response of 2 on the 5-point Likert scale and one subject's response of 5 on the 5-point Likert scale. All the rest of the subjects responded in the 3-4 range.

Table 39. Mann-Whitney U Test Results of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Groups Based on Home Computer Use

Variable	Computer at Home 1 n	Mean Rank	Computer at Home 2 n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
How Teachers See the Use of Computers Enhancing Learning	11	10.91	8	8.75	34.00	0.41

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

As Table 39 shows, when compared by teacher use of a computer at home, the teachers who used a computer at home often or very often more strongly agreed that computers could be used to enhance student learning compared to the teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home. The cluster "How Teachers See the Use of Technology Enhancing Learning" revealed no statistically significant differences between the two groups. The differences between the mean ranks of 10.91 for the group of teachers who used a computer at home often or very often and 8.75 for the group of teachers who never used a computer at home, seldom used a computer at home or sometimes used a computer at home are similar.

Table 40. Mean Likert Scores of How Teachers See the Use of Computers Enhancing Student Learning in Two Teacher Groups Based on Home Computer Use

	Computer at Home 1			Computer at Home 2			
How Teachers See the Use of Computers Enhancing Learning	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Computers Would Enhance My Students' Math Skills	9	4.00	0	8	3.75	0.88	0.25
Computers Would Enhance My Students' Reading Skills	11	3.82	0.87	8	3.63	0.92	0.19
Computers Would Enhance My Students' Writing Skills	11	4.18	0.87	8	3.62	0.74	0.56
Computers Would Enhance My Students' Problem Solving Skills	10	3.70	0.68	8	3.88	0.99	0.18
I would Plan to use Computers More if I had More Access	10	4.30	0.68	8	3.50	0.93	0.80
Computers Should be Used to Reinforce Student Learning	10	4.10	0.88	8	4.25	0.71	0.15

Note. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes used a computer at home.

Further analysis of the data (Table 40) reveals that for each of the components of the "How Teachers See the Use of Technology Enhancing Learning" cluster, the differences between the two teacher age groups were between 0.15 and 0.80 on the five-point scale. The largest difference between the two groups was in the "I Would Plan to use Computers More if I had More Access" category. When breaking down how teachers saw the use of technology enhancing learning into individual components it was found that the group of teachers who used a computer at home often or very often more strongly agreed that computers would enhance math, reading and writing than the group of teachers that never used a computer at home, seldom used a computer at home or sometimes used a computer at home. The group of teachers that often or very often used a computer at home also more strongly agreed that if they had more access to computers they would plan to use them more. The group of teachers that never used a computer at home, seldom used a computer at home or sometimes use a computer at home more strongly agreed that computers would enhance their students' problem solving skills and that computers should be used to reinforce concepts studied in the class. The differences between the two groups were not statistically significant.

The standard deviation of 0.92 in the "Computers Would Enhance My Students' Reading Skills" category for the group of teachers that never used a computer at home, seldom used a computer at home or sometimes used a computer at home can be attributed to one subject's response of 2 on the five-point Likert scale and on subject's response of 5 on the five-point Likert scale. All other subjects responded in the 3-4 point range on the five-point Likert scale. The standard deviation of 0.99 in the "Computers Would Enhance My

Students' Problem Solving Skills" for the group of teachers that never used a computer at home, seldom used a computer at home or sometimes used a computer at home can be attributed to one subject's response of 4 on the five-point Likert scale, three subjects' responses of 5 on the five-point Likert scale and four subjects' response of 3 on the five-point Likert scale. The standard deviation of 0.93 in the "I Would Plan to use Computers More if I had More Access" category for the for the group of teachers that never used a computer at home, seldom used a computer at home or sometimes used a computer at home can be attributed to one subject's response of 2 on the five-point Likert scale and one subject's response of 5 on the five-point Likert scale. All of the other subjects responded in the 3-4 range on the five-point Likert scale.

Following interviews and focus group discussions I chose quotes of interest to the findings of Tables 31-40: Leslie stated that in order for teachers to use computers, they need to know what they can do: "We could have workshops to the show the possibilities of computer integration. The school would need to offer the classroom teachers support: a helper, a computer expert." Bonney saw the possibilities of computers in the area of Language Arts: "You could have the children write a story, pick a character, write dialogue and then make a movie acting in character. You would cover other areas of the curriculum as well, such as art when completing the background." Bonney continued, "They [computers] should be used as support for other subjects. I liked the comment about the stations as a way of supporting knowledge and skills in other areas. Computers should be a means to an end." Jackie felt that she would be able to use computers in all subject areas: "I would use it [a computer] for all assignments: projects, graphs,

research." Leslie saw the need for the classroom teacher and the computer teacher to work together: "The classroom teacher should design what they need for assignments and the computer teacher can teach the computer skills. The classroom teacher develops content criteria for the assignment. There needs to be collaboration between the computer teacher and the classroom teacher."

Preferred Location for Computers

The following four tables (Tables 41-44) describe the teachers' preference of location of computers. Table 41 and Table 42 look at the preference for computers in the classroom The preference for having computers in the classroom was compared to age; teaching experience; computer confidence of teacher; the amount of emphasis the school has placed on computers as perceived by the teacher; and the use of computers at home by the teacher.

As Table 41 shows the younger teachers more strongly agreed that the best place for computers is in the classroom. When compared by age (under or over 40), the question of whether or not the best place for computers was in the classroom revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 11.79 for the younger teacher group and 8.05 for the senior teacher group are substantial. Because the numbers of subjects are so small (7, 11), the findings might reflect a Type II Error, and the mean difference between the two teacher age groups may be real.

Table 41. Mann-Whitney U Test Results of Teacher Preference for the Location of Computers in the Classroom

	Group 1		Group 2			
Teacher Preference for the Location of Computers in the Classroom	n	Mean Rank	n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Age	7	11.79	11	8.05	22.50	0.15
Experience	7	12.50	11	7.59	17.50	0.05*
Confidence	7	11.14	10	7.50	20.00	0.13
Emphasis	11	11.23	7	6.79	19.50	0.07
Home Use	11	10.64	7	7.71	26.00	0.23

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

*p. $\leq$ 0.05

The less experienced teachers more strongly agreed that the best place for computers is in the classroom. When compared by years of teaching experience (0-10 years and 11+ years), the location of computers revealed statistically significant differences between the two groups. The differences between the mean ranks of 12.50 for the less experienced group of teachers and 7.59 for the more experienced group of teachers are substantial. Because the numbers of subjects are so small (7, 11) the findings might reflect a Type I Error.

The more confident teachers more strongly agreed that the best place for computers is in the classroom. When compared by confidence level, the placement of computers revealed no significant differences between the two groups. However, the differences between the mean ranks of 11.14 for the more confident teacher group and 7.50 for the less confident teacher group are substantial. Because the subjects are so small (7, 10) the findings may reflect a Type II Error, and the mean difference between the confidence groups may be real.

The teachers who feel that computers are underemphasized in the school more strongly agreed that the best place for computers is in the classroom. When compared by teacher perception of emphasis on computer use at school, the responses revealed no statistically significant differences between the two groups. The differences between the mean ranks of 11.23 for the teacher group who feel that computers are underemphasized at the school and 6.79 for the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized are substantial. Because the number of subjects

is so small (11, 7), the findings might reflect a Type II error and the difference between the two teacher groups may be real.

The teachers who use computers at home often or very often more strongly agreed that the best place for computers is in the classroom. When compared by teacher use of a computer at home, the responses revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 10.64 for the group of teachers who use a computer at home often or very often and 7.71 for the group of teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home are substantial. Because the number of subjects is so small (11, 7) the findings might reflect a Type II Error and the mean difference between the two groups may be real.

Further analysis of the data (Table 42) reveals that the difference between the two teacher groups was 0.53 and 0.87 on the five-point scale. The younger group of teachers more strongly agreed that the best place for computers is in the classroom compared to the senior group of teachers. The differences between the two groups were not statistically significant. The standard deviation of 1.03 for the senior group of teachers can be attributed to a wide range of responses for this question. Two subjects' responses were 2 on the five-point scale and two subjects' responses were 5 on the five-point scale. All of the other subjects' responses ranged from 3-4.

Table 42. Mean Likert Scores of Teacher Preference for the Location of Computers in the Classroom

	Group 1			Group 2			
Teacher Preference for the Location of Computers in the Classroom	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Age	7	4.00	0.58	11	3.36	1.03	0.64
Experience	7	4.14	0.69	11	3.27	0.91	0.87
Confidence	7	4.00	1.16	10	3.30	0.68	0.70
Perceived Emphasis	11	3.91	0.94	7	3.14	0.69	0.77
Home Use	11	3.82	0.98	7	3.29	0.76	0.53

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

The less experienced group of teachers more strongly agreed that computers should be placed in the classroom compared to the more experienced teachers. The differences between the two groups were statistically significant. The standard deviation of 0.91 for the more experienced group of teachers can be attributed to a wide range of responses for this question. The responses varied from two subjects' responses of 2 on the five-point scale and one subject's response of 5 on the five-point scale. All of the other subjects' responses ranged from 3-4.

The more confident group of teachers more strongly agreed compared to the less confident group of teachers that the best place for computers is in the classroom. The differences between the two groups were not statistically significant. The standard deviation of 1.16 for the more confident teacher group can be attributed to one subject's responses of 5 and one subject's response of 2 on the five-point scale. All of the other subjects' responses were in the 3-4 range.

The teachers who feel that computers are underemphasized at the school more strongly agreed that the best place for computers is in the classroom compared to the teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school. The differences between the two groups were not statistically significant. The standard deviation of 0.94 for the teacher group who feel that computers are underemphasized at the school can be attributed to one subject's response of 2 on the five-point scale and one subject's response of 5 on the five-point scale. All other subjects' responses ranged from 3-4.

The teachers who use a computer at home often or very often more strongly agreed that the best place for computers is in the classroom compared to the teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home. The differences between the two groups were not significant. The standard deviation of 0.98 for the more confident teacher group can be attributed to the range of subject responses from one subject's response of 2 one subject's response of 5. All other subjects' responses ranged from 3-4.

Following interviews and focus group discussions I chose quotes of interest to the findings of Tables 41 and 42.

Jackie likes the convenience of computers in the classroom: "I think that they should be in a classroom. They are more convenient. When you need one you can walk over right away, they are accessible immediately...the lab is isolated." Rhonda, an intermediate teacher with less than ten years experience and over 40 years of age, stated, "I prefer to teach my own computers. Computers in the classroom opens things up to more possibilities; they would lend themselves to a station approach." Paula, a teacher over 40 years of age, with over 10 years experience, believes that computers should be in the lab. "Computers should be in the lab. I would not make full use of them if they were in the class." Kendra, also an intermediate teacher with over 10 years experience, and over 40 years of age, saw the value of having computers in both the lab and the classroom. "The ideal would be if we could take the students to the lab to teach a concept to all of the students and then have them work on what was taught in the classroom." Leslie was

undecided about the optimal location of computers. "It depends how you use them. They should be in the lab if you are teaching the children how to use them. Time can be an issue since the lab is not always available. Computers in the classroom depend on numbers. You need to have four to five computers in a class. If you have the numbers they would work well using the station approach."

The following two tables (Tables 43 & 44) describe the teachers' preference for having computers in the computer lab. The preference for having computers in the computer lab was compared to age; teaching experience; computer confidence of teacher; the amount of emphasis the school has placed on computers as perceived by the teacher; and the use of computers at home by the teacher.

As Table 43 shows, the younger teachers more strongly agreed that the best place for computers is in the computer lab compared to the senior teachers. When compared by age (under or over 40), the question of whether or not the best place for computers was in the computer lab revealed no statistically significant differences between the two groups. The differences between the mean ranks were similar, 9.75 for the younger teacher group and 9.30 for the senior teacher group.

When compared by years of teaching experience (0-10 years and 11+ years), the more experienced teachers more strongly agreed that the best place for computers is in the computer lab compared to the less experienced teachers. The location of computers revealed no statistically significant differences between the two groups. The differences

between the mean ranks of 7.94 for the less experienced teacher group and 10.75 for the more experienced teacher group are substantial. Because the numbers of subjects are so small (7, 11) the findings might reflect a Type II Error and the differences between the two groups may be real.

When compared by confidence level, the less confident teachers more strongly agreed that the best place for computers is in the computer lab. The placement of computers in the computer lab revealed no significant differences between the two groups. However, the differences between the mean ranks of 7.93 for the more confident group of teachers and 9.75 for the less confident group of teachers are substantial. Because the subjects are so small (7, 10) the findings may reflect a Type II Error, and the mean difference between the two groups may be real.

When compared by teacher perception of emphasis on computer use at school, the teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized more strongly agreed the best place for computers is in the computer lab compared to the group who feel that computers are underemphasized at the school. The placement of computers in the computer lab, the responses revealed no statistically significant differences between the two groups. The differences between the mean ranks of 9.38 for the teacher group who feel that computers are underemphasized at the school and 9.75 for the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized are similar.

When compared by teacher use of a computer at home, the teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home more strongly agreed that the best place for computers is in the computer lab compared to the group that use a computer at home often or very often. The responses revealed no statistically significant differences between the two groups. The differences between the mean ranks of 9.18 for the group of teachers who used a computer often or very often at home and 10.00 for the group of teacher who never used a computer at home, seldom used a computer at home or sometimes used a computer at home are similar.

Further analysis of the data (Table 44) reveals that the difference between the two teacher groups was between 0.08 and 0.57 on the five-point Likert scale. The younger teacher group more strongly agreed that the best place for computers is in the computer lab than the senior group of teachers. The differences between the two groups are not statistically significant. The standard deviation of 0.93 in the younger group of teachers can be attributed to one subject's response of 1 on the five-point scale and one subject's response of 4 on the five-point scale. All the rest of the subjects' responses were in the 2-3 range. The standard deviation of 1.03 in the senior group of teachers can be attributed to a wide range of responses for this question. Two subjects' responses were 2 on the five-point scale and two subjects' responses were 5 on the five-point scale. All of the other subjects' responses were in the 3-4 range.

Table 43. Mann-Whitney U Test Results of Teacher Preference for the Location of Computers in the Computer Lab

	Group 1		Group 2			
Teacher Preference for the Location of Computers in the Computer Lab	n	Mean Rank	n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Age	8	9.75	10	9.30	38.00	0.85
Experience	8	7.94	11	10.75	27.50	0.25
Confidence	7	7.93	10	9.75	27.50	0.45
Emphasis	12	9.38	6	9.75	34.50	0.88
Home Use	11	9.18	7	10.00	35.00	0.74

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Table 44. Mean Likert Scores of Teacher Preference for the Location of Computers in the Computer Lab

	Group 1			Group 2			
Teacher Preference for the Location of Computers in the Computer Lab	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Age	8	2.50	0.93	10	2.40	1.17	0.10
Experience	8	2.13	0.84	10	2.70	1.16	0.57
Confidence	7	2.29	1.38	10	2.70	0.68	0.41
Perceived Emphasis	12	2.42	1.08	6	2.50	1.05	0.08
Home Use	11	2.36	1.20	7	2.57	0.79	0.21

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 teachers feel that computers are underemphasized at the school. Emphasis 2 teachers feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

The more experienced group of teachers more strongly agreed that computers should be placed in the classroom than the less experienced group of teachers. The differences between the two groups are not statistically significant. The standard deviation of 1.16 for the more experienced group of teachers can be attributed to a wide range of responses for this category. Two subjects' responses were 1 on the five-point Likert scale, three subjects' responses were 2 on the five-point Likert scale and three subjects' responses were 3 on the five-point Likert scale.

The less confident group of teachers believe more strongly that the best place for computers is in the computer lab. The differences between the two groups are not statistically significant. The standard deviation of 1.38 for the more confident group of teachers can be attributed to three subjects' responses of 1 on the five-point Likert scale, one subjects' response of 2 on the five-point Likert scale, one subjects' response of 3 on the five-point Likert scale and two subjects' responses of 4 on the five-point Likert scale.

The teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school more strongly agreed that the best place for computers was in the classroom compared to the group of teachers who feel that computers are underemphasized at the school. The differences between the two groups are not statistically significant. The standard deviation of 1.08 for the teachers who feel that computers are underemphasized at the school can be attributed to three subjects' responses of 1 on the five-point Likert scale, three subjects' responses of 2 on the five-point Likert scale, four subjects' responses of 3 on the five-point Likert scale and two

subjects' responses of 4 on the five-point Likert scale. The standard deviation of 1.05 for the teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school can be attributed to one subjects' response of 1 on the five-point Likert scale, two subjects' responses of 2 on the five-point Likert scale, two subjects' responses of 3 on the five-point Likert scale and one subject's response of 4 on the five-point Likert scale.

The group of teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home more strongly agreed that that computers should be placed in the computer lab compared to the group of teachers who use a computer at home often or very often. The differences between the two groups are not statistically significant. The standard deviation of 1.20 for the group of teachers who often or very often use a computer at home can be attributed to four subjects' responses of 1 on the five-point scale, one subject's response of 2 on the five-point scale, four subjects' responses of 3 on the five-point scale and two subjects' responses of four on the five-point scale.

As illustrated in Tables 42 and 44, the ratings for preference for having computers in the classroom, for both groups, (age, experience, confidence, perceived emphasis and computer use at home) were between 3.14 and 4.14. The ratings for preference for a having computers in the computer lab, for both groups, were between 2.13 and 2.70.

The following is a quote of interest from the interviews and focus group discussions relating to Tables 43 and 44:

Paula felt that computers would be most effective in a computer lab. "We would not use them to the fullest if they were in the class. There is not enough time in the day. There are specific skills that need to be taught, you need someone there [with the children]."

Teacher Preferred Operating Platform

The following four tables (Table 45-48) describe the teachers' preference of operating platforms. Tables 45 and 46 describe the teachers' preference for PC (Windows) operating platform and Tables 47 and 48 describe the teachers' preference for Mac operating platform.

As shown in Table 45, when compared by age the younger teachers more strongly agreed student learning would be best served using PC computers compared to the senior teachers. When compared by age there were no statistically significant differences between the two groups. The differences between the mean ranks of 9.56 for the younger group of teachers and 8.50 for the senior group of teachers are not substantial. Because the number of subjects is so small (8, 11), the findings might reflect a Type II Error, and the mean difference between the two teacher age groups may be real.

Table 45. Mann-Whitney U Test Results of Teacher Preference for PC Operating Platform

	Group 1		Group 2			
Teacher Preference for PC Operating Platform	n	Mean Rank	n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Age	8	9.56	9	8.50	31.50	0.65
Experience	8	10.50	9	7.67	24.00	0.23
Confidence	7	8.64	9	8.39	30.50	0.91
Emphasis	11	9.23	6	8.59	30.50	0.79
Home Use	10	9.90	7	7.71	26.60	0.36

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

When compared by years of teaching experience, the less experienced teachers (<10 years) more strongly agreed student learning would be best served using PC computers compared to the more experienced teachers (>10 years). When compared by years of teaching experience, the preference of computer operating platform revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 10.50 and 7.67 are substantial. Because the numbers of subjects are so small (8, 9) the findings might reflect a Type II error and the differences between the two groups may be real.

When compared by confidence level, the more confident group of teacher more strongly agreed student learning would be best served using PC computers compared to the less confident teachers. The preference of the type of operating platform revealed no statistically significant differences between the two groups The differences between the mean ranks of 8.64 for the more confident teacher group and 8.39 for the less confident group are similar.

When compared by teacher perception of emphasis of computer use at school, the teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school more strongly agreed student learning would be best served using PC computers compared to the teachers who feel that computers are underemphasized at the school. The preference of the type of operating platform revealed no statistically significant differences between the two groups. The differences between

the mean ranks of 9.23 for the teacher group who feel that computers are underemphasized at the school and 8.59 for the group of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school are similar.

When compared by teacher use of a computer at home, the teachers who use a computer at home often or very often more strongly agreed student learning would be best served using PC computers compared to the group that never use a computer at home, seldom use a computer at home or never use a computer at home. When compared by teacher use of a computer at home, the preference of the type of operating platform revealed no statistically significant differences between the two groups. However, the differences between the mean ranks of 9.90 for the teachers who use a computer at home often or very often and 7.71 for the teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home are significant. Because the numbers of subjects are small (10, 7) the findings might reflect a Type II Error, and the mean differences between the two teacher groups may be real.

Further analysis of the data (Table 46) reveals that the difference between the two teacher groups was between 0.10 and 0.77 on the five-point Likert scale. The difference between the two teacher age groups was 0.30 on the five-point Likert scale, which was not statistically significant.

Table 46. Mean Likert Scores of Teacher Preference for PC Operating Platform

	Group 1			Group 2			
Teacher Preference for PC Operating Platform	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Age	8	3.63	1.30	9	3.33	1.12	0.30
Experience	8	3.88	1.36	9	3.11	0.93	0.77
Confidence	7	3.43	1.27	9	3.33	1.12	0.10
Perceived Emphasis	11	3.55	1.30	6	3.33	1.03	0.22
Home Use	10	3.70	1.25	7	3.14	1.07	0.56

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

The younger group of teachers more strongly agreed that student learning would be best served using PC computers compared to the senior group of teachers. The standard deviation of 1.30 for the younger teachers can be attributed to three subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, two subjects' response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point Likert scale. The standard deviation of 1.12 for the senior teachers can be attributed to two subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, four subjects' response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point Likert scale.

The difference between the two teacher experience groups was 0.77 on the five-point Likert scale. The less experienced teacher group more strongly agreed that student learning would be best served using PC computers compared to the more experienced teacher group. The difference between the two groups was not statistically significant. The standard deviation of 1.36 for the less experienced teacher can be attributed to four subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, one subject's response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point Likert scale. The standard deviation of 0.93 for the more experienced teachers can be attributed to one subject's response of 5 on the five-point scale, one subject's response of 4 on the five-point Likert scale, five subjects' response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point scale.

The difference between the two teacher confidence groups was 0.10 on the five-point Likert scale. The more confident teacher group more strongly agreed that student learning would be best served using PC computers compared to the less confident teacher group. The difference between the two groups was not statistically significant. The standard deviation of 1.27 for the more confident teachers can be attributed to two subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, two subjects' response of 3 on the five-point Likert scale, and two subjects' response of 2 on the five-point Likert scale. The standard deviation of 1.12 for the less confident teachers can be attributed to two subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, four subjects' response of 3 on the five-point scale, and two subjects' response of 2 on the five-point scale.

The difference between the two perceived emphasis teacher groups is 0.22 on the five-point Likert scale. The teacher group who feel that computers are underemphasized at the school more strongly agreed that student learning would be best served using PC computers compared to the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school. The differences between the two groups were not statistically significant. The standard deviation of 1.30 for the teacher group who feel computers are underemphasized at the school can be attributed to four subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, three subjects' response of 3 on the five-point Likert scale, and three subjects' response of 2 on the five-point Likert scale. The standard deviation of 1.03 for the teacher group feel that computers are highly overemphasized,

overemphasized or correctly emphasized at the school can be attributed to one subjects' response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, three subjects' response of 3 on the five-point Likert scale, and one subject's response of 2 on the five-point Likert scale.

The difference between the two teacher groups based on use of a computer at home was 0.56 on the five-point Likert scale, which was not statistically significant. The teacher group who use a computer at home often or very often more strongly agreed that student learning would be best served using PC computers compared to the teacher group who never use a computer at home, seldom use a computer at home or sometimes use a computer at home. The standard deviation of 1.25 for the teacher group who use a computer at home often or very often can be attributed to four subjects' responses of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, three subjects' response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point Likert scale. The standard deviation of 1.07 for the teacher group who never use a computer at home, seldom use a computer at home or sometimes use a computer at home be attributed to one subjects' response of 5, one subject's response of 4, three subjects' response of 3, and two subjects' response of 2 on the five-point Likert scale.

In the focus groups one of the teachers provided a rational for preferring a PC operating platform: Kendra noted, "If we go to PC's they [the computers] will be compatible with home use."

Table 47. Mann-Whitney U Test Results of Teacher Preference for Mac Operating Platform

	Group 1		Group 2			
Teacher Preference for Mac Operating Platform	n	Mean Rank	n	Mean Rank	Mann-Whitney U	Asymp. Sig. (p. value)
Age	8	8.56	9	9.39	32.50	0.73
Experience	8	7.56	9	10.28	24.50	0.25
Confidence	7	8.71	9	8.33	30.00	0.87
Emphasis	11	8.86	6	9.25	31.50	0.88
Home Use	10	8.65	7	9.50	31.50	0.73

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

As Table 47 shows, the senior teachers more strongly agreed that they preferred their students' work on a Mac computer operating platform compared to the younger teachers. When compared by age, the data revealed no statistically significant differences between the two groups. The differences between the mean ranks of 8.56 for the younger teacher group and 9.39 for the senior teacher group are similar, and so it seems unlikely that the results can be attributed to a Type II error.

When compared by years of teaching experience, the more experienced teachers more strongly agreed that that they preferred that their students work on a Mac computer operating platform compared to the less experienced teachers. The preference for the type of operating platform revealed no statistically significant differences between the two groups. The differences between the mean ranks of 7.56 for the less experienced group of teachers and 10.28 for the more experienced group are substantial. Because the numbers of subjects are so small (8, 9) the findings might reflect a Type II error and the differences between the two groups may be real.

When compared by level of confidence, the more confident teachers more strongly agreed that they preferred that their students work on a Mac computer operating platform compared to the less confident group. The preference for the type of operating platform revealed no significant differences between the two groups. The mean ranks of 8.71 for the more confident teacher group and 8.33 for the less confident teacher group are similar, and so it seems unlikely that the results can be attributed to a Type II error.

When compared by teacher perception of emphasis of computer use at school, the teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school more strongly agreed that they preferred that their students work on a Mac computer operating platform compared to the group that feel that computers are underemphasized at the school. The preference for the type of operating platform revealed no significant differences between the two groups. The differences between the mean ranks of 8.86 for the teacher group who feel computers are underemphasized at the school and 9.25 for the teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school are similar, and so it seems unlikely that the results can be attributed to a Type II error.

When compared by frequent or infrequent teacher use of a computer at home, the teachers who never use a computer at home, seldom use a computer at home or sometimes use a computer at home more strongly agreed that they preferred that their students work on a Mac computer operating platform compared to the teachers who use a computer at home often or very often. The preference for the type of operating platform revealed no significant differences between the two groups. The mean ranks of 8.65 for the teacher group who use a computer at home often or very often and 9.50 for the teacher group who never use a computer at home, seldom use a computer at home or sometimes use a computer at home are similar, and so it seems unlikely that the results can be attributed to a Type II error.

Table 48. Mean Likert Scores of Teacher Preference for PC Operating Platform

	Group 1			Group 2			
Teacher Preference for Mac Operating Platform	n	$\bar{x}$	SD	n	$\bar{x}$	SD	Dif. in $\bar{x}$
Age	8	2.63	1.30	9	2.89	1.17	0.26
Experience	8	2.38	1.41	9	3.11	0.93	0.73
Confidence	7	2.86	1.57	9	2.78	0.97	0.08
Perceived Emphasis	11	2.73	1.42	6	2.83	0.75	0.10
Home Use	10	2.70	1.34	7	2.86	1.07	0.16

Note. The Age 1 group is made up of teachers under 40 years of age. The Age 2 group is made up of teachers over 40 years of age. The Experience 1 group is made up of teachers with 0-10 years of teaching experience. The Experience 2 group is made up of teachers with 11+ years of teaching experience. Confidence 1 teachers believe that they are using computers in many applications and as an instructional aid; or are able to integrate them into the classroom. Confidence 2 teachers believe that they are aware of computers, but have not used them; or they lack confidence using computers; or they are beginning to understand the process of using computers and can think of specific tasks in which they may be useful; or they are beginning to gain a sense of confidence in using the computer for specific tasks and are starting to feel comfortable using the computer. Emphasis 1 group is made up of teachers who feel that computers are underemphasized at the school. Emphasis 2 group is made up of teachers who feel that computers are highly overemphasized, overemphasized or correctly emphasized. Computer at Home 1 teachers use a computer at home often or very often. Computer at Home 2 teachers never use a computer at home, seldom use a computer at home or sometimes use a computer at home.

Further analysis of the data (Table 48) that the difference between the two teacher groups was between 0.08 and 0.73 on the five-point Likert scale. The difference between the two

teacher age groups is 0.26. The senior teacher group more strongly agreed that student learning would be best served using Mac computers compared to the younger teacher group but the differences were small and not statistically significant. The standard deviation of 1.30 for the younger teacher group can be attributed three subjects' response of 4 on the five-point Likert scale, one subject's response of 3 on the five-point Likert scale two subjects' response of 2 on the five-point Likert scale and two subjects' response of 1 on the five-point Likert scale. The standard deviation of 1.17 for the senior teacher group can be attributed to one subject's response of 5 on the five-point Likert scale, one subject's response of 4 on the five-point Likert scale, four subjects' response of 3 on the five-point Likert scale, two subjects' response of 2 on the five-point Likert scale and one subject's response of 1 on the five-point Likert scale.

The difference between the two teacher experience groups was 0.73 on the five-point Likert scale. The more experienced teacher group more strongly agreed that student learning would be best served using Mac computers compared to the less experienced teacher group, these differences were not statistically significant. The standard deviation of 1.41 for the less experienced teacher group can be attributed to three subjects' response of 4 on the five-point Likert scale, two subjects' response of 2 on the five-point Likert scale and three subjects' response of 1 on the five-point Likert scale. The standard deviation of 0.93 for the more experienced teacher group can be attributed to one subject's response of 5 on the five-point scale, one subject's response of 4 on the five-point Likert scale, five subjects' response of 3 on the five-point Likert scale and two subjects' response of 2 on the five-point scale.

The difference between the two teacher computer confidence level groups was 0.08 on the five-point Likert scale. The more confident teacher group more strongly agreed that student learning would be best served using Mac computers than the less confident teacher group, the differences were very small and not statistically significant. The standard deviation of 1.57 for the more confident group can be attributed to one subject's response of 5 on the five-point Likert scale, three subjects' response of 4 on the five-point Likert scale, two subjects' response of 3 on the five-point Likert scale and one subject's response of 1 on the five-point Likert scale. The standard deviation of 0.97 for the less confident teacher group can be attributed to two subjects' response of 4 on the five-point Likert scale, four subjects' response of 3 on the five-point scale, two subjects' response of 2 on the five-point scale and one subject's response of 1 on the five-point scale.

The differences between the two teacher perceived emphasis groups was 0.10 on the five-point Likert scale. The teacher group who feel that computers are highly overemphasized, overemphasized or correctly emphasized at the school more strongly agreed that student learning would be best served using Mac computers compared to the teacher group who feel that computers are underemphasized at the school, the differences are not statistically significant. The standard deviation of 1.42 for the teacher group who feel that computers are underemphasized at the school can be attributed to one subject's response of 5 on the five-point Likert scale, three subjects' response of 4 on the five-point Likert scale, two subject's response of 3 on the five-point Likert scale, one subject's response of 2 on the five-point Likert scale, and three subjects' response of 1 on the five-point Likert scale.

The difference between the two teacher groups was 0.16 on the five-point Likert scale. The teacher group who never use a computer at home, seldom use a computer at home or sometimes use a computer at home more strongly agreed that student learning would be best served using Mac computers compared to the teacher group who often or very often use a computer at home. The standard deviation of 1.34 for the teacher group who often or very often use a computer at home can be attributed to one subject's responses of 5 on the five-point Likert scale, two subjects' response of 4 on the five-point Likert scale, two subjects' response of 3 on the five-point Likert scale, three subjects' response of 2 on the five-point Likert scale and two subjects' response of 1 on the five-point Likert scale. The standard deviation of 1.07 for the teacher group who never use a computer at home, seldom use a computer at home or sometimes use a computer at home can be attributed to two subjects' response of 4 on the five-point Likert scale, two subjects' response of 3 on the five-point Likert scale, two subjects' response of 2 on the five-point Likert scale and one subject's response of 1 on the five-point Likert scale.

As illustrated in Tables 46 and 48, the ratings for preference for a PC operating platform for both groups were between 3.11 and 3.88, the ratings for preference for a Mac computer operating platform for both groups (age, experience, confidence, perceived emphasis and computer use at home) were between 2.38 and 3.11.

Following interviews and focus group discussions I chose interesting quotes related to Tables 47 and 48.

Bonney liked the video applications offered by the Macs. "I would love to have Macs because of the artistic applications. You are able to do video, I-Movie is great."

Leslie was undecided. "The limited memory of the Macs is frustrating, and you can't take home work if you have a PC. However, the one unit, and the simple set up of the Mac is nice, and they are user friendly. Windows may make PC's easier to use. The programs are better and more available. The programs are also quite cheap in the stores. At first it is more difficult to save but you can learn. There are more steps on a PC and this makes it easier to lose information."

Summary

Although most of these differences did not reach statistical significance, the younger teacher group more strongly agreed that computer skills should be taught, had a more positive attitude towards computers, were more open to the possibilities of how computers could enhance student learning ($p. \leq 0.05$), more strongly agreed that computers should be placed in the classroom, and felt more strongly that a PC operating platform would be most beneficial for the students. However, the senior teacher age group is currently using computers more that the younger teacher age group.

The less experienced teachers more strongly agreed that computer skills should be taught to the students, had a more positive attitude towards computers, more strongly agreed that computers were being used in their classes to enhance learning, were more open to the possibilities of how computers could enhance student learning ($p. \leq 0.05$), more strongly

agreed that the best place for computers was in the classroom and felt more strongly that a PC operating platform would be most beneficial for the students. Again, however, most of these differences were not statistically significant.

Although most of these differences did not reach statistical significance, the teachers with the greater degree of confidence towards computers more strongly agreed that computer skills should be taught, expressed a more positive attitude towards computers, were using computers more to enhance student learning ($p. \leq 0.05$), were more open to the possibilities of how computers could enhance student learning, more strongly agreed that the best place for computers was in the classroom, and felt more strongly that a PC operating platform would be most beneficial for the students.

Teachers who felt that computers were underemphasized in the school more strongly agreed that computer skills should be taught ($p. \leq 0.05$), expressed a more positive attitude towards computers, more strongly agreed that they were using computers to enhance student learning, were more open to the possibilities of how computers could enhance student learning ($p. \leq 0.05$), more strongly agreed that the best place for computers is in the classroom, and felt more strongly that a PC operating platform would be most beneficial for the students.

Teachers with greater computer use at home more strongly agreed that computer skills should be taught, expressed a more positive attitude towards computers, were currently using computers more to enhance student learning, were more open to the possibilities of

how computers could enhance student learning, more strongly agreed that the best place for computers is in the classroom, and felt more strongly that a PC operating platform would be most beneficial for the students. None of these findings were statistically significant.

Following the first focus group, it was agreed upon by the staff and administration that computers would be best served in the classroom to optimize the learning environment for the students. A written plan was developed after the second focus group, which outlined a three-year plan to integrate wireless internet-connected computers into each classroom (see Appendix I for a copy of the plan).

CHAPTER V

DISCUSSION

The purpose of this study was to examine the factors that affect the integration of computer technology into the curriculum, from the perspective of the teacher, at an elementary school, and to develop methods to facilitate the integration of computers into the elementary curriculum. Following a review of the findings from the study a plan was devised and implemented in order to ensure that computer technology was being used to improve the learning opportunities of the students. A review of literature and research was undertaken to ensure that the study was being completed using a framework that included current practices and theory.

Summary

In order to identify factors affecting the integration of computers into the curriculum, from a teacher perspective, information was gathered from participants using questionnaires, in-depth interviews and focus group discussions. The results of the study indicate that a number of factors affect the integration of computers into the curriculum. Age of the teacher, years experience of the teacher, the level of confidence in the teacher using a computer, the teachers' perceived emphasis of computer use in the school all played a significant role in how children are using computers at school and how computers are being integrated into the curriculum. While not statistically significant, how much teachers used a computer at home did affect how children are using computers at school and how computers are being integrated into the curriculum.

Overview of Significant Findings

Teachers who expressed confidence when using computers reported that they are using computers in many applications and as an instructional aid, or are able to integrate them into the classroom. The teachers who were not as confident were grouped into a category where they reported an awareness of computers, but did not use them; or they lacked confidence using computers; or they were beginning to understand the process of using computers and could think of specific tasks in which they may be useful; or they were beginning to gain a sense of confidence in using the computer for specific tasks and were starting to feel comfortable using the computer. The teachers who reported being confident using computers themselves had their students complete more assignments on computers, more often planned the integration of computers into their units, and used computers to individualize learning more than the teachers who were not as confident. Teachers who reported a higher level of computer confidence were able to see the possibilities available to the students by using computers. This finding is supported by various researchers. Rogers (2000) notes "...as teachers become more familiar with technology...their focus on barriers [to adopting emerging technologies] decreases" (p. 465). Henry (as cited in Hardy, 1998) concluded "once a teacher acquired knowledge of technology, either formally or self-initiated, that technology was more likely to be implemented (p. 120). Hardy (1998) recommends administrators "...promote classroom use of computers by nurturing teachers' confidence and computer self-efficacy with on-going technology inservice and staff development" (p. 133).

Younger teachers (under the age of 40) believed that computers would enhance their students' academic skills, and would have their students use computers more often if they had greater access to computers. Computer technology has developed rapidly and younger teachers would have had more access to computers as students in school and in their teacher training programs. I was unable to find literature of experimental studies related to age of teachers and the integration of computers. However, Glenman and Melmed hypothesize:

> ...over the coming decade a significant number of newly trained teachers will enter the nation's schools [USA]. The training of these new teachers should impart skills and attitudes that will allow these teachers to function effectively in technology-enabled environments...a number of experiments by schools of education using technology. (Glenman & Melmed, 2000, pp. 68-69)

As with younger teachers, this study revealed that less experienced teachers (10 years of teaching experience or less) believed that computers would enhance their students' academic skills and would have their students use computers more often if they had greater access to computers. This finding, however, is in conflict with McGee (2000) who found "...the literature about beginning teachers reveals that most new teachers are concerned about managing their classrooms and tend to see computer integration as ancillary" (p. 198). Generally, less experienced teachers would also fit into the younger teacher group. This group of teachers would have had a higher level of exposure to computers in their own personal education than their more experienced counterparts.

The less experienced group of teachers (10 years of teaching experience or less) also felt that the best place for computers was in the classroom, as opposed to a laboratory. Perhaps, because of personal experience with computers in their own education, the less experienced teachers expressed a preference for computers in the classroom because they are more aware of the possibilities using computer technology. By having computers in the classroom the teacher is able to use the computer on an as-needed basis. Denise and Sam (pseudonyms for teachers in the less experienced group) both agreed that computers in the classroom would lend themselves to a stations or centers approach. On the other hand, Paula an experienced teacher stated, "They should be in the lab. I would not make full use of them if they were in the class...you need someone there all the time." The more experienced teachers at the school are also familiar with the computer lab used at the school. This may be a reason why the more experienced teachers preferred to have computers in the computer lab.

Teachers who felt that computers were underemphasized at the school believed that computers would enhance their students' academic skills, would have their students use computers more often if they had greater access to computers, and believed that the best place for computers was in the classroom. These teachers preferred to have computers in their classroom because they could ensure that their students were using them. The teachers who felt that computers were underemphasized were the teachers who had a positive view of computers and felt comfortable using them. They also believed that the students should be taught a variety of computer skills and were able to see the possible opportunities presented by computer technology. Jackie believes that more access to

computers would allow the teachers to realize the potential of the technology. "Computers should be in the classroom. When you need one you can walk over right away; they are accessible immediately." However, she did note some frustration over the limited number of computers in her classroom. "Because we don't have many computers it is difficult."

Overview of Non-Significant Findings (p. ≤ 0.10)

The following findings were not statistically significant but had a p. value of ≤ 0.10 (the small sample size may cause a Type II error): Younger teachers (less than 40 years of age) displayed a more positive attitude towards computers. Although not statistically significant, the data suggest younger teachers felt that computers would improve teacher performance, improve student work, motivate students and with guidance they were more open to using them. Perhaps younger teachers have more experience with the use of computers in their own education compared to than the older teachers. Older teachers claimed that they value teaching with computers more. This point is of interest since generally younger teachers appeared to be using computers more and one would assume that they also would value teaching with computers more than the older teachers. Perhaps the younger teachers take computers for granted somewhat.

Less experienced teachers (10 years or less of teaching experience) displayed a more positive attitude towards computers. Although not statistically significant, the data suggest the less experienced teachers believe that computers would improve teacher performance, improve student work, and with guidance were more open to using

computers. Less experienced teachers were more open to the possibilities that computers presented them as teachers and learning opportunities for the students in their charge. Bonney, a teacher with less than 10 years experience, saw the benefits of integrating computers into the classroom would be "Integrating computers into the classroom would be fantastic. The kids already have computer skills and we would be able to build on these skills. Kids would be excited about school. We would be addressing a variety of learning skills." More experienced teachers reported that they valued teaching with computers more. While less experienced teachers saw the potential of computers, more experienced teachers saw the value of computers but did not fully understand how to use them in an educational setting. The challenge is taking the high value that more experienced teachers place on computers and getting them to use them in their teaching more frequently and effectively. Paula, a teacher with more than ten years experience felt that her lack of familiarity with computers was a factor when it came to using computers. "If I was more familiar with computers I might do more."

Findings of Interest (p. > 0.10)

The following findings were of interest but not statistically significant with p. value > 0.10 (the small sample size may have caused a Type II Error): There is no significant difference between the senior and young teachers when it comes to who is using the computer more often to enhance learning. Although not statistically significant, the data suggest students of the older teacher group are completing more assignments on the computer and the older teacher group is also planning to integrate computers more often. Due to their familiarity of the curriculum, the older teacher group has a better

understanding of what needs to be taught and therefore may have a greater understanding of what could be integrated using computer technology. These teachers may then be able to present the students with more opportunities to complete assignments on the computer. However, this is an area that requires more research to measure the effectiveness of using computers in education. Clifford and Friesen (2001) observed:

> Teachers thought about applications and software in the same way they thought about worksheets, textbooks, tests and course delivery. It has been difficult for most of us to understand that while computers can do the old and familiar things at the speed of light, they *shouldn't* be used that way. There are far better things to do with information and communication technologies. (p. 33)

Although not statistically significant, the data suggest the younger teacher group is using computers to individualize learning more often. This would indicate that the younger teacher group is able to adapt the computer technology to the needs of the individual student and is therefore using the computer to help the child learn. Smeets and Mooij (2001) concluded:

> ICT can contribute to innovative, pupil-centred learning environments that stimulate active learning, discovery learning, and higher-order thinking skills. This is accomplished by adapting lesson content and learning activities to the needs and skills of individual pupils, by facilitating cooperation, and by providing rich contexts and tasks are as authentic as possible. (pp. 414-415)

Bonney, a teacher under 40 years of age stated, "computers would allow the children to explore a variety of ways to represent an idea."

There is no significant difference between experienced and inexperienced teachers when it comes to who is using the computer more to enhance student learning. Although not significant, the data suggest students of the more experienced teacher group are completing more assignments on the computer. Teachers who are comfortable with the curriculum are able to allow their students to complete tasks on the computer. It appears as if this is to complete word processing tasks. Although not statistically significant, the data suggest less experienced teachers plan to integrate computer technology more often and more frequently use computers to individualize learning. The less experienced group of teachers is more open to the possibilities of the computer in each child's learning experience. Dennis, a teacher with two years' experience, saw the potential of using computers. "Computers in the classroom opens things up to more possibilities."

Perceived emphasis of computers in the school by the teacher did not have a bearing on how they were being used in the classroom. Although not statistically significant, the data suggest teachers who felt that computers were highly overemphasized, overemphasized or correctly emphasized were planning to integrate computers more than teachers who felt that computers were underemphasized. Although not statistically significant, the data suggest students of teachers who felt that computers were underemphasized completed

more assignments on the computer and had more of their learning individualized with the computer.

Integrating Computers into Our School

Following the presentation of the preliminary questionnaire and interview results to the education committee (Appendix G) it was decided that funding would be provided for the purchase of 24 new PC computers. The existing computer lab (of MacIntosh computers) would remain intact. The new computers would be placed in six classrooms using a pilot study approach. Teachers volunteered to begin the first year of the pilot study by accepting four computers (with wireless Internet connection) in their classrooms, with the goal to integrate computer technology into the curriculum. Following a discussion (second focus group; for important points raised in focus group see Epilogue) of what support would be required to ensure successful integration of computers, a staff development model was created that would provide the teachers with initial training so they would feel comfortable using the computers in the classroom and also provide continued support for the teachers as the school year progressed. Teachers volunteered to have computers in their classroom with the understanding that their students would no longer receive computer instruction from the computer teacher in the computer lab. Instead the computer teacher would come to those classrooms to provide support for the teachers and students as they completed tasks on computers related to the curriculum. It was also discussed that part of the computer teacher's job would be to work with the teachers during prep time to ensure that they were confident integrating computer technology. In years two and three of the plan, teachers who had been using computers in

their classrooms would then mentor the teachers who did not receive the computers the first year of the plan. Dexter et al. (2002) findings supported this model:

> When technology support is designed with the instructional needs of teachers in mind—such as creating classroom-convenient access to necessary resources, providing teachers with one-on-one support, teaching them about integrating educational technology, and encouraging professional collaboration—the effects on teachers' uses are pronounced. Quality technology support is associated with teachers' increased uses of technology, correlating with greater frequency and variety of uses as well as increased use over time. (p. 279)

Implications for Further Research

This study has a number of implications for future research. Based on the research and the data collected PC computers have been purchased and are being moved into the classrooms at the school studied using a three year mentor-based integration plan. Clifford and Friesen (2001) theorized that having computers in the classroom would allow the students to use computer technology at the moment they needed to instead of "a teacher bringing an entire class down at the same time every week to do something with computers" (p. 36). Whitehead (1993) described how his school moved computers out of the lab and into the classrooms. At his school, the majority of teachers expressed a desire to have computers in the classrooms. However, there is not a great deal of data to support the theory that children do indeed learn better with computers in the classroom. A study to investigate the improvement in children's academic achievement could reveal the

benefit of computers in the classroom. A follow up on the teachers to see if they are using computer technology more often and how they are using computer technology now that the computers are in their classroom would also be beneficial.

The more experienced teacher group reported that they valued teaching with computers but in practice they were not using computers in their teaching regularly. Hardy (1998) concluded that teachers' concerns about using computer technology are:

- lack of hardware and software (availability and quality)
- not having enough time for computer activities in the classroom,
- how to effectively integrate computers into the curriculum, and
- lack of adequate training to build their confidence and computer skills to use computer technology effectively. (p. 131)

This may address the question of why this group of teachers is not using computers more when they do place a high value on computers in education. However, the question of why they are not using them when they do place a high value on computers does need to be investigated.

Recommendations for Educators

"One of the major concerns about using technology in education is teacher training, specifically, moving teachers away from using computers for drill-and-practice toward a more integrated approach" (Dias, 1999, p. 11). Often teachers taught how they were

taught. Hardy (1998) concludes teachers "feel ill-prepared to use these tools in the instructional setting. At times, when faced with a technologically rich classroom, many teachers feel intense conflict and frustration with new approaches required to use the technology, which can be very different from their understanding of pedagogy and learning" (p. 130). "Teachers are bombarded with the notion that computers should be an integral part of their classroom activities" (Dias, 1999, p. 11).

The first step toward successful integration is to help teachers understand the importance of computers in today's classroom. This can be done by allowing teachers time to review current research, and by encouraging teachers to visit classrooms where computers are being used. Dias (1999) suggests that one of the barriers to integration of computers is lack of time to collaborate with the other teachers. Dufour (1998) theorizes "People who engage in collaborative team learning are able to learn from one another, thus creating momentum..." (p. 27). It would therefore be beneficial to schedule meetings to enable the teachers to discuss questions and issues that arose while reading computer literature and visiting the technology-rich classroom(s). Furthermore, teachers can brainstorm all of the ways that they could integrate computers into the classroom.

Development of computer confidence is key in this area as well. Hardy (1998) stressed the importance of helping teachers "to build their confidence with computers, and to prepare them to use computers as instructional tools in their teaching" (p. 131). Mentoring programs for the teachers can be used to provide training and to increase computer confidence. Hadley & Shiengold found that "onsite support and colleagueship

are critical ingredients to successful technology use" (p. 299). Gilmore (1995) states that, "School-based training... allowed teachers to work with colleagues whom they knew, on equipment with which they wanted to become familiar, and with software actually available to them in the school. It was described as professional development over which teachers had a considerable amount of control." (p. 254)

While not statistically significant, the study revealed an association between frequent computer use at home and how teachers are using computers in the classroom. Perhaps providing teachers with a laptop computer with classroom software for home and school use would increase their own computer skill level and thus computer confidence. Ross, Hogaboam-Gray and Hannay (1999) found positive relationships among more access to information technology, greater opportunities for successful teaching experience, and computer confidence.

Fabry and Higgs (1997) identify cost as one of the factors affecting the integration of computers into the classroom. Budget considerations must always be made when evaluating a program or looking at new programs. Following the completion of our study we examined what needed to be done to enhance the learning opportunities of the students. From there we calculated the estimated cost of completing the project. A Power Point Presentation was constructed to review:

- current literature that found integrating computers into the curriculum improved the learning opportunities of the students
- the results of the study

- the finding that PC computers in each classroom would best meet the needs of the students
- the estimated cost of purchasing wireless internet-connected PC computers for each classroom (using a 3 year plan).

Following the presentation, the Parish Education Committee made it a priority to allocate money towards the project. Rogers (2000) suggests that is important to, "consider the needs of the institution in terms of teaching and learning *first*, then determine what technologies can support these educational goals" (p. 470).

Conclusion

"To understand how to achieve integration, we need to study teachers and what makes them use computers, and we need to study computers and what makes teachers want to—or need to—use them" (Marcinkiewicz, 1993-1994, p. 234). From my study, it was found that the following statistically significant factors affect the integration of computers into the elementary curriculum at the school studied: age of the teacher, years experience of the teacher, the level of confidence in the teacher using a computer, and the teachers' perceived emphasis of computer use in the school. Though not statistically significant, how teachers used computers at home also affected the integration of computers.

Following the questionnaires, interviews and focus group discussions, the administration concluded that in order for the learning opportunities of the students to be maximized and to integrate computers effectively into the curriculum, computers would be best served in

the classroom, opposed to a computer laboratory. It was also decided that PC computers would be more beneficial than Mac computers (the operating platform that was used in a laboratory setting at the beginning of the study). A review of the literature, and interview and focus group findings substantiated the need for a long-term, on-site mentor program to provide a teacher training program necessary for successful technology integration. Following presentation of the results of this study to the Parish Education Committee, a three-year plan was devised and implemented to integrate PC wireless internet-connected computers into all the classrooms.

CHAPTER VI

EPILOGUE

This paper reflects how a school determined the needs of its students and planned to change to meet those needs. This plan for change was done in full consultation with the professionals responsible for implementing this change, the teachers. As a result of this study the school created a three-year plan to integrate effectively the computers into the curriculum. Another positive spin-off of this study was that it improved the lines of communication between not only administration and teachers but also among the teachers. Teaching in a classroom, a teacher can feel quite isolated. Opening up the topic of what to do with the computers it gave the teachers a voice in the decision-making process and it also allowed them to get insight into how their peers are using computers and how they will use computers in the future. The plan developed after this study allowed the school to take advantage of the local computer expertise and allowed us to develop a staff-mentoring program in the school.

After completing the thesis I spent time reflecting on the work completed over the last two years. When piloting the questionnaire I was working on a strict timeline since I was completing the work not only as a requirement for my Masters Degree but also as a work project a vice principal of an elementary school. While I did pilot the questionnaire with three teachers from different backgrounds, because of this timeline I was unable to pilot the questionnaire as thoroughly as I would have liked. When developing the questionnaire I found I spent a great deal of time searching for existing surveys and reading through them in order to develop my questionnaire. In retrospect it would have

been more efficient to spend less time looking for existing questionnaires to fit my study and develop my own questionnaire based on the literature and my objectives.

I have no formal academic training in statistics. This presented challenges when completing Chapter IV. After data input and analysis was completed I realized that I should have designed my questionnaire differently. My questionnaire was divided into two parts, each part beginning with the number one. However, I neglected to name either part. It would have been easier to assign each question one number. Upon further reflection I realized that I would have structured some of the questions differently if I had had a stronger background in statistics. I would have surveyed more people so I would have had a larger sample size; a larger sample size would have given me more options when analyzing the data. In retrospect, I could have used the data from my school to complete my work project and then, for the purpose of this paper, surveyed and interviewed teachers from other schools to increase my sample size.

Although it would have been advantageous to have a stronger understanding of statistics prior to completing this work, my paper focuses on integration and learning skills and concepts as needed. I was fortunate to have Dr. Maria Trache, a statistician, provide guidance when I began the statistical analysis section of my paper. I can definitely say that I developed an understanding of statistics in a meaningful and practical way.

I had prepared a list of questions to ask teachers at the school. I knew prior to the interviews that my bank of questions was too large to ask during each interview. The first

two questions of each interview were the same. The remainder of the questions for each interview was chosen as the interview progressed. On reflection I can see the benefit of asking each teacher the same questions because it would have made it easier to analyze the data and I would have had more information for each question.

As a result of the study new peer relationships amongst teachers were formed. This study also allowed the school to develop a relationship with an Internet company, and become a pilot school, that deals with educational software. This software allows websites to be catalogued (according to the Dewy Decimal System) and cached on the school server. This system ensures that the students are using sites that have been previewed and approved by the school. As a result of this relationship the school was provided with computers at a very low price (much less than previously budgeted). The school was also equipped with wireless technology that would enable the computers to be Internet accessible anywhere in the school building. As a result of being a pilot school the company agreed to provide training and support to all teachers taking part in the project. The school quickly underwent a change from having outdated software and hardware, with little connections between what was happening in the classroom and what was happening in the lab, to having current software and hardware and a strong link between technology and the classroom.

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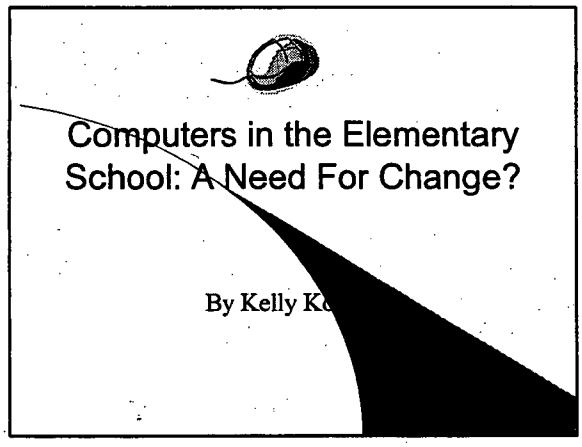


Current IT Program

- At the present time our computer lab is made up of 17 computers: 15 Macintosh Performa 5200 CD, and 2 Macintosh 5260/
- Some classrooms (primarily intermed have computers (PCs or MACs)
- Grades 1-7 receive 30 minutes of compu instruction per week in the lab with a computer teacher present
- [redacted] instructs the kindergarten class (they receive 15-30 minutes per week)

Options for Computers at [redacted]

- To continue with the status quo
- To outfit the computer lab with new c puters and continue to instruct in the computer lab
- To purchase lap top computers that can be from class to class, with a computer teacher moves with the lap tops

Options for Computers at [redacted] continued...

- To purchase lap top computers that can be moved from class to class but continue instruction in the computer lab with new computers ([redacted] has with 15 i-MACs and 14 i-Books. The are used both in the lab and in the classr
- To purchase computers for the classroom aim for a ratio of 1 computer for 4-5 studen (computer teacher supports instruction alon with classroom teacher)

Plan

- To develop a model that will allow the students at [redacted] to use tech logy to enhance their learning experiences

Breakdown of Plan

- Survey and interview classroom teachers to find out what teachers feel is the ro of the computer and how it can be used in t classrooms to enhance their students learning experiences
- To interview past computer teachers at [redacted] to get feedback on how the computer lab has reached it present form

Breakdown of Plan continued...

Survey and interview students to find out:

- their attitudes about computers
- how they are using computers at school
- if and how they are using computers at ho (and what type of computer)
- how they feel they could use computers in the classroom

Breakdown of Plan continued...

- To find out how other schools are teaching/using computers
- To re-visit the Ministry Documents r to computer instructions
- Randomly interview parents at our schoo gain an understanding of their attitudes towards our computer program and our ideas for change

Breakdown of Plan continued...

- To continue with literature reviews of how technology is used in elementary classr as, how teacher attitudes affect computer instructi computer science programs and evaluations
- To complete my Masters Thesis on factors affecting teacher attitudes toward integrating computers into the elementary classroom

Timeline

- Complete focus group studies (to generate topics for surveys and interview questions) by October 19, 2001
- Design survey questionnaires and interview questions by November 1, 2001
- Complete ethics application for UBC by November 15, 2001

Timeline continued...

- Begin distributing student questionnaires by December 1, 2001 and to begin interviewing students and parents by December 7, 2001
- Distribute teacher questionnaires and to begin interviewing teachers by February 1, 2002

Appendix C

Facilitating the Integration of Computers into the Elementary School Curriculum: A Survey

The six categories below describe educators' involvement with computers. Please circle the number of the category which best describes your use of computers in your life.

Category 1: Awareness
I am aware that computers exist but have not used them; perhaps I am avoiding them.

Category 2: Learning the process
I am currently trying to learn the basics. I am sometimes frustrated using computers. I lack confidence when using computers.

Category 3: Understanding and application
I am beginning to understand the process of using computers and can think of specific tasks in which they might be useful.

Category 4: Familiarity and confidence
I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Category 5: Adaptation to other contexts
I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

Category 6: Creative application to new contexts
I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the classroom.

1. How many computers do you have in your classroom?

_____0 _____1-5 _____6+

Current Computer Access (please circle the most appropriate number)

2. I currently use a computer at home.

Never	Seldom	Sometimes	Often	Very Often
1	2	3	4	5

3. I currently use the Internet at home.

Never	Seldom	Sometimes	Often	Very Often
1	2	3	4	5

4. I currently use the Internet at school.

Never	Seldom	Sometimes	Often	Very Often
1	2	3	4	5

5. In the school, I prefer to use a computer from the following locations (please circle the appropriate number):

	Dislike	Somewhat Dislike	Neutral	Somewhat Like	Like
A. Classroom	1	2	3	4	5
B. Computer Lab	1	2	3	4	5
C. Library	1	2	3	4	5
D. Staff Room	1	2	3	4	5
E. Office	1	2	3	4	5

Instructions: Please read each statement and then circle the number which best describes how you feel.

SD=Strongly Disagree D=Disagree U=Undecided A=Agree SA=Strongly Agree

	SD	D	U	A	SA
6. The majority of my computer knowledge is self-taught.	1	2	3	4	5
7. The majority of my computer knowledge comes from collegues.	1	2	3	4	5
8. The majority of my computer knowledge comes from family members.	1	2	3	4	5
9. The majority of my computer knowledge comes from my students.	1	2	3	4	5
10. The majority of my computer training was done at college or university.	1	2	3	4	5
11. I have received instruction in computer applications (word processing, spreadsheets).	1	2	3	4	5
12. I have received instruction in computer integration (how to use in classroom curriculum).	1	2	3	4	5

13. What is your preference for receiving computer training?

_____1/2 day workshops _____whole day workshops

_____1 hr. demos _____1:1 assistance

14. How do you feel about being assigned a peer (teacher) who lacks computer knowledge so you can assist him/her in developing computer skills?

_____positive _____neutral _____negative _____unqualified

15. How do you feel about being assigned a peer (teacher) who had computer knowledge to assist you in developing your computer skills?

_____positive _____neutral _____negative _____I do not need assistance

16. How long have you been teaching?
_____0-1 years _____2-5 years _____6-10 years _____11+years

17. Age: _____under 30 _____30-39 _____over 40

Instructions: Please read each statement and then circle the number which best describes how you feel.

SD=Strongly Disagree D=Disagree U=Undecided A=Agree SA=Strongly Agree

	SD	D	U	A	SA
1. Computers would significantly improve the overall quality of my students' work.	1	2	3	4	5
2. Computers in my classroom would make me a better teacher.	1	2	3	4	5
3. Anything a computer can be used for I can do just as well some other way.	1	2	3	4	5
4. Using computers is a waste of time.	1	2	3	4	5
5. I think students are more motivated when they use computer technology.	1	2	3	4	5
6. When utilizing computers, the teacher becomes a guide/facilitator.	1	2	3	4	5
7. I do not value teaching with technology.	1	2	3	4	5
8. The best place for computers is in a lab.	1	2	3	4	5
9. The best place for computers is in the classroom.	1	2	3	4	5
10. If computers were put into my class I would need training on how to use them.	1	2	3	4	5
11. I would not incorporate computer technology into my classes even if it was available.	1	2	3	4	5
12. With guidance I could see computer technology playing a larger role in my classroom.	1	2	3	4	5

SD=Strongly Disagree D=Disagree U=Undecided A=Agree SA=Strongly Agree

	SD	D	U	A	SA
13. I am able to give advice and guidance to my students when they are working on projects using technology.	1	2	3	4	5
14. I need more access to computers for my students.	1	2	3	4	5
15. Student time on the Internet is a waste of time.	1	2	3	4	5
16. We do not have enough computers or software in our school.	1	2	3	4	5
17. The software and computers we do have are outdated.	1	2	3	4	5
18. Student learning would be best served using Mac computers.	1	2	3	4	5
19. Student learning would be best served using PC computers (i.e. IBM).	1	2	3	4	5
20. Students should be taught keyboarding skills on the computer.	1	2	3	4	5
21. Computers should be used to reinforce concepts studied in the classroom.	1	2	3	4	5
22. Students should be taught word processing skills on the computer.	1	2	3	4	5
23. Students should be taught graphing and spreadsheet skills on the computer.	1	2	3	4	5
24. Students should be taught presentation applications on the computer.	1	2	3	4	5
25. Students should be taught how to search the Internet.	1	2	3	4	5
26. Computer technology would enhance my students' math skills.	1	2	3	4	5

SD=Strongly Disagree D=Disagree U=Undecided A=Agree SA=Strongly Agree

	SD	D	U	A	SA
27. Computer technology would enhance my students' reading skills.	1	2	3	4	5
28. Computer technology would enhance my students' writing skills.	1	2	3	4	5
29. Computer technology would enhance my students' problem solving skills.	1	2	3	4	5
30. I have space in my classroom for computers.	1	2	3	4	5
31. Presently, my students complete a variety of assignments on the computer.	1	2	3	4	5
32. When planning a unit I try to integrate computers whenever possible.	1	2	3	4	5
33. If I had more access to computers I would plan so that my students would use them.	1	2	3	4	5
34. I use computers to individualize the learning experiences of my students.	1	2	3	4	5

35. On average how much time do your students spend actually using a computer each week at school?

_____over 1 hr _____45 min.-1hr _____30-45 min.

_____15-30 min. _____less than 15 min.

36. Please rate your opinion of the emphasis on computer use at school.

_____Highly Overemphasized _____Overemphasized

_____Correctly Emphasized _____Underemphasized

Interview Questions

- Tell me about your experience(s) with computers.
- If you use a computer for teaching, how do you use it?
    - Do you surf the web for teaching ideas, lesson plans or unit plans?
    - If yes, how regularly?
    - When was the last time?
    - Do you use a spreadsheet to keep track of students' progress?
    - What program do you use to write your students report cards?
- Do you require your students to do homework on a computer?
- If yes, what type of activities are they?
- Do you have your children work on a computer in the classroom?
- What types of activities do they perform on the computer?
- Would you like to have more computers in your classroom?
- How many more computers would you like?
- What types of computers would you like to have?
- What would you use the computers for?
- If training was provided for you what would you like to learn?
- What do you know about the Information Technology Integrated Resource Package?
- What is your feeling about integrating computers into the classroom?
- In what ways does computer technology make the role of the teacher more complex?
- What are your concerns for the future use of computers at our school?
- How would you like to see computers used at the school?
- What can we do to support you to make this (the above) possible?

Teachers' Perspective

- **The majority of our teachers are at least feeling familiar and confident using computers, over 30% of the staff is more than confident**
- **The majority of our staff would feel comfortable with having some kind of mentor program in place to get help with computers**
- **While it is not overwhelming, the majority of the teachers feel the best place for computers is in the classroom**
- **Most teachers feel that they need more access to computers**
- **While not overwhelming, it appears that more teachers would be in favour of having PC's in the school**
- **The majority of teachers feel that there is space in their classrooms to have computers**
- **Currently, the majority of teachers are not trying to integrate computers into their planning**
- **If teachers had more access to computers they would plan to use them more**
- **The majority of the teachers at [redacted] feel that computers are underemphasized**
- **The lab is isolated, difficult to integrate into classroom**
- **There are more programs available with PC's**
- **MAC's appear to be easier to use: one unit, simple to set up**
- **PC's are more difficult to use at first, but Windows may make PC's easier**
- **We need workshops to show the possibilities (to teachers)**
- **If a teacher used computers in the classroom as a station it would go unsupervised**
- **We need to get computers networked (between lab and classroom)**

Facilitating the Integration of Computers into the Elementary School Curriculum: *Survey Statistics*

Each teacher was asked to circle the category that best described his/her use of computers in his/her life.

Category 1: *0 % circled this level*
Awareness
I am aware that computers exist but have not used them; perhaps I am avoiding them.

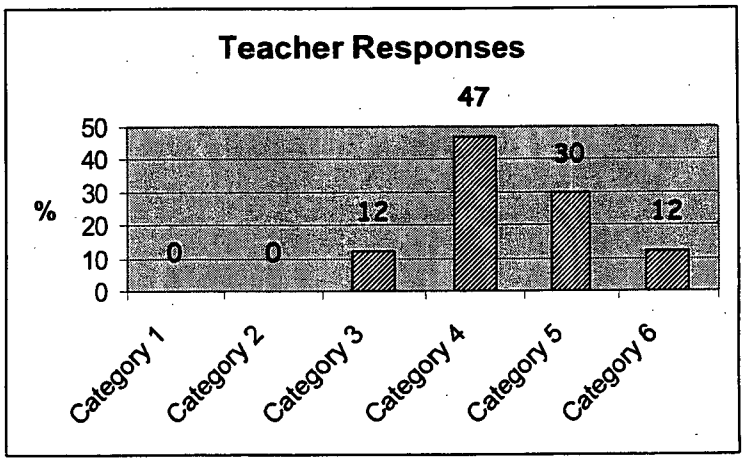
Category 2: *0 % circled this level*
Learning the process
I am currently trying to learn the basics. I am sometimes frustrated using computers. I lack confidence when using computers.

Category 3: *12 % circled this level*
Understanding and application
I am beginning to understand the process of using computers and can think of specific tasks in which they might be useful.

Category 4: *47 % circled this level*
Familiarity and confidence
I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Category 5: *30 % circled this level*
Adaptation to other contexts
I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

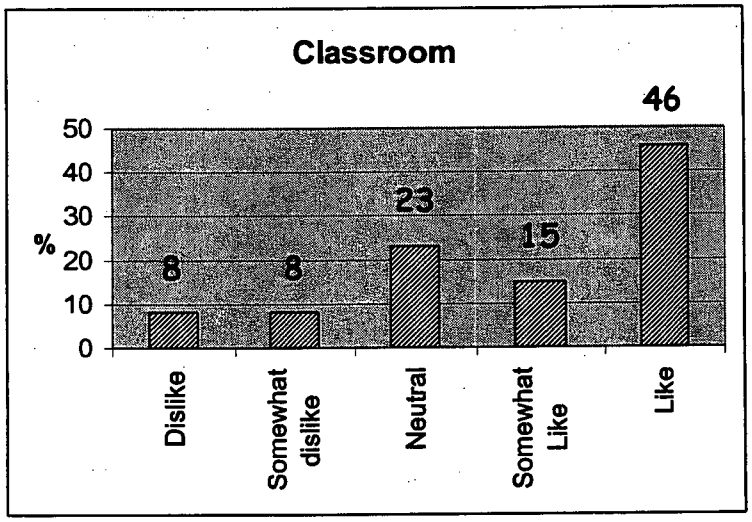
Category 6: *12 % circled this level*
Creative application to new contexts
I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the classroom.



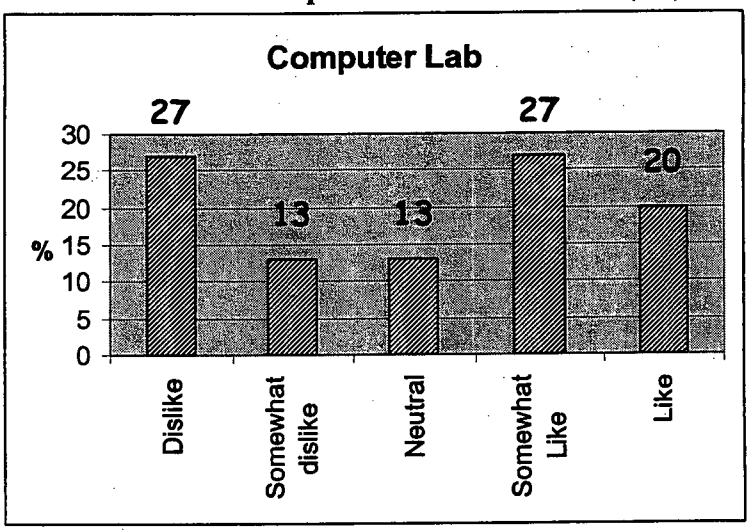
Mean response was Category 4 (4.4)

1. In the school, I prefer to use a computer from the following locations (please circle the appropriate number):

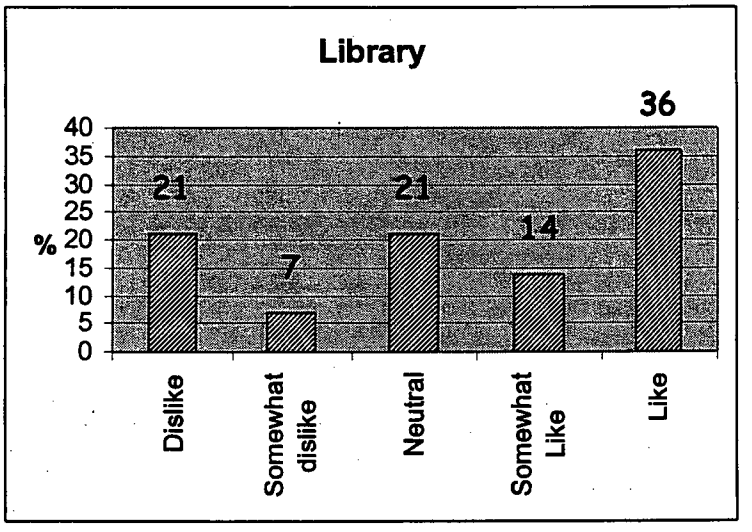
	Dislike	Somewhat Dislike	Neutral	Somewhat Like	Like
A. Classroom	1 (7 %)	2 (7 %)	3 (21 %)	4 (21 %)	5 (43 %)
B. Computer Lab	1 (27 %)	2 (13 %)	3 (13 %)	4 (27 %)	5 (20 %)
C. Library	1 (21 %)	2 (7 %)	3 (21 %)	4 (14 %)	5 (36 %)
D. Staff Room	1 (13 %)	2 (0 %)	3 (6 %)	4 (31 %)	5 (50 %)
E. Office	1 (21 %)	2 (7 %)	3 (33 %)	4 (7 %)	5 (27 %)



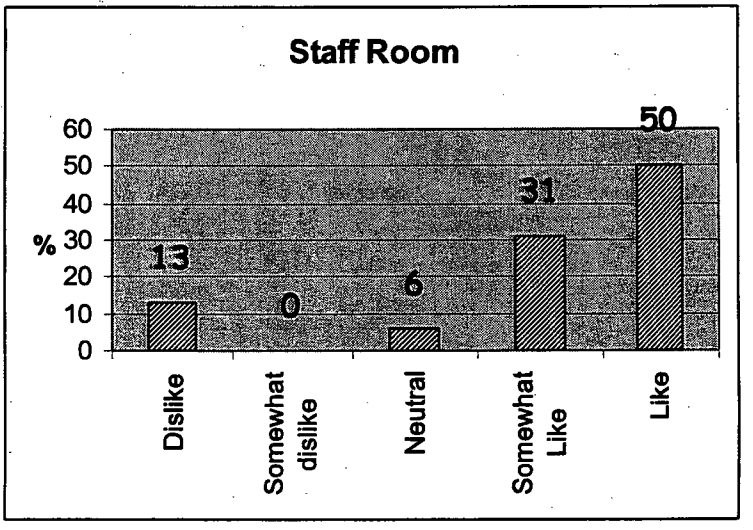
mean response = somewhat like (3.8)



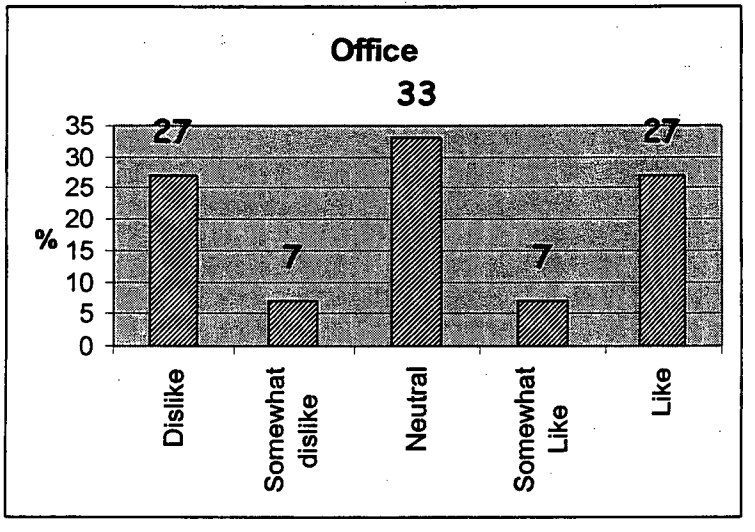
mean response = neutral (3)



mean response = neutral (3.1)

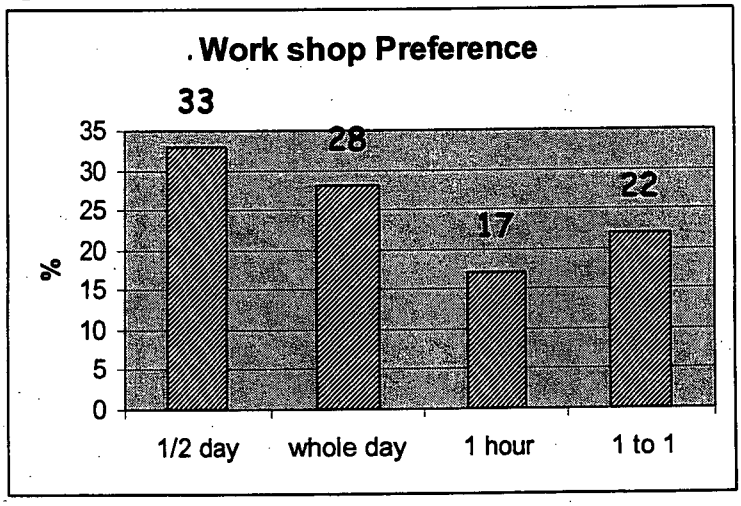


mean response = somewhat like (4.1)

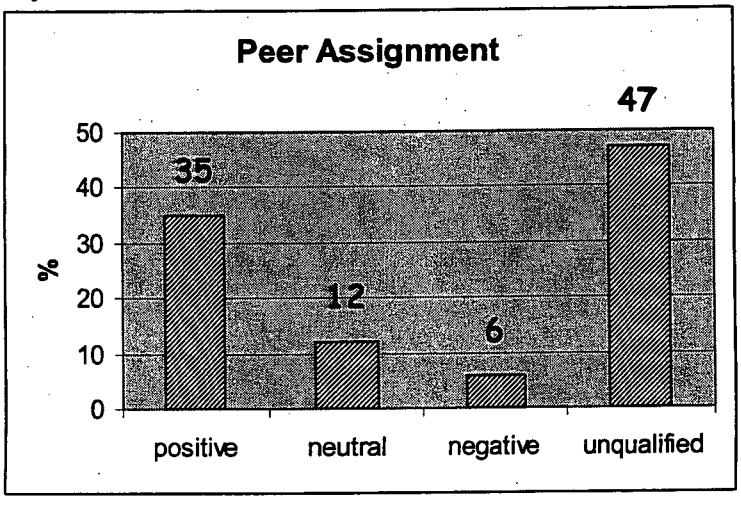


mean response = somewhat like (4)

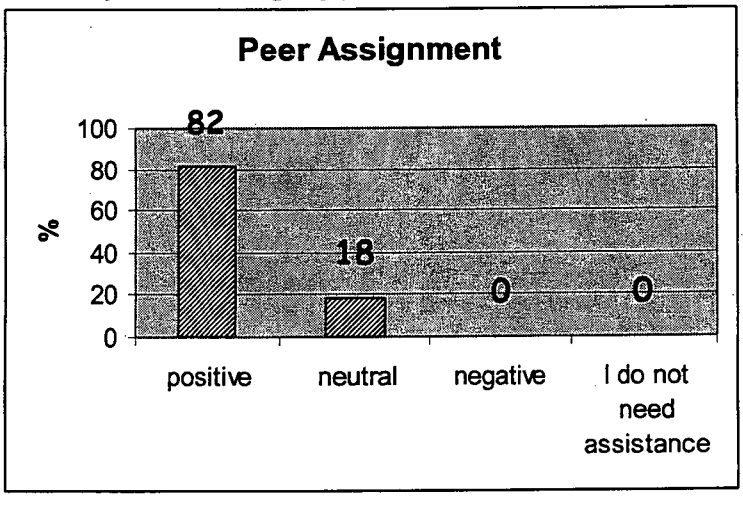
2. What is your preference for receiving computer training?



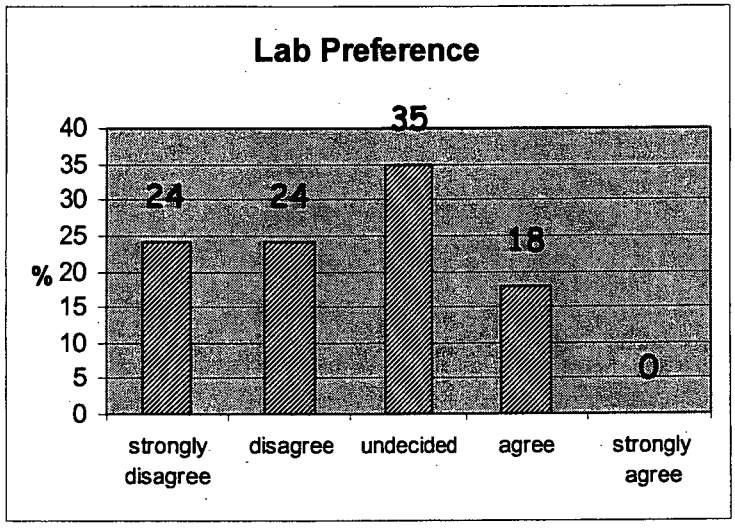
3. How do you feel about being assigned a peer (teacher) who lacks computer knowledge so you can assist him/her in developing computer skills?



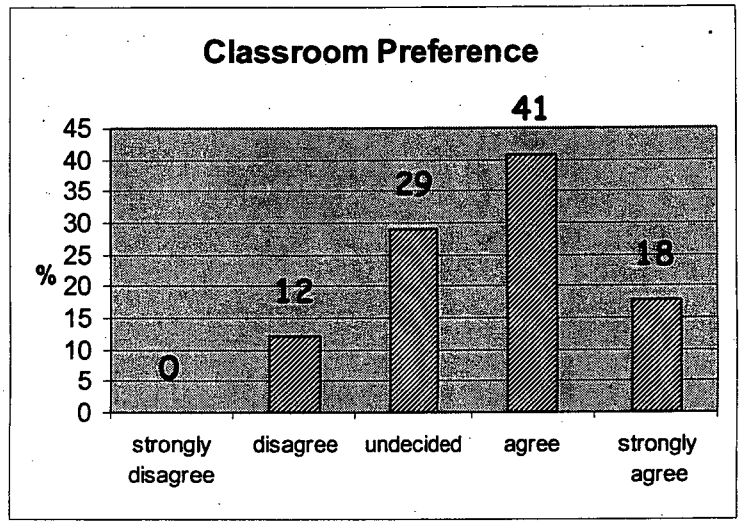
4. How do you feel about being assigned a peer (teacher) who had computer knowledge to assist you in developing your computer skills?



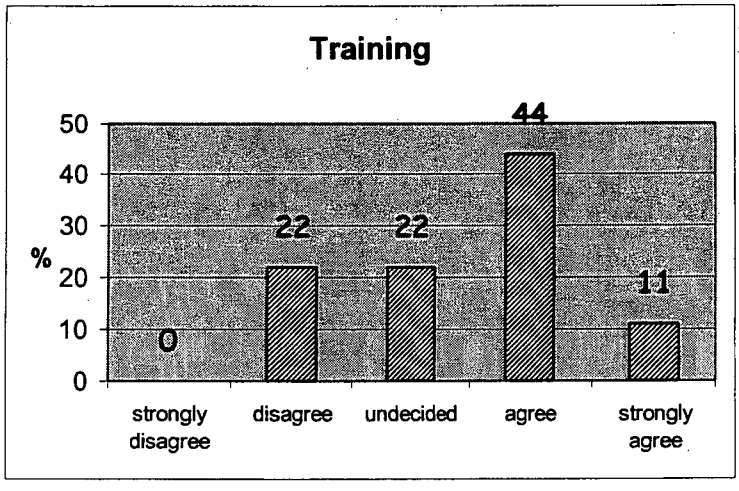
5. The best place for computers is in a lab.



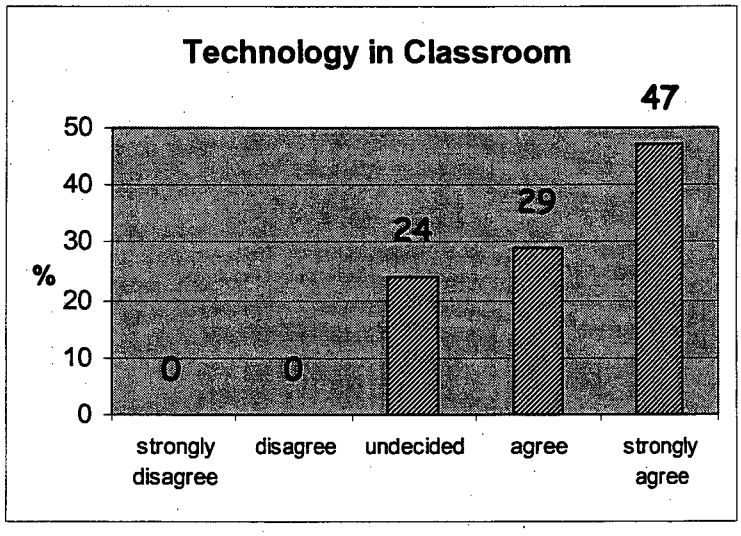
6. The best place for computers is in the classroom.



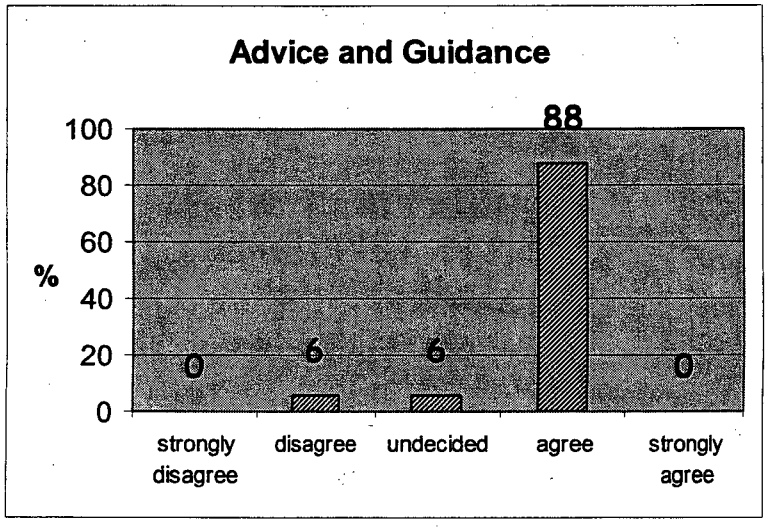
7. If computers were put into my class I would need training on how to use them.



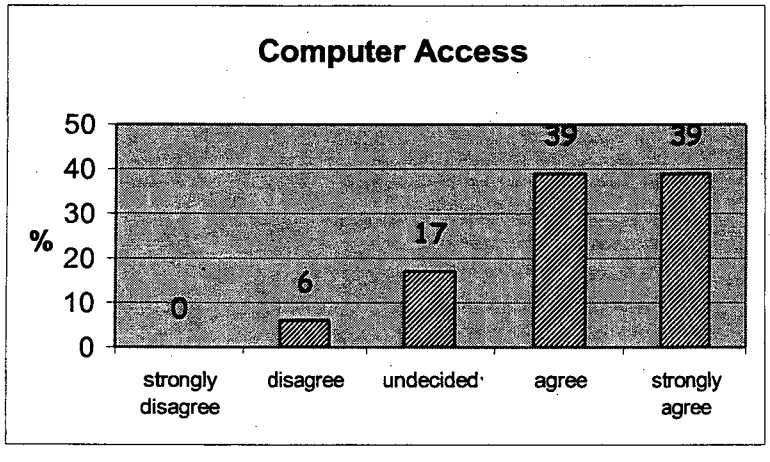
8. With guidance I could see computer technology playing a larger role in my classroom.



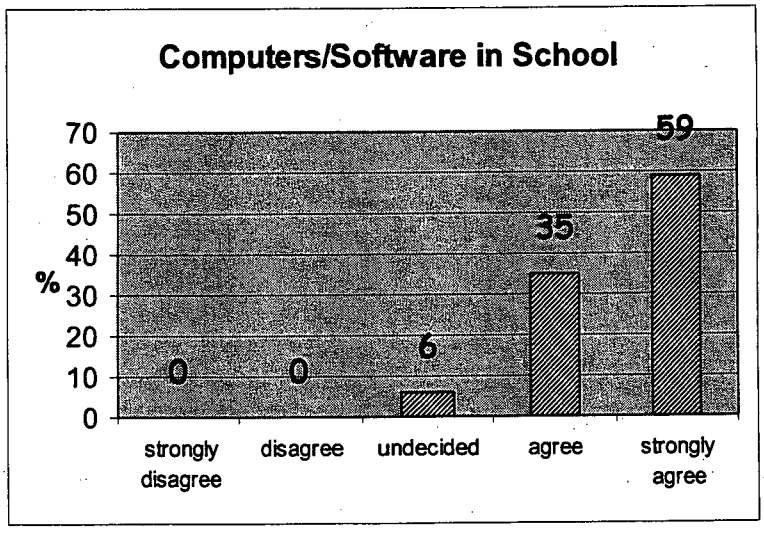
9. I am able to give advice and guidance to my students when they are working on projects using technology.



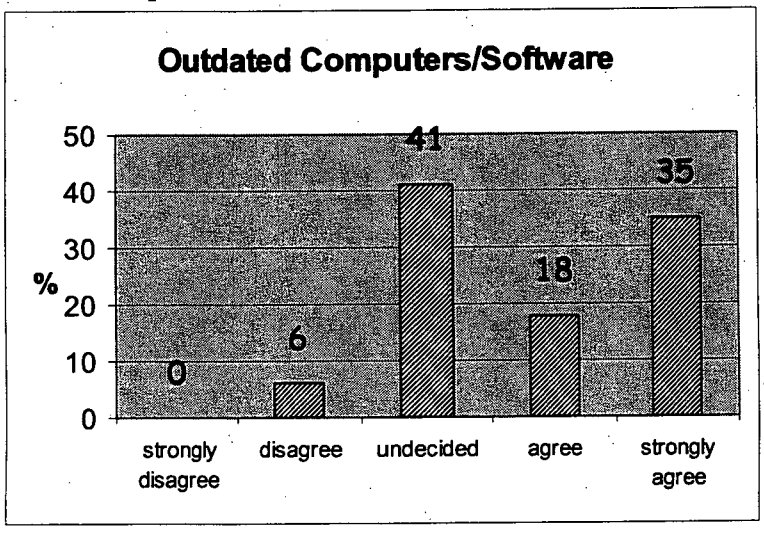
10. I need more access to computers for my students.



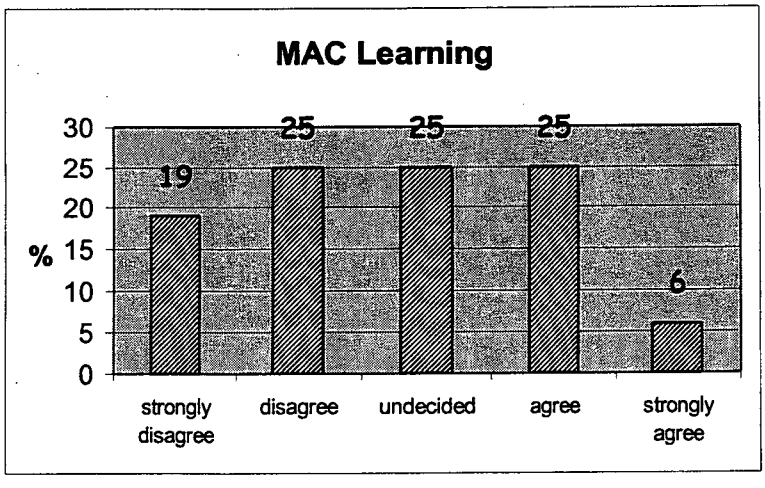
11. We do not have enough computers or software in our school.



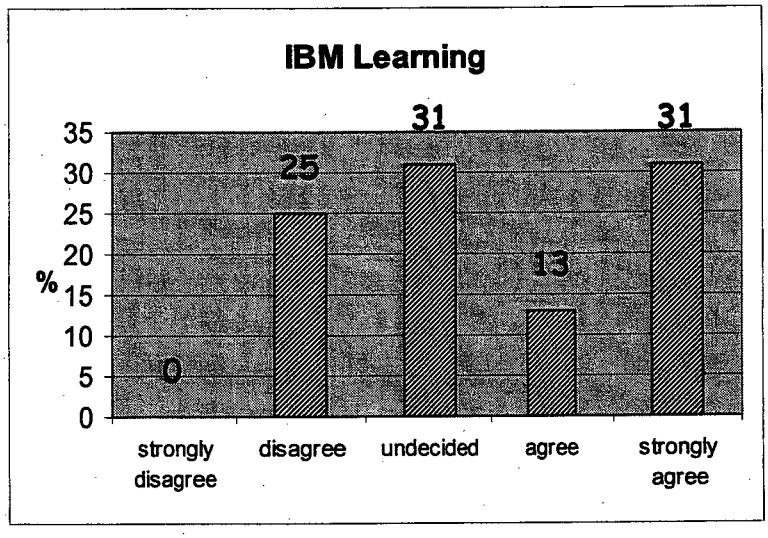
12. The software and computers we do have are outdated.



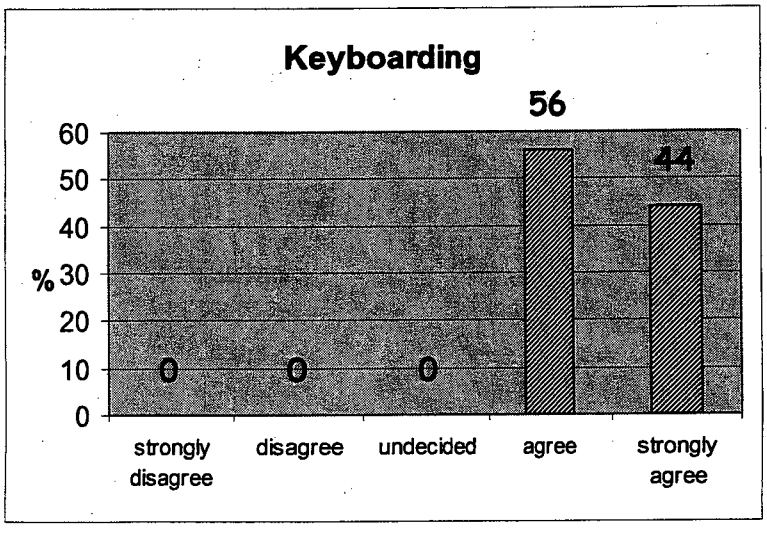
13. Student learning would be best served using Mac computers.



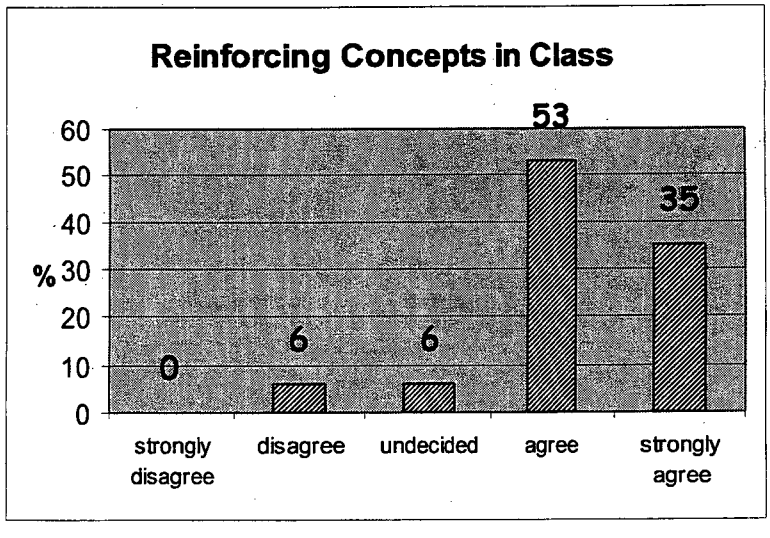
14. Student learning would be best served using PC computers (i.e. IBM).



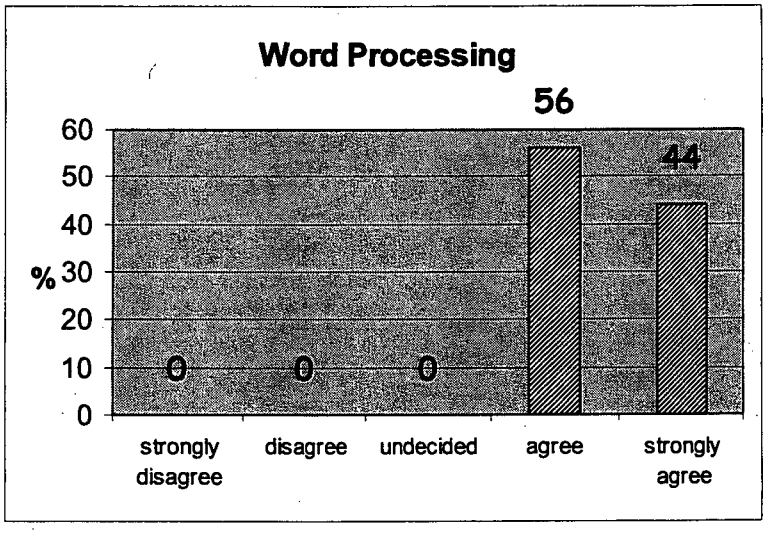
15. Students should be taught keyboarding skills on the computer.



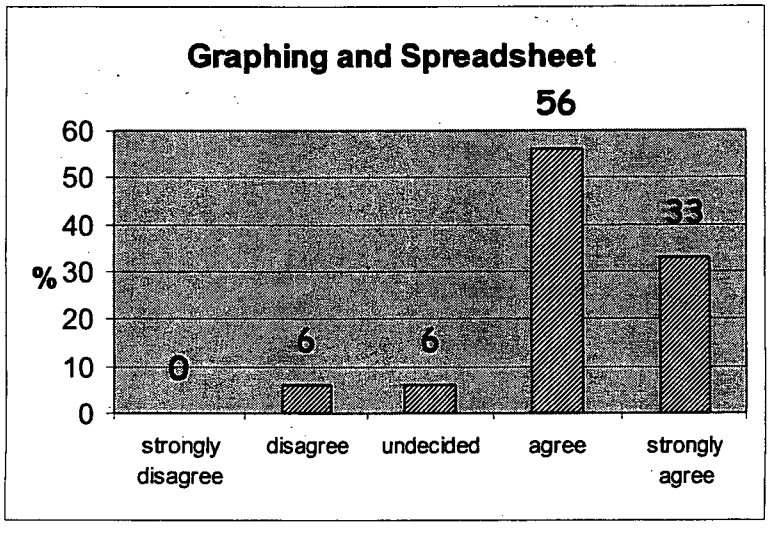
16. Computers should be used to reinforce concepts studied in the classroom.



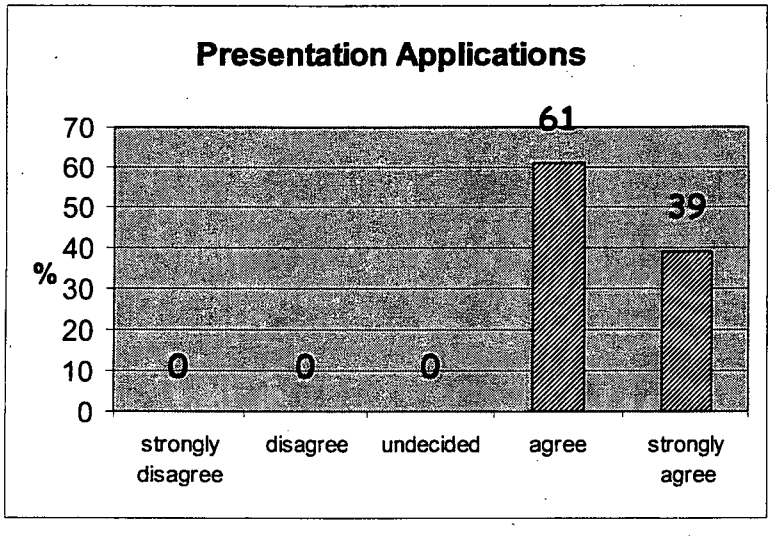
17. Students should be taught word processing skills on the computer.



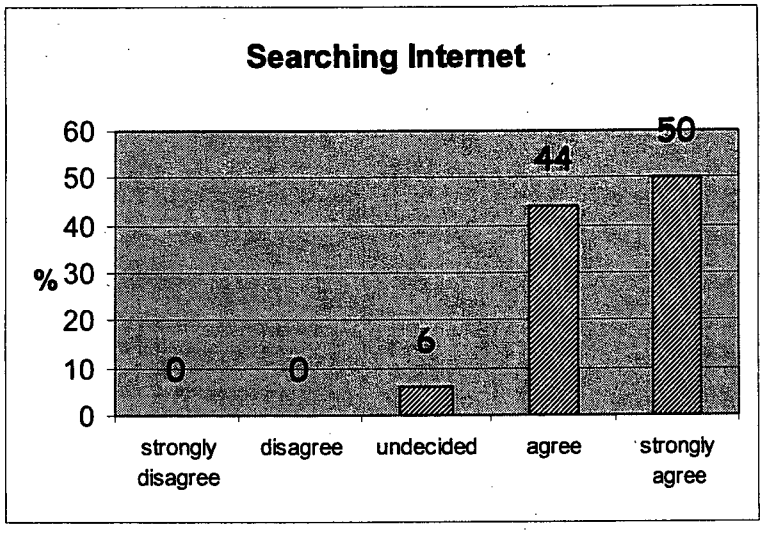
18. Students should be taught graphing and spreadsheet skills on the computer.



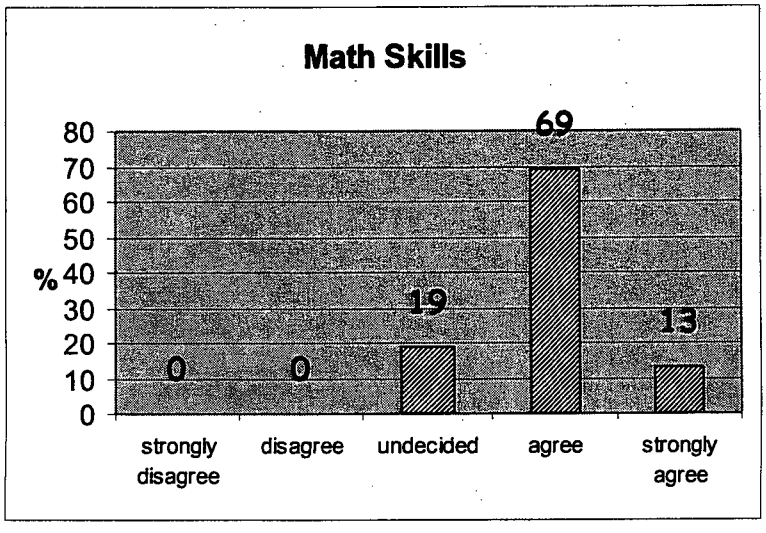
19. Students should be taught presentation applications on the computer.



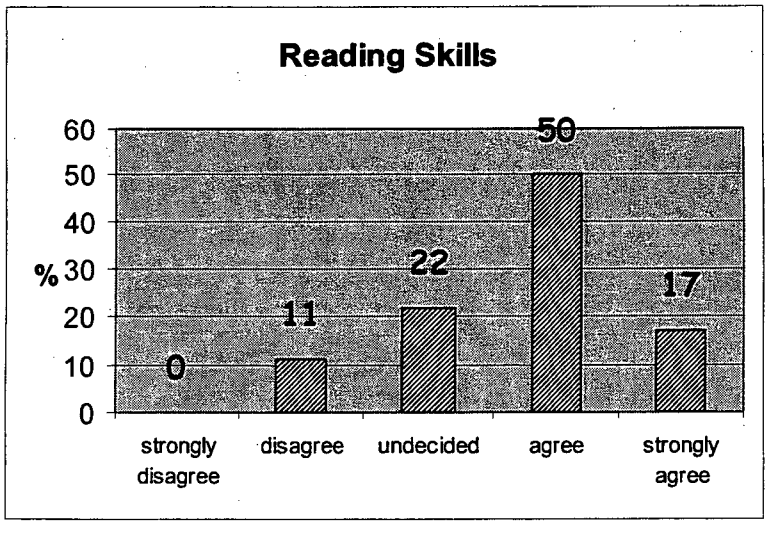
20. Students should be taught how to search the Internet.



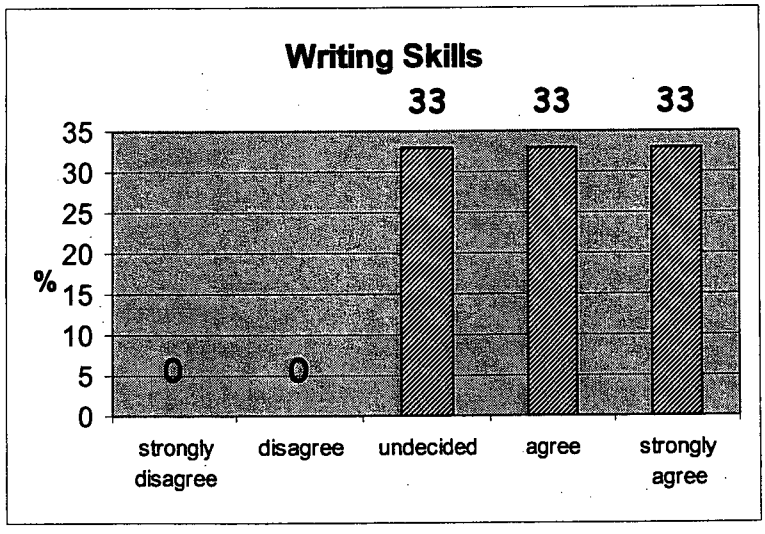
21. Computer technology would enhance my students' math skills.



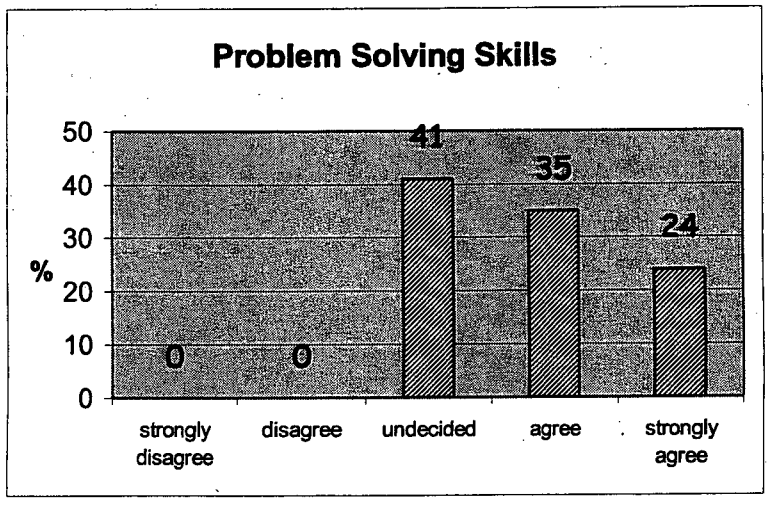
22. Computer technology would enhance my students' reading skills.



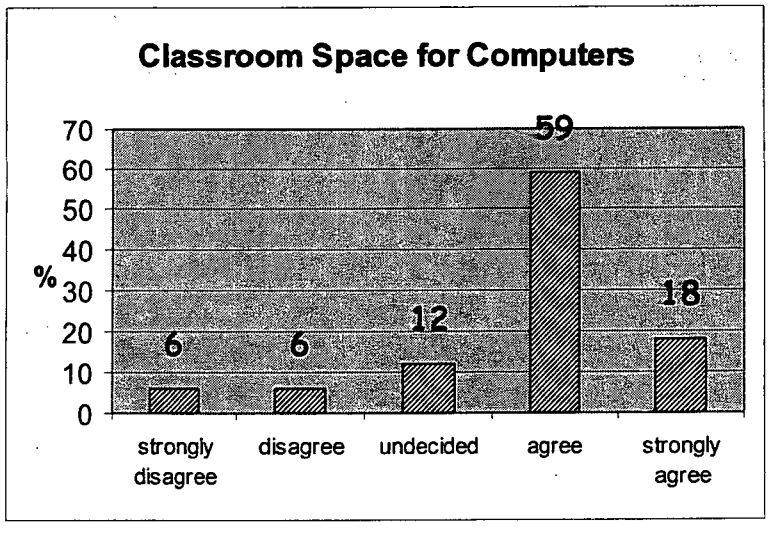
23. Computer technology would enhance my students' writing skills.



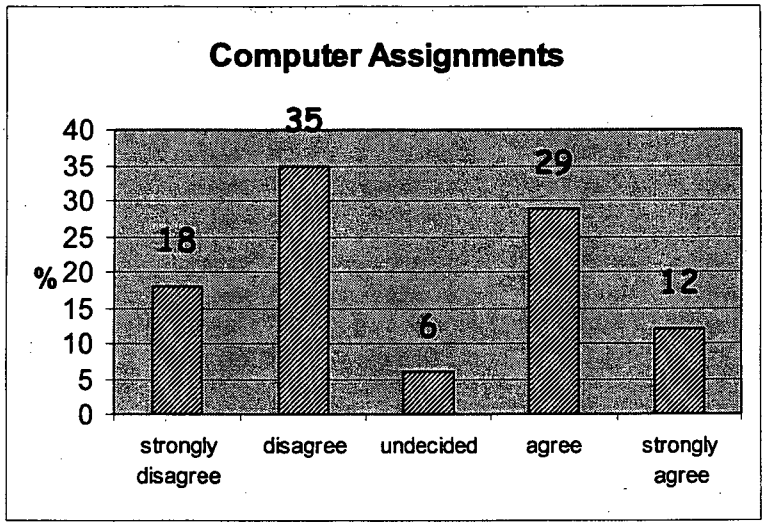
24. Computer technology would enhance my students' problem solving skills.



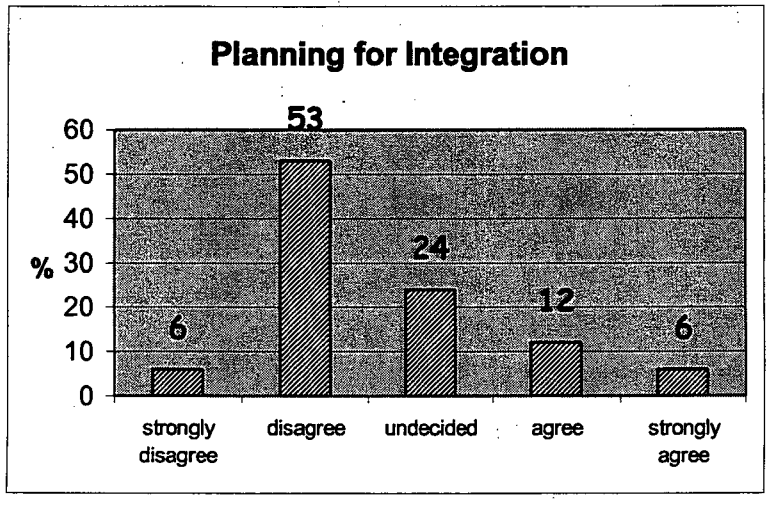
25. I have space in my classroom for computers.



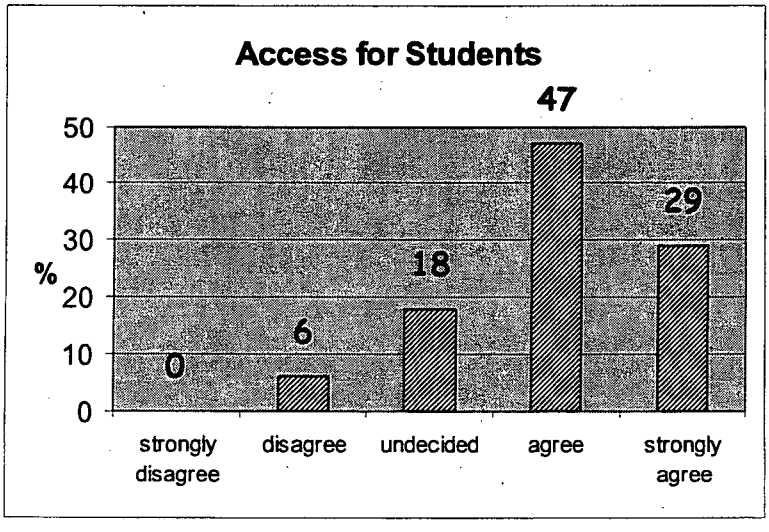
26. Presently, my students complete a variety of assignments on the computer.



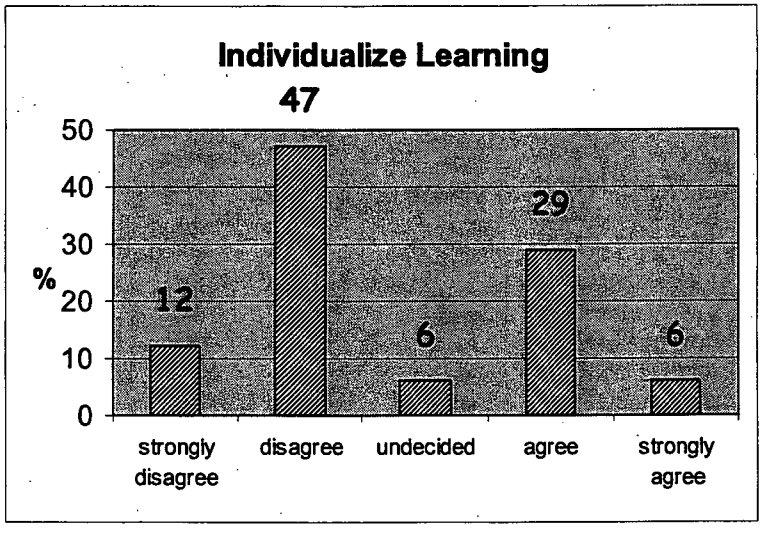
27. When planning a unit I try to integrate computers whenever possible.



28. If I had more access to computers I would plan so that my students would use them.



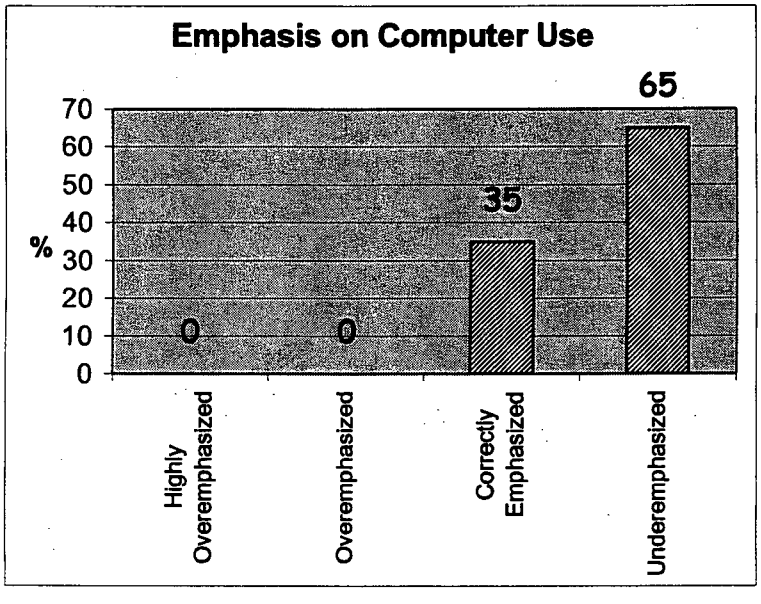
29. I use computers to individualize the learning experiences of my students.



30. Please rate your opinion of the emphasis on computer use at school.

_____Highly Overemphasized _____Overemphasized

_____Correctly Emphasized _____Underemphasized



Options For Computers

- Refurbish computer lab with new MAC computers $1125/ computer, look at buying some lap tops to compliment the lab
- Refurbish computer lab with Dell computers $1299/ computer, it appears to be easier to get PC computers (used) from businesses, we can adapt them to be used at school
- We may want to look into leasing the computers, most computers do have lease programs

One of the key issues we have to recognize is time on the computers. By moving them into the classroom we are providing the children with the opportunity to access the computers more often. Teachers could share computers at certain times of the day therefore allowing more computers in one classroom.

If we decide to stay with the lab then we should increase the teaching time of the computer instructor. One thing that prevents our lab from being used more is that we only have enough computers for $\frac{1}{2}$ a class. A teacher cannot go to the lab with their class because there would be no supervision for the other half of the class. Our lab does not really allow for any more computers.

Another issue that must be addressed is the matter of integrating the computers into the curriculum. Removing the children from the class for 30 min./ week of computer time does not allow the computers to be used to help learning. Because most of the children have PC's at home and we have MAC's at school often they are not able to complete the work begun in the lab in a reasonable amount of time. Therefore integration does not take place on a regular basis. If computers were in the classroom, teachers would be able to plan how to use them. Individualizing the curriculum would also be easier if the computers were in the classroom.

Computers should be phased in over a three year period:

- Yr. 1: 3 computers each for D. 13. 14, 15, 16 plus a printer for each division

- Yr. 1: buy an LCD projector that can be used for presentations
- Yr. 2: 3 computers each for D. 9, 10, 11, 12 plus a printer for each division
- Yr. 3: 3 computers each for D. 5, 6, 7, 8 plus a printer for each division
- In each of the years we ensure that those rooms are equipped with the Internet
- The classes that do not receive new computers can continue going down to the lab until they receive new computers. This will free time up for L.A. to use some of the computers
- D. 1,2,3,4 will get the MAC computers after year 3
- We can continue to use the lab for the next three years, the computer teacher will provide support to the classes with computers, help them plan units, and teach lessons

February 23, 2004

As [redacted] Education Committee Chairperson I give Kelly Kozack permission to use the computer evaluation proposal that he prepared and presented to the committee at the 2001 planning retreat. I also give him permission to use the results of the teacher survey that he prepared and presented to the Committee in the spring of 2002. I understand that he is using this information in Masters Thesis.

[redacted]

Chairperson signature

feb 25, 2004

Date

Computer Final Report

1. Sign a three-year agreement with School Web. This will allow the school to become a pilot project for School Web. They will provide us with a server, where we can cache up to 30 000 web sites; they will provide us with training to get the teachers comfortable using the technology; they will train the teachers on how to develop and use Web Quests. This contract will also give us access to refurbished Pentium computers and refurbished ink jet printers from Computers for Schools.
2. Purchase software for the computers. [redacted] is looking into the price of obtaining a license for Microsoft Office.
3. Purchase an LCD Projector for presentations of student work.
4. 78% of the teachers felt that they needed more access to computers. Our existing program only allows for 30 minutes per week. The best way to ensure access to computers is to put them into the classrooms. However, the budget does not allow us to put computers into every classroom for the upcoming school year. Also, not every teacher feels comfortable having computers in their classroom. In order to change school culture the implementation of this program must take place over the course of several years. Six intermediate teachers expressed an immediate interest in having computers in their class. The plan is to put computers into the class over the course of three years.

   Year One
   - Supply Divisions 10, 12, 13, 14, 15, 16 with four computers and one ink jet printer. Division 4 will have 3 Mac computers and a printer.
   - Divisions 1, 2, 3, 5, 6, 7, 8, & 10 will continue to go to the computer lab for instruction.

   Year Two
   - Take the computers out of Divisions 15 & 16 and put into Divisions 9 &11.
   - Purchase or lease 8 new computers for Divisions 15 & 16 and a printer for each room.
   - Divisions 1, 2, 3, 5, 6, 7 & 8 will continue to go to the lab for instruction.

Year Three

- Take the computers out of Divisions 13 & 14 and put into Divisions 7 & 8.
- Purchase or lease 8 new computers for Divisions 13 &14 and a printer for each room.
- Take computers out of the computer lab and put into Divisions 1/2, 3, 5, & 6 each class will need a printer as well.

5. The computer teacher's job will be the following:
   - Plan the integration of computers into curricula with the classroom teacher
   - Provide technical support to the classroom teachers and Learning Assistance teachers
   - Train classroom teachers and Learning Assistance teachers how to integrate computers into curricula
   - Teach computer classes to those still using the lab
   - Trouble shoot small problems, call [redacted] to fix larger problems
   - Liase with School Web
   - Attend training sessions with School Web so teachers can be trained at a later date
   - Develop a school web page, [redacted] is a good contact person for this job
   - The computer teacher will act as a mentor for the teachers with computers in their classes. It would be advised that he receive training from School Web prior to the staff receiving training so he will be able to help out at the training sessions as well
   - Besides being a mentor the computer teacher will facilitate peer coaching sessions where teachers will teach each other
   - Alert teachers to workshops where they may be able to enhance their computer skills, which help allow them to feel more comfortable about integrating the m into their daily classroom work.
   - Keep teachers informed about workshops that may upgrade their present knowledge and skill base
6. Establish computer club to work on web page design and to train students to help trouble shoot problems and act as peer helpers.

7. Have [redacted] work on some sort of station for the computers. I will talk to him about this before I leave. A fixed station is not desirable since the wireless technology allows for the flexibility of moving the computers around. A station that would allow the computers to move from class to class would be ideal. Our classes are arranged in such a way that it would be quite easy to move the computers to another class for a short period of time if a class was working on an assignment that required more that four computers. The wireless technology would also enable the computers to be out in the hall if so desired.
8. Get a subscription to Learning and Leading With Technology for the school. This magazine/journal is written primarily by teachers for teachers.

February 23, 2004

As principal of [redacted] School I give Kelly Kozack permission to use a copy of the final report and recommendations on computers at the school. This report was completed by Kelly Kozack and submitted to the administration in August 2002. I understand that he is using this information in Masters Thesis.

[redacted]

Principal's signature

Feb 23, 2004

Date