IMPLEMENTING INFORMATION TECHNOLOGY: THE EFFECT ON TEACHING STYLE AND THE ROLE OF THE TEACHER

DOUGLAS HOGG

B.A., University of Texas, 1972

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Abstract

The purpose of this study was to examine teachers' perceptions of the effect of using computer technology on their role in the classroom and on their personal teaching style. The subject group consisted of twenty-six educators in School District No. 5 (Southeast Kootenay) who were part of a vanguard group that received leadership training in using educational technology in the classroom. The subject group represented all geographic areas of the school district and included teachers from both elementary and secondary schools. The study consisted of a four-part questionnaire that asked teachers to rate their individual technology skills, their attitudes towards the use of technology in the classroom, and assess their individual teaching style and perceived role in the classroom. Both Likert type scale and open-ended questions were used. The questionnaire was administered to all participants in the fall of 1999 and the data compiled and analyzed in January 2000. The initial findings support the argument that the role of the teacher changes with the implementation of technology in the classroom. The survey indicates that teachers integrating technology into their classrooms favor a constructivist approach to knowledge and learning. Gender differences were noted in teacher attitudes towards the use of technology in the classroom, teacher skill levels in using technology and also the role of the teacher. Female elementary and secondary teachers rated themselves lower in technology skills than their male counterparts and were less likely to view technology as important to their daily instruction. Elementary teachers were more likely to change their instructional practices to accommodate students than secondary teachers. In addition, elementary teachers used computers more frequently than secondary teachers for class preparation and non-school activities.

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"I could tell you my adventures--beginning from this morning," said Alice a little timidly: "but it's no use going back to yesterday, because I was a different person then."

Lewis Carroll

Introduction

Like Alice in her adventures in Wonderland, I too am a different person than I was yesterday. As I reflect on who I am as an educator and what my role as a teacher in the new millennium entails, it appears that I have a different vision of teaching and learning than the one I began with. Knowledge is now less a series of facts to be transferred intact, from me to my students, and more of a process whereby my students make sense of the facts and create a new understanding. When I began my teaching career, the educators that I worked with influenced me a great deal. Their beliefs became my beliefs as I was evaluated and indoctrinated into the system. Whether it was through a formal process, such as the yearly evaluation, or more informally in the staffroom, my beliefs concerning teaching were grounded in the common practices of the day. I believe I taught as I was taught. What changed this?

Computer technology has played an important part in my growth as a teacher, but has my teaching been influenced by the introduction of technology or has my emerging philosophy shaped the way I incorporate technology into my classroom? Miller and Olsen (1994) feel that any innovative change associated with the introduction of technology has more to do with the teachers' prior practices and routines than with the

actual advent of technology. Perhaps this may be the case, but without the catalyst of technology I might be teaching in much the same way as I did when I began. I cannot go back to my old teaching style because, like Alice, I was a different person then.

Teaching breeds a conservative culture as noted by Jackson (1997), one that promotes a stable physical and social environment and is easily recognizable and defined by a distinct set of rules. So why change? Why leave the comfort of tradition to explore new avenues of learning and teaching? My personal answer lies within the realm of technology. It has changed how I access and utilize information, opening doors to an outside world I hardly knew existed.

My personal journey began several years ago, at a time when I was looking for answers to questions that most teachers have likely pondered in the course of their careers:

Is what I am teaching to my class having an impact on them?

Am I reaching most of the children in my class with my teaching methods and practices?

Why do some of my units and lessons generate more student interest than others?

I had no research base to begin with other than my own feelings and perceptions, no great body of literature that I could turn to for answers. I felt that something had to change in my teaching if I was to continue in the profession. As perhaps it is for many, I find the job of teaching both quite stressful and tiring, yet very rewarding and satisfying. As I began to reflect on my teaching I noticed that as I became more tired or frustrated, my teaching reverted to what Sandholtz, Ringstaff and Dwyer (1996) refer to as a "lecture-recitation-seatwork model" (p. 175). It was much easier for me to function in

this environment; the students were expected to work quietly at their desks, raising their hands if assistance was required and generally behaving in a positive manner. Everyone is doing the same thing at the same time. As the teacher in this situation I had total control over the environment in my classroom. The textbook became the curriculum and worksheets dominated the lessons. To some, this would appear to be learning at its best, but I knew I was cutting corners in order to make my job a bit easier and less stressful (Apple & Jungck, 1992).

My personal satisfaction level with this more traditional method of teaching was very low, so I began to examine my lessons and teaching strategies to find a solution for me. Was there some part of my teaching that I enjoyed more than others? What kinds of strategies did I employ when I was refreshed?

I noticed there was a shift in many students' perceptions about writing assignments when I began using HyperStudio, a multi-media presentation piece of software that allows students to incorporate text, sound and graphics into a document. Students seemed much more motivated to write, and their finished product was of a higher quality. Students who normally produced very little or nothing in a traditional writing lesson were able to develop a presentation that clearly demonstrated their level of understanding of the topic.

My classroom structure had to change to incorporate using the computer for these projects. As students experimented with the software and developed their presentations, they moved beyond the basic instruction and assignment format. One student would find a method of incorporating an audio clip into their document and immediately others would ask for help in order to do the same. No longer was I the only expert in the room,

as many of my students quickly surpassed my knowledge. I found that I was often telling students that I didn't know how to do a particular task but perhaps another classmate knew how and suggested that they talk with them. I began observing how other students taught each other and was impressed by how focussed and on task they were. Noise levels were higher and students were not sitting in rows quietly but I sensed that more learning was occurring.

I decided to cast myself in the role of the learner to try and experience what being a student felt like. I wanted to experience the joy and frustration, success and failure associated with learning something completely new, just as my students did. How did I learn something new, and how could I apply that to my teaching practice so that student learning increased in my classroom? A friend suggested that I join a group of amateur radio enthusiasts who were beginning to study Morse code. This became an opportunity to experience what it was like to be a learner.

I quickly came to the realization that sitting at a desk listening to someone tell me how to receive and send Morse code was not my learning style. In learning how to send and receive Morse code, I found that I had to work with others, not alone quietly at my desk. Peer coaching and evaluation were coupled with individual assignments. Each person brought different strengths to the group and this resulted in a positive learning environment. We set our own goals and worked at our own pace, allowing us time to focus on areas that were weak or of particular interest.

Armed with this bit of knowledge of my learning preferences, I decided that I wanted my students to see me go through a similar learning cycle to theirs. So I signed

up for snowboarding lessons as part of our school's ski program and took five lessons with children from my class. What an experience for all of us.

I learned what it felt like to experience failure at first but to persevere and experience success overall. For a brief time I became just another student in the class. I was definitely not the expert and students did not look to me in a teaching role. I accepted their advice and suggestions. They were more knowledgeable and skilled and could act as a tutor to me. This change of role helped me to begin to understand the potential for using students as facilitators and leaders in the class.

Similarly, my use of technology to enhance and support student learning in my classroom gave me the opportunity to experiment with some different teaching strategies and practices. Did using technology force some changes on my teaching practices? Where other teachers undergoing similar changes as they introduced and integrated technology into their teaching practices?

Research Question

To find the answers to these questions, and also to provide overall direction for the study, a research question that became my primary focus was developed:

> In what ways does the effective integration of information technology into the school curriculum require classroom teachers to change their teaching styles and strategies?

This question provided the conceptual basis for the development of the survey instrument, overall design of the study and a compass to guide me as I looked for personal meaning in what I was doing.

Purpose of the Study

> Like many others, I believe that the computer revolution is already changing how students acquire and use information; if our schools do not rise to this technological opportunity and challenge, they risk becoming completely anachronistic. (Gardner, as quoted in Scherer, 1999b, p. 16)

Schools have been acquiring computers and other information technology tools for over almost two decades, yet many teachers are still unable to effectively use computers to help students learn. Information technology is quickly changing the world around us and demands are being placed on the school system to prepare students to participate in an information-based society.

The purpose of this study was to investigate the effect that the integration of technology had on the individual teaching practices and strategies of the school district's vanguard group. Specifically, do these vanguard teachers perceive their role and function changing because of the introduction of technology into their classrooms and are there factors that might be predictors of effective integration?

Additionally, the data gathered from this exploratory study will provide a framework for future study and observation associated with the implementation of technology in the school district. This research into the changes that vanguard teachers make in how they teach will provide a basis for helping other teachers in the district to effectively integrate technology into their classroom.

Definitions

Constructivism:	A philosophy of learning in which knowledge is viewed as personally constructed meaning that results from interaction between existing knowledge and new experience.
Constructivist teaching:	A method of instruction in which the teacher deliberately addresses the fundamental role of interaction between existing knowledge and new experience in an attempt to facilitate learning.
Effective integration:	Information technology tools are used on a regular basis to enhance student learning in curricular areas (Sandholtz et al., 1996).
Information technology:	The tools and resources used by teachers including computers, multi-media and the technologies for local and global communications.
Instructional strategies:	The specific activities or practices used in teaching the prescribed curricular outcomes, including the arrangement of the classroom, multi-age or multi-year groupings and team-based project work.
IRP	Integrated Resource Package. These documents are the curriculum packages provided to all schools by the British Columbia Ministry of Education.

Review of the Literature

Much has been written about the integration of technology into the educational system in recent years. Wellburn (1996) notes that research into this field has advanced more rapidly than many experts predicted. Hundreds of published studies have examined the educational effect of introducing information and communication technology into the school system. Others have questioned whether computers really have anything to offer education.

> It is natural to expect that computers are having an equally transformative effect on educational practice, leading to dramatically fresher, more engaging, and more powerful process of learning – education in wonderland! Yet, recalling that the Red Queen in *Alice in Wonderland* routinely believed five impossible things before breakfast, we may pause to ponder whether one of them might be the technological revolution in education. After all, where is it?
>
> (Salomon & Perkins, 1996, p. 111)

This study has not examined the value of using technology to meet students' educational needs compared to other ways of learning, rather the assumption is made that the use of technology is a worthwhile educational activity. While the majority of studies have focussed on the benefits or lack thereof to student learning achievable through the use of technology, the changing role of the teacher and student is alluded to in most articles. (Wellburn, 1996; Wilson & Peterson, 1995). This became the focus of the review of the literature, specifically:

Does the effective integration of technology into the classroom require teachers to change their teaching style?

Are there specific teaching styles or strategies associated with the effective integration of technology

What factors are necessary for the successful integration of technology?

Are there predictors of success for the successful integration of technology?

Several major themes emerged from a review of the literature:

- Teachers' backgrounds, beliefs and attitudes influence their teaching styles and strategies.
- The role of the teacher changes with the implementation of technology into the classroom.
- There are specific teaching strategies and practices that enable teachers to effectively implement technology into the classroom.
- Teachers' computer expertise is related to the effective implementation of technology in their classrooms.

Teachers' Backgrounds , Beliefs and Attitudes

A teacher's beliefs, prior practices and routines determine whether the introduction of computers into the classroom will result in innovative practice (Miller & Olsen, 1994). When an innovation is successful, is it because the technology had a profound effect on the teacher, or is it the other way round? The Apple Classrooms of Tomorrow (ACOT) study found that as teachers became learners, they began to reflect

on their teaching strategies and question the value of what they were currently doing in their classrooms (Sandholtz et al., 1996).

Becker (1998) found that a teacher's pedagogical beliefs and practices was a strong predictor in whether Internet resources were viewed as essential to good teaching. Teachers who had adopted a constructivist philosophy were more likely to use Internet resources than teachers who followed a traditional approach of distributing facts and skills in a fixed sequence were. Becker's study found that the following variables were associated with higher levels of computer usage: high levels of classroom connectivity; computer expertise; constructivist pedagogy; participation in staff development; high frequency of informal contacts with other teachers; involvement in professional leadership activities; being a young teacher; and not being a math teacher.

Becker's study noted that while teachers who supported project based teaching and other constructivist practices, changing other teachers' philosophies to become more constructivist may not work.

The Changing Role of the Teacher

McDonald and Ingvarson (1997) found that the use of computers forced teachers to adopt strategies, which reinforced the philosophy of independent learning and constructionism. Their four-year study noted that computers were a central component of the educational innovations at the school. A strong commitment to computer technology was coupled with a school philosophy that embraced constructionism and independent learning. The study suggests that the use of computer technology in a school has the potential to free teachers from the demands of whole class teaching and allow them to focus on individualized instruction.

Teachers have found the change from didactic content delivery to the facilitation of student centered learning harder than anticipated (Hsi, 1998). Collaboration and sharing among colleagues, with a deeper understanding of the material was required. More support and resources were required. It takes more time to plan and prepare and carry out project based learning activities (Sandholtz et al., 1996).

While Swan and Mitriani (1993) feel that computers can change the nature of teaching and learning at its most basic level, others argue that there must be a valid educational reason to use the technology (Salomon & Perkins, 1996). Teachers must see an educational value to the technology before they incorporate into their repertoire.

If educational reform is to succeed, Dede (1998) argues that teachers must alter their pedagogical approaches. He believes that teaching can become more effective and efficient with new types of technology based curriculum and pedagogy. There must be change throughout all levels if the shift to active learning is to thrive (Dwyer, 1994). The ACOT project found that over time the role of the teachers involved in the project changed. Interactions with student s increased, teachers began teaming and collaborating, working across disciplines and modifying school schedules (Sandholtz et al., 1996).

A point of view expressed in several studies is that while computers are here to stay; teachers must accept that and adapt teaching styles and strategies to work with them (Monke, 1996; Strommen & Lincoln, 1992). Teachers must compensate for the mechanistic approach of computers by focussing on the more human aspects of teaching and emphasizing them in their classrooms.

There is a rift between the process of teaching and learning at schools and society at large (Dede, 1998; Strommen & Lincoln, 1992). The role of the teacher requires more

flexibility as it becomes more complex. In fact, Apple and Jungck (1992) found that teachers began to cut corners as intensification of their jobs occurred. The use of outside experts increased and there was a perceived loss of professional control of their lives. Teachers will revert to direct instruction and a lecture-recitation-seatwork model when adequate resources and support are not available (Sandholtz et al., 1996).

Teaching Strategies for Effective Implementation of Technology

A common thread throughout the research is the connection between constructivism and the use of computers in the classroom (Cradler, 1995; MacDonald & Ingvarson, 1997; Strommen & Lincoln, 1992). MacDonald and Ingvarson (1997) feel that a guiding philosophy is needed for effective implementation of technology into the classroom and that constructivism, a theory of cognitive growth and learning holds promise. Collaborative and cooperative environments were seen to be enhanced by the introduction of technology (Software Publisher's Association, 1996). Their research noted increased teacher-student interaction.

The Apple Education Research Series (1994) reported significant pedagogical changes associated with the use of laptop computers. There were increases in the amount of inquiry-oriented instruction and project based activities as well as increased collaboration with colleagues. The Peakview study found that teachers using technology increased the amount and quality of cooperative learning activities (Wilson & Peterson, 1995). Teachers changed the way they worked professionally resulting in greater satisfaction and effectiveness. The ACOT study found that in the elementary school, traditional recitation and seatwork have been balanced with interdisciplinary instruction (Sandholtz et al., 1996).

The benefits of using technology for teaching are generally positive according to Cradler (1995). He noted that there was less directive and more student-centered teaching, an increased emphasis on individualized instruction and more time used by teachers to advise students. Brown (1997) states that new teaching strategies are required. Teachers need to step outside personal experience and into the realm of the learner. Teachers need to focus on outcomes rather than techniques and give students power over their own learning. For learning to be authentic it must have relevance beyond school.

Teachers' Computer Expertise

Improving teachers' skill levels in technology is an important component of teachers' in-service. Becker's (1998) study found that teacher expertise was a strong predictor of teacher valuation of the Internet as essential to good teaching. As the teachers' basic computer skill level increased, so did the teachers' value of technology as an important resource in the classroom and for teacher preparation.

As a teacher's computer skill levels increase there is an impact in the nature and level of technology use in their classroom (Sandholtz et al., 1996).

In their study, Hawkins and Honey (1993) found that short, motivational technological workshops did little to change the ways that experienced teachers taught with computers. There also needs to be a move away from training that one attends away from the job as the primary form of teacher in-service. Job embedded learning and using tools such as action research, study groups and journal writing bring about lasting changes in teachers' instructional practices (Sparks, 1997).

Constructivism and Technology

> Constructivism cannot replace 'teaching'...but others do interpret it as a replacement for teaching. Children need more. We cannot abandon our responsibility to teach, which some think we do in the name of constructivism.
>
> (Sandholtz et al., 1996, p. 177)

Constructivism is a theory of learning in which the learner is an active participant in the educational process. Rather than passively receiving knowledge from others, the learner constructs his or her own knowledge from experience and interaction with others (Scherer, 1999a). Knowledge and learning are dependent on context requiring the teacher to provide an authentic learning environment (Greening, 1998).

A constructivist teacher employs specific teaching practices that enhance student learning and develops a classroom environment in which the learning process is as or more important than the knowledge gained. Integrated learning, differentiated curricula, student led discussion and a focus on a problem solving or project-based activities describe in part a constructivist classroom environment (Fosnot, 1989).

Measurement of student achievement is difficult to assess in a constructivist classroom. Standardized tests do not reflect many of the new learning outcomes that are associated with a constructivist model of teaching (Dede, 1998). It is difficult to quantify creative problem-solving strategies or collaboration with others for a mark in the teacher's grade-book. Sandholtz et al. (1996) link the assessment of student learning with educators beliefs about what constitutes effective teaching. The ten-year ACOT study found that changing teacher's beliefs required much support and time. They suggest that teachers need to develop alternate methods to measure student progress.

Technology is one of the tools that teachers can employ as they seek to improve student learning in their classrooms. Teachers who incorporated technology into their classrooms noted a shift in their instructional patterns as they began to incorporate inter-disciplinary project based instruction into their teaching practices (Sandholtz et al., 1996).

Critics argue that constructivism has no place in the classroom: the methodologies are unsound; the educational benefits have not been proven and there is no accountability (Scherer, 1999a). The research suggests however, that teaching styles and practices must change with the introduction of technology, whether this change is forced on the teacher by the technology or is a planned strategy (Strommen & Lincoln, 1992).

Design of the Study

Overview and Timelines

The purpose of this study was to explore the possible effects of implementing technology into the classroom had on the teaching practices of a specific group of teachers, a vanguard team, in the Southeast Kootenay school district of British Columbia. The vanguard team was based on the ACOT model of assisting classroom teachers in effectively integrating technology into teaching and learning.

Thirty-two teachers initially volunteered for this group from each of the geographic areas of the district and all teaching levels. The purpose for forming this vanguard group was to develop a cadre of innovative classroom teachers who would be given support and training in becoming leaders in the district in integrating technology into their classroom practices.

The results from this exploratory research will form the basis for a more detailed examination of how the teaching practices and role of the teacher changes with the advent of computer technology.

The study was conducted in the fall of 1999 while the school district was undergoing a massive network upgrade. At this time, all schools in the district were becoming wired for fast Ethernet network capability, a significant improvement from what previously existed. The vanguard concept was put on hold while the network infrastructure was completed. The data was collected and entered into the database in December 1999 for statistical analysis. The results were tabulated and the report prepared in the spring of 2000.

Description of the Study

This is a case study of a group of teachers in the Southeast Kootenay school district who volunteered to become members of a vanguard team. A case study was chosen as the appropriate model for this research based on the specific group being studied and the volunteer nature of their selection. Borg and Gall (1983) believe that a case can be located that is typical of many other cases. In this instance, a case study offered the potential to better understand the vanguard group and develop a detailed description of the specific teaching practices and roles associated with them.

Initially a combination of a survey and semi-structured interviews was proposed but time constraints led to the abandonment of the interview section. Ideally, a follow-up to this research would include a series of semi-structured interviews with the topic outlines based upon the survey results obtained.

A preliminary survey instrument was designed and field-tested in the spring of 1999 with a group of teachers who were not members of the vanguard team. Based on these preliminary survey results, additional topic areas and questions were developed and refined. These changes were incorporated into the final document (Appendix D) that was sent to the vanguard group in October 1999.

Characteristics of the Sample

The sample group consisted of members of the school district's technology vanguard team, a structure developed to provide support for instructional change based upon ideas developed in the ACOT study (Sandholtz et al., 1996). Thirty-two teachers volunteered to be part of the vanguard team in the spring of 1999. The teachers who volunteered were representative of the disparate geographic areas of the school district

and consisted of balanced numbers of elementary and secondary teachers. The vanguard team received four days of in-service in April and May, 1999 specific to incorporating technology into their classroom practices. In addition, teacher volunteers were expected to commit to becoming teacher-leaders in their schools working as mentors with other teachers, modeling appropriate instructional strategies for the use of technology and providing role models for other teachers.

A survey package with a covering letter (Appendix B) outlining the study was sent to all 32 vanguard team teachers in October of 1999. Included in the package were the consent letter (Appendix A), survey document (Appendix D), and a self-addressed return envelope.

Completed surveys and consent letters were received from 26 respondents resulting in a participation rate of 81.25%. After the first batch of surveys were returned, a follow-up letter (Appendix C) was sent in November 1999 to those vanguard team members who did not respond to the initial package. Two teachers chose not to be part of the survey, replying by letter or notation on the survey form that they did not wish to be part of the survey. Four others did not respond in any manner to either the first or second survey package and no further follow-up was made. Table 1, Characteristics of the Sample, describes the demographics of the 26 respondents.

Table 1: Characteristics of the sample

Sample	Number	Percent of Category	Percent of Total
Elementary (male)	6	46	19
Elementary (female)	7	54	22
Subtotal	13	100	41
Secondary (male)	6	46	19
Secondary (female)	7	54	22
Subtotal	13	100	41
Surveys Not returned	6	19	
Surveys Returned	26	81	
Total Sample	32	100	101

Design of the Survey Instrument

The design of the survey instrument was based upon the basic themes identified in the review of the literature:

- Teachers' backgrounds and philosophies and attitudes influence their teaching styles and strategies.
- Teachers' computer expertise is related to the effective implementation of technology in their classrooms.
- There are specific teaching strategies and practices that enable teachers to effectively implement technology into the classroom.
- The role of the teacher changes with the implementation of technology into the classroom.

The first section included demographic questions for developing a teacher profile. The information requested from each teacher included the grade level taught, years of experience, gender, academic degrees, number of workshops attended, computer availability and the availability of Internet access at home.

The second section was designed to examine teachers' attitudes towards the use of technology in the classroom. Nineteen topic statements were devised to measure attitudinal indicators of effective implementation and integration of technology as identified by Sandholtz et al. (1996) and Becker (1994, 1998).

Several studies have shown a relationship between a teacher's computer skill level and the degree and effectiveness of the implementation of technology into the classroom (Becker, 1994, 1998; Sandholtz et al., 1996). The third section used 17 questions to assess teachers' technology skills. The topic statements were based in part on the expected student learning outcomes of the B.C. Information Technology IRP (Ministry of Education, 1996) and the school district's scope and sequence guidelines for technology skills.

The fourth section, an examination of teaching style and practice was a set of paired questions which compared contrasting views of instruction and construction. Each pair of questions contained a traditional teaching style and practice coupled with a constructivist teaching style and practice. In developing these paired statements, I relied heavily on the work of Sandholtz et al. (1996, p. 14).

The final section of the survey instrument used a mix of closed and open-ended questions to assess the degree of change in the teacher role over the past three years and the effect of technology on any changes. The open-ended questions were included so that

respondents could answer in more detail, elaborate on some complex issues and provide an opportunity for a wider examination of the topic.

Data Collection and Analysis

The data obtained from the surveys were initially tabulated by hand on paper and checked twice for accuracy. The raw data was used in preparing a specific dataset that could be used by the statistical software package. Once the data was entered into the dataset, it was checked for accuracy against the hand tabulations and any errors checked and corrected. Descriptive statistics were calculated for each of the survey items with the exception of the open-ended questions.

Data tables were produced for each of the four sections of the survey. These tables included the mean, standard deviation, standard error, count, range and number of missing responses. An analysis of variance was completed on all survey items using gender, teaching level (Elementary or Secondary) and teacher location (East or West) as factors. ANOVA tables were prepared for each of the items analyzed and significant differences were noted in the data tables.

The open-ended responses were transcribed and examined for trends and similarities. As themes emerged for each question, individual responses were grouped then analyzed for content and comparison with other sections of the survey.

Results

As a result of my interest in examining how technology changes the role and function of a teacher in the classroom, I was able to gather data pertinent to the question: Does the effective integration of information technology into the school curriculum require classroom teachers to change their teaching styles and strategies?

The results from the survey were collected and entered into a database for analysis by StatView 4.01, a statistical software package developed for the Macintosh computer system by Abacus Concepts. Descriptive statistics were prepared for all responses and each survey item was analyzed for variance (ANOVA) based on the gender, teaching level and geographic location of the respondents.

In determining how I should interpret the results, data tables were developed showing frequency distribution of the responses with associated percentages as well as means tables, including standard deviation and standard error. Due to the small sample size and nature of the group studied, I was interested more in any trends I could attribute to the survey items and the individual comments from the respondents than in a pure statistical analysis of the numbers.

A combination of the two approaches seemed to work the best. The results have been organized around the four sections of the survey instrument: Teacher Attitudes Towards Information Technology, Teacher Information Technology Skills, Teacher Practices and the Role of the Teacher. Each section includes tables or figures that detail the results obtained and form the basis for my description of the findings. The comments for each section include details of the survey items, the scale used and an analysis

of findings. Items that are significant at $p < .005$ are noted and commented on separately.

For the analysis of variance, Fishers PLSD test, a component of the StatView 4.01 statistical package was used. A significance level of $p < .005$ was chosen due to the small sample size and nature of the group. While significant differences were indicated based upon the teaching level and or gender of the respondents, no significant differences were noted based upon the geographic location of the respondents.

Teacher Attitudes Towards Information Technology

Vanguard team members were asked to use a four-point scale to indicate their agreement with a range of questions related to the use of technology in the classroom. Scale values ranged from 1 indicating "Strongly Disagree" to 4, representing "Strongly Agree" with a mid-point of 2.5. Table 2 is ordered by means response for all vanguard team members who answered the questions.

The responses confirm what one might expect from a self-selected group such as the vanguard team; a very positive outlook on the educational use of technology for themselves and in the classroom. One would expect that teachers with a positive attitude towards technology would rate "I would like to integrate technology into my class more often" (3.77) high and "I see little benefit to my teaching responsibilities or to my students from the use of computer technology and software" (1.15) low, just as the vanguard team did. All survey items that directly relate to teacher attitude towards technology rated above the mid-point on the scale. It is clear from these responses that members of the vanguard team are extremely positive in their attitude towards the use of technology, both personally and professionally.

The following responses earned mean values below the mid-point on the scale indicating possible areas of concern for the respondents:

- Increased professional control of my teaching role (2.47)
- Adequate technical support for the maintenance of hardware and software (1.58)
- Adequate provision made to prepare me to use computers in the classroom (1.46).

These three topics have been identified as critical barriers to implementing and integrating technology into the classroom (Sandholtz et al., 1996).

Table 2 also describes the significant differences noted in this section. In all of the analyses of variance for each of the topics, it became evident that there are significant gender differences associated with all aspects of technology. In this section, female teachers are less likely to indicate that they would use personal time to gain computer skills than their male counterparts. They were also less likely to respond that they collaborated with colleagues more due to the impact of technology than did males counterparts, and were also less likely than males to keep abreast of current trends in Information Technology. The implications for these differences and recommendations are discussed in the summary section of this document.

Table 2. Teacher Attitudes towards Information Technology

	Elementary		Secondary		
Attitude	Female	Male	Female	Male	Total
Comfortable learning about and using technology	4.00	4.00	3.71	3.80	3.85
Like to integrate technology into class more often	4.00	3.83	3.71	3.60	3.77
Will use technologies proven to improve teaching practice	3.57	4.00	3.43	3.40	3.62
District staff focus should be on integrating technology	3.86	3.67	3.14	3.80	3.64
Technology helps me do things in the classroom	3.57	4.00	3.00	3.60	3.54
Comfortable helping others with technology	3.29	4.00	3.14	3.80	3.50
Take personal time to use learn and practice (1)	3.43	4.00	3.00	3.60	3.46
Hands on workshops give me skills to teach effectively	3.14	3.83	3.14	3.80	3.42
My teaching is more effective because of technology	3.00	3.83	2.71	3.00	3.15

(table continues)

Table 2. (continued)

Attitude	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Informed and keep abreast of current trends in technology (2)	3.00	3.67	2.43	3.60	3.08
School-based administrative support for using technology	3.00	3.67	2.86	2.40	3.00
District-based encouragement for using technology	3.14	2.83	3.00	3.00	3.00
Collaborate and share more with colleagues (3)	2.29	3.67	2.29	3.00	2.73
Cutting corners as teaching duties increase	2.00	3.17	2.86	2.80	2.72
Increased professional control of teaching role	3.40	2.50	2.17	2.00	2.48
There is adequate technical support for maintenance	1.00	1.83	2.00	1.60	1.58
One day workshops give me skills to teach effectively	1.14	1.33	1.71	1.40	1.54
Adequate provision made to prepare me to use computers	1.29	1.33	2.00	1.20	1.46

(table continues)

Table 2. (continued)

	Elementary		Secondary		
Attitude	Female	Male	Female	Male	Mean
I see little benefit to using technology in my classroom	1.14	1.00	1.14	1.40	1.15

1. Female teachers differed significantly from male teachers [$p < .005$]
2. Female teachers differed significantly from male teachers [$p < .005$]
3. Female teachers differed significantly from male teachers [$p < .005$]

Teacher Information Technology Skills

The vanguard team members were asked to use a five-point scale to indicate their skill level in using computers and other information technology tools. The scale values ranged from 1 indicating "no skill" to 5 "proficient" with a mid-point of 3.0. Table 3 is ordered by mean response of all vanguard team members who answered the question.

Teachers who have a high level of computer expertise are more likely to be successful in integrating technology successfully into their classrooms (Becker, 1998). It is apparent that the vanguard team members rate their skill level high most areas. All topics except posting student work to the World Wide Web had mean scores greater than 3.0 indicating that the vanguard team members believe they have basic or higher skills in almost every topic covered in the survey.

Teachers did not rate their skills in using technology to enhance or promote student learning as high as their own personal computer skills with the following areas receiving mean scores less than 4.0:

- Using technology to enhance instruction (3.92)
- Designing, delivering and assessing learning activities that use technology (3.83)
- Troubleshooting basic hardware problems (3.73)
- Use digital imaging devices (3.38)
- Use drill and practice activities (3.35)
- Develop instructional units based on IRP (3.20)
- Use presentation software (3.07)
- Post student work to the World Wide Web (2.73).

Significant differences were again noted between the perceptions of male and female vanguard team members regarding their individual computer skill levels (see Table 3). The female teachers rated their skill level in designing, delivering and assessing student learning activities that integrate technology significantly lower than their male counterparts. Also, female teachers rated their skills in designing instructional units that incorporate the learning outcomes from the Information Technology IRP lower than male teachers did. The third area where female teachers differed from male teachers was in posting student work, resources and other material on the World Wide Web.

Table 3. Information Technology Skills

	Elementary		Secondary		
Skill	Female	Male	Female	Male	Mean
Create a simple word processing document	5.00	5.00	5.00	4.80	4.96
Prepare student report cards	4.86	5.00	4.71	4.80	4.77
Browse the Internet	4.57	4.50	4.86	4.80	4.69
Use multi-media interactive encyclopedia	4.57	4.83	4.43	4.80	4.65
Use Internet search engines	4.43	4.67	4.43	4.80	4.58
Operate a multi-media computer with printer	3.71	5.00	4.14	5.00	4.34
Download material from the Internet	3.86	4.67	4.00	4.80	4.27
Send and save e-mail attachments	4.43	4.67	3.43	4.80	4.19
Use advanced features of word-processing software	4.29	4.50	3.43	4.60	4.12

(table continues)

Table 3. (continued)

Skill	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Use technology to enhance instruction	3.43	4.67	3.57	4.20	3.92
Design and deliver learning activities that use technology (1)	3.00	4.67	3.17	4.80	3.83
Troubleshoot basic hardware problems	4.00	4.67	2.43	4.63	3.73
Use imaging devices: such as scanners, cameras, videos	2.71	4.50	2.86	4.00	3.38
Use drill and practice applications	3.00	4.67	3.00	3.00	3.35
Integrate IRP outcomes into instructional units (2)	2.29	4.50	2.67	3.60	3.20
Use presentation software	2.71	4.50	2.00	3.80	3.07
Post student work and resources on the World Wide Web (3)	2.29	4.17	1.43	3.60	2.73

1. Female teachers differed significantly from male teachers [$p < .005$]

2. Female teachers differed significantly from male teachers [$p < .005$]

3. Female teachers differed significantly from male teachers [$p < .005$]

Teacher Practices

Teachers were asked to describe their teaching style by indicating the frequency of use for specific strategies and approaches in their classrooms. The 20 questions were designed as structured pairs, each pair set based on the concepts described by Sandholtz et al. (1996) regarding the shift from knowledge instruction to knowledge construction in the classroom. Respondents were asked to use a five-point scale to respond to each pair of items. Scale values ranged from 20 % to 100% in 20% increments. The respondents were asked to answer each pair of questions, ensuring that the total percentage for each pair equaled 100%. In Table 4, the teaching practices/strategies are arranged in paired sets according to percentage of time respondents indicated they utilized either constructivist or traditional teaching approaches. The first question in each pair reflects a constructivist approach while the second question is based on a traditionalist methodology.

Vanguard team members use a variety of instructional practices and approaches. While there are slight variations between the percentage of time devoted to traditional instruction versus constructivist activities, overall constructivist instructional practices account for over 50% of the time allocated in each of the categories. Figure 1, percentage of time associated with teacher instructional practices, depicts a graphical representation of these results.

Table 4. Classroom Practices

	Elementary		Secondary		
Practice	Female	Male	Female	Male	Mean
Technology used for communication, collaboration and creativity	68.57	70.00	82.85	75.00	75.20
Technology used for drill and practice and basic skills	31.42	30.00	16.66	25.00	25.00
Learning is co-operative	80.00	66.66	71.42	68.00	72.30
Learning is competitive	20.00	33.33	28.57	32.00	27.69
Student success measured by quality of knowledge	80.00	63.33	74.28	50.00	68.07
Student success measured by quantity of knowledge	20.00	36.33	25.71	48.00	31.53
Emphasis on the learning process, problem-solving	68.27	70.00	71.42	56.00	67.69
Emphasis on facts and replication	31.42	30.00	28.57	48.00	33.84

(table continues)

Table 4. (continued)

	Elementary		Secondary		
Practice	Female	Male	Female	Male	Mean
Teacher role as facilitator	65.71	66.66	62.85	48.00	61.53
Teacher role as fact teller and expert	34.28	33.33	37.14	52.00	38.46
Learning environment adapts to student	77.14	66.66	57.14	40.00	60.76
Student adapts to the learning environment	22.85	33.33	42.85	60.00	39.23
Assessment by student performance/ portfolios	60.00	63.33	57.14	52.00	57.69
Assessment by norm, criterion referenced and multiple choice	40.00	36.66	42.85	48.00	42.30
Student assumes role of collaborator and expert	45.71	70.00	60.00	48.00	56.14
Student assumes role of listener and learner	54.28	30.00	40.00	52.00	43.84

(table continues)

Table 4. (continued)

	Elementary		Secondary		
Practice	Female	Male	Female	Male	Mean
Teaching activities are learner focussed and interactive	57.14	63.33	48.57	52.00	55.38
Learning activities are teacher centered and highly structured	42.85	33.33	51.42	48.00	43.84
Instruction is interdisciplinary and thematic	65.71	60.00	45.71	44.00	53.84
Instruction focuses on specific study content	34.28	40.00	54.28	56.00	46.15

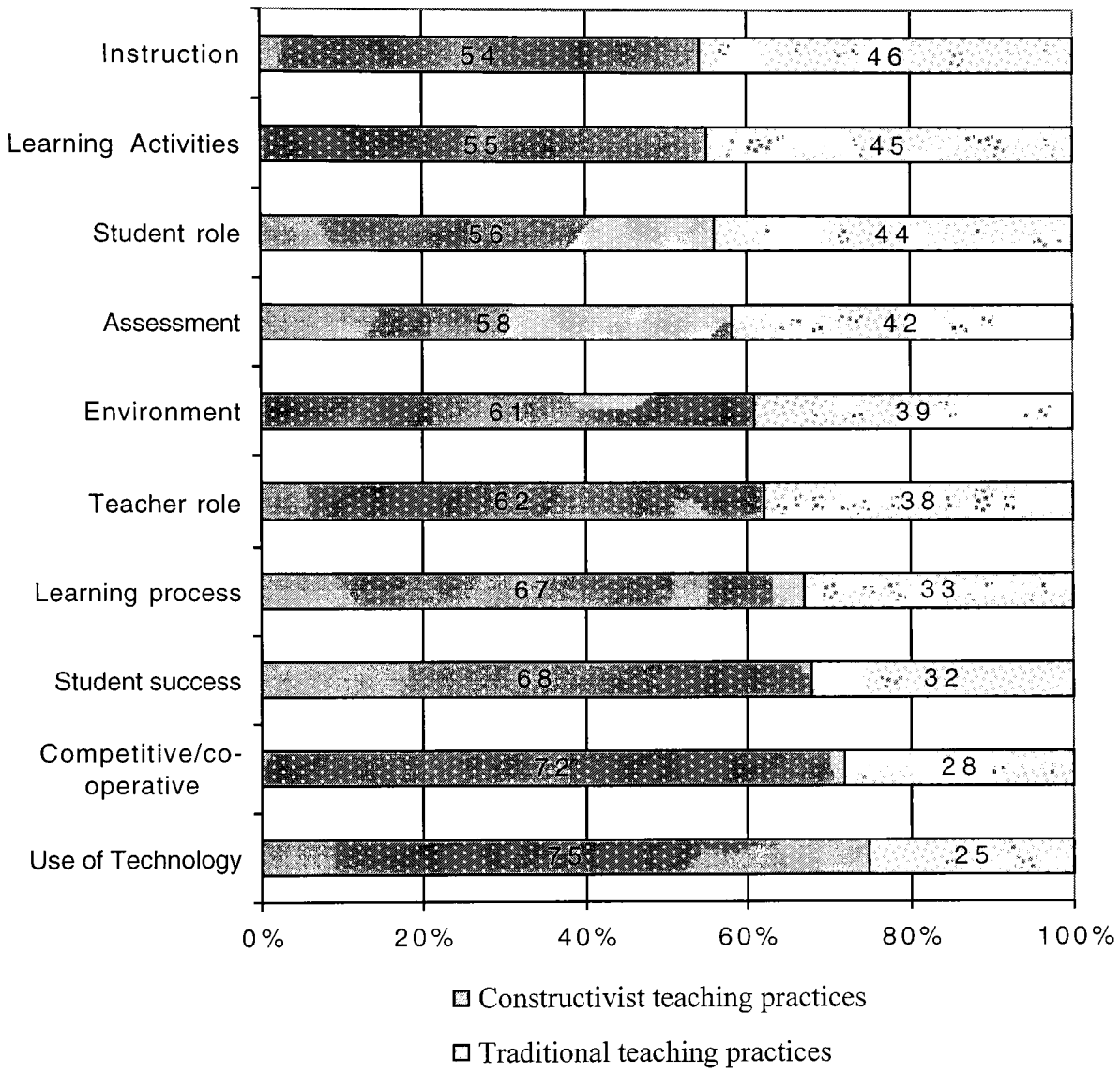

Figure 1: Percentage of time associated with teacher instructional practices

Role of the Teacher

Respondents were asked to use a three-point scale to indicate (1) the importance of computers in their instruction and (2) the frequency that specific teaching practices were used. Scale values for the importance of computers ranged from 1 indicating "not important" to 3 "very important" with a mid-point of 2. Scale values for the frequency that specific teaching practices were used ranged from 1 indicating "less frequently" to 3 "more frequently" with a mid-point of 2. In Table 5, the mean responses are recorded for each of the topic areas.

Significant differences were noted between female teachers and male teachers in the importance of computers to their teaching in 1997-1998. There were also significant differences noted between elementary and secondary teachers in frequency of use of computers (see Table 5). Elementary teachers use the computer more for class preparation and non-school activities than secondary teachers.

The data indicates that computers are becoming more important to teaching. The three year trend shows the mean progressing from 2.19 (1997-1998) to 2.46 for the current school year.

Respondents noted that they are using computers more frequently for non-school activities (2.65); for teacher preparation (2.46); for trying out new software (2.42); and for student projects (2.42).

Compared to three years ago, teachers use the following practices more frequently: evaluating students through products instead of tests (2.65); having multiple activities going on at the same time (2.57); and allowing themselves to be taught by

students (2.53). Computers have played a major role in these changes as noted by teachers (2.44)

The vanguard teachers are more likely to be using the following assignments or practices now compared to three years ago: students working together in groups (2.57); students teaching or helping each other (2.50); students working on own projects (2.38) and students reviewing and revising their own work (2.38).

Table 5. Role of the teacher

Teacher role and technology	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Importance of computers to your teaching in each of past 3 years					
This year, 1999-2000 (1)	2.57	2.50	2.28	2.40	2.46
Last year, 1998-1999	2.28	2.83	2.14	2.20	2.38
1997-1998	1.85	2.50	1.85	2.60	2.19
Are you using computers more frequently in these ways?					
Using the computer for class preparation (2)	3.00	2.83	2.14	1.80	2.46
Assigning students to use computers	2.28	2.00	2.28	2.60	2.26
Requiring students to use computers for projects	2.28	2.16	2.57	2.60	2.42

(table continues)

Table 5. (continued)

Role	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Using computers for non-school activities (3)	3.00	3.00	2.57	1.80	2.65
Trying out new software/hardware	2.71	2.66	2.00	2.20	2.42
Compared to three years ago, how much do you use the following practices?					
Plan a lesson using principles of direct instruction	1.42	1.50	1.42	2.00	1.61
Have multiple activities going on at the same time	2.42	2.83	2.42	2.60	2.57
Use the textbook as the primary source for planning a unit	1.28	1.50	1.57	2.00	1.57
Let student interest influence lesson topics	2.57	2.83	2.00	2.40	2.46

(table continues)

Table 5. (continued)

Role	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Evaluate students through their products rather than tests	2.85	2.83	2.57	2.20	2.65
Allow myself to be taught by students	2.71	2.83	2.42	2.00	2.53
How much of a role have computers played in the changes noted above?	2.42	3.00	2.00	1.80	2.44
Compared to three years ago how often do you give the following assignments?					
Students teach or help each other	2.85	2.50	2.57	1.80	2.50
Students work together in groups	3.00	2.50	2.57	2.00	2.57
Students work on their own projects with minimal direction	2.28	2.83	2.42	1.80	2.39

(table continues)

Table 5. (continued)

Role	Elementary		Secondary		Mean
	Female	Male	Female	Male	
Students answer questions from the textbook	1.14	1.16	1.71	1.40	1.34
Students review and revise their own work	2.57	2.66	2.00	2.20	2.38
Students take comprehensive notes	1.28	1.16	1.57	1.60	1.38
How much of a role have computers played in the changes you noted above?	2.42	2.66	2.00	1.80	2.28

1. Female teachers differed significantly from male teachers [$p < .005$]
2. Elementary teachers differed significantly from secondary teachers [$p < .005$]
3. Elementary teachers differed significantly from secondary teachers [$p < .005$]

Open-ended responses.

Teachers were asked to complete five open-ended questions as part of the survey. The individual responses have been included in their entirety in Appendix E. The first open-ended question asked teachers to draw diagrams comparing their classroom organization and structure as it was three years ago with today. In examining the

responses it became obvious that there were no discernible patterns or similarities that could be graphically stated. My intention was to look for trends or patterns that could describe a typical classroom where technology was being integrated or implemented into the curriculum. Based upon the responses received, I was unable to do this.

The second question asked how integrating technology into the curriculum changed the way you taught. The responses were coded into three separate groupings: responses that mentioned project based or student centered learning, responses that describe the Internet or other on-line technologies and a third general category. The largest group of responses related to the use of project based instruction. Four respondents indicated that the Internet was responsible for changes in their teaching. The remaining responses were recorded under a general heading.

Many of the respondents commented on how project based or student centered learning allowed for more flexibility in the classroom. Students were able to work on independent projects and the teacher was able to manage more groups working simultaneously in the classroom.

The Internet allowed for more flexibility in project presentation, group work and individual work. Teachers felt that there were opportunities to enhance student learning through the use of the Internet.

The remaining responses included a wide range of comments, from the efficiency afforded by the use of computers to the numerous possibilities available and the lack of departmental budgets to fund technology.

The third question asked teachers to state any educational concerns they had regarding the use of technology in their school or class. The responses fit into three broad

categories. The majority of the responses had to do with the cost and time implications of implementing technology. Many respondents were concerned with the lack of time for teachers to become familiar with technology, the lack of support for hardware/software problems, the costs associated with technology and the ability to keep up with the fast pace of technological change.

Another cluster of responses was around the appropriate use of software, hardware and the Internet, with concerns raised about student plagiarism due to the ease of copying files over the Internet. The value of educational software was another issue mentioned. The appropriate utilization of high-end computers was another concern.

The teaching methods or beliefs related to the use of technology in the schools were the last theme to emerge from the third question. Technology needs to be seen as an educational tool to attain learning objectives. The pace of introduction has been slow and little thought has been given to future needs. At the elementary level there is too much emphasis on technology.

The fourth question, asking teachers whether removing computers from the classroom would have an impact on how they taught, elicited responses that were clustered around three areas: teacher preparation and use, impact on student learning, and no impact. Teachers on the vanguard team are using technology to support both their teaching in the classroom and in their preparation for instruction.

The final section asked the vanguard team teachers what technology related skill they would most like to learn in the upcoming year. Teachers who responded indicated the most interest in learning about web design and related activities followed by video and other techniques, networking skills and software tools. This correlates with the low skill level noted in Section C of the survey for web related skills. Vanguard teachers recognize the need for training in this area.

Observations

The results indicate that the subject group has a positive attitude towards the use of technology to enhance student learning. They want to learn more about integrating technology into their teaching and develop specific skills to help them use the technology in the classroom. There is a lack of technical support for maintaining the hardware and software in the schools. The provisions for staff training in the effective use of technology are inadequate.

The vanguard teachers rate their individual computer skill levels intermediate to proficient in most areas. From creating a simple word-processing document to using advanced features of the software to create professional looking products, teachers' perceptions of their skill levels are high. Web based skills and using presentation software are two areas of weakness for most teachers in the subject group.

Teachers structure their lessons and assignments to reflect a constructivist approach to learning and knowledge. Elementary teachers are more likely to use a constructivist approach than secondary teachers are. Teachers view the computer as an important factor in changes in their role of teacher.

Summary

The data described in great detail in the previous chapter needs to be examined in a different light, perhaps under another lens, in order to make it meaningful in the context of the classroom teacher. This study developed from my strong interest in understanding more about how I had grown and changed as an educator coupled with my personal belief that the integration of technology into my classroom was an essential element of this equation. The research question that provided the structure and guidance for the study needs to be examined and evaluated in the light of the results:

> Does the effective integration of information technology into the school curriculum require classroom teachers to change their teaching styles and strategies?

At this point I can only state, perhaps. This study has given me the opportunity to peek behind the classroom door and look at how other teachers perceive their teaching skills, practices, roles and beliefs. It is but a first step in a much larger project, one that will require more time and greater resources. The results from this exploratory study will, however, provide a strong foundation for this next and important step.

So what does this all mean? I have some observations and comments that may prove helpful in interpreting the findings and providing meaning for the reader. Each section of the study will be commented on in the following pages.

Discussion

All of the schools in the district were undergoing a massive data-cabling renovation to upgrade existing computer networks to a Fast-Ethernet capability. Things were happening in the schools and the anticipation of integrating modern technology into

their classrooms had many teachers excited and hopeful. The reality six months later is slightly less optimistic. Delays in construction and the attendant technical problems with designing and installing a new network have left many teachers without access to computers for the better part of the school year. Hopes and dreams of integrating technology into daily instruction have evaporated for many. Inadequate levels of funding have resulted in a scaling down of the overall project with fewer features that teachers need to ensure a positive implementation. If the survey was to be conducted in this climate, I believe that the results would reflect a different perception of technology and its importance to education.

Teacher attitudes.

I had expected that the vanguard group would have very positive attitudes towards the use of technology and I was not disappointed. The very nature of the group precluded those who did not see an important role for technology in the classroom. These teachers are the innovators in the district; teachers who are willing to invest the time and effort to use technology to enhance the learning climate in their school. Sandholtz et al. (1996) found that there needs to be a supportive atmosphere for innovation to flourish. If this support is not present then the innovation will not be successful.

Several questions were put to teachers that asked for their perceptions regarding various levels of support for technology. There was strong agreement with the idea that a district staff focus should be on learning how to integrate technology. However, when asked if adequate provision had been made to prepare teachers to use computers in the classroom, the responses were strongly in disagreement. This is an area of weakness in the district and will have to be addressed.

Surprisingly, there appeared to be strong agreement that there was school and district-based support for using technology. This is surprising because one would assume that this level of support would be closely linked to provisions for preparing teachers to learn to use the new technologies. We are dealing with teachers' perceptions only, and perhaps the hype and glitz that accompanies an innovation causes a more positive outlook that the reality suggests. I feel that if the survey was to be conducted again, the results might be slightly lower due to the circumstances of the network delays and other infrastructure problems. As Sandholtz et al. (1996) point out, there needs to be strong administrative support at all levels for technology to implemented effectively and these results support that belief.

No matter how motivated a teacher is to integrate technology, if the technology doesn't work then it won't be used. Adequate technical support in order to keep the network and individual computers functioning is another of the ACOT study's key findings that Dwyer (1994) notes. This means that teachers must be able to count on the technology to work for them, and when it breaks down, to be fixed quickly. The perceptions of vanguard teachers show that this support is not in place. They strongly disagree with the survey statement. These are just perceptions of the teachers surveyed but they do reflect those teachers' realities. The school district must be proactive in addressing this concern or the enthusiasm of these technology proponents may be lost.

A single question in the attitude section addressed the issue of one-day motivational workshops and their effectiveness. The question was poorly worded and may impart an unintended bias to the respondents. The question was included because of the nature of many of the staff development options regarding technology. Many staff

development opportunities are little more than sales pitches for the latest software or hardware. This is the context then, that the question was framed. Not surprisingly, teachers did not agree that these one-day motivational workshops gave them the skills necessary to teach effectively with technology. In a subsequent question, teachers rated hands-on workshops as being very effective in providing teachers with the skills they needed to teach effectively. A serious effort needs to be made to couple the vanguard team's strong interest in learning how to implement technology into their classrooms with their perception that some of the current in-service opportunities may not be effective.

The significant differences between female and male teachers may be indicative of the realities faced by female teachers in the educational system. Female teachers may have the added responsibilities of looking after children and maintaining the household, thus not having personal time to learn and practice their skills. Keeping abreast of most technology and sharing and collaborating with colleagues may also have much to do with the availability of time. So rather than an attitude difference between male and female respondents, it might be more deeply rooted in our society. Females may have less time to utilize than their male counterparts. The extra time they have is used for family and other societal expectations.

The key observations from this section are:

- There needs to be strong support and encouragement from all levels of the district, both school and district-based.
- Technical support for both software and hardware is critical to the success of any technology innovation.

- Provision must be made for professional development opportunities that are hands-on and geared to the needs of teachers looking to teach effectively with technology.

Teacher Skills.

Becker (1998) found that there was a strong relationship between teacher skill levels and their perceived value of the use of technology for educational purposes. The stronger the teachers' computer skill levels, the higher value they placed on the importance of using technology in the classrooms. Becker did not measure actual teacher skill levels, rather he asked teachers to rate their individual skill levels in much the same way as this study did. What these results give us are teachers' perceptions only. These perceptions may be valuable in predicting teacher acceptance and use of technology for educational purposes.

This group rates its individual skill level in using the computer as tool for educational purposes very high. Taken at face value it shows that these teachers have the necessary skills to incorporate technology into their classrooms. My personal feeling is that these self-ratings are somewhat high. My sense is that the vanguard team interpreted each topic statement based on their own reality rather than on an objective set of standards. This is the fault of the survey instrument. In hindsight, it is clear to me now that there were several levels of interpretation open to respondents. While using the ruler to set tabs may be an advanced feature of a word-processor to some, others might not agree. As a rough guide to teachers' technical competencies, this part of the survey was adequate, however to truly assess teachers' skill levels a much more detailed tool must be

employed. Subsequent surveys should ask detailed, skill specific questions, ones that are not subject to personal interpretation.

Several topics are important to note. Teachers' skills in posting material on the World Wide Web are self-rated from minimal to basic. In fact, many secondary female teachers felt they had no skills in this area. With the introduction of the district network and the expectation that many of our resources will be shared on-line, the implications for in-service needs are great. If the innovators in the district have minimal skills in this area, what about the technologically hesitant? The technology leaders in the district need to share their enthusiasm and skill with other teachers in order for the innovation to be successful (Becker, 1998). Without a strong group of leaders, those who have the skills and can share them, the integration of technology may be unsuccessful.

It is important to note that female teachers perceive their skill levels as being lower than males. In almost every category, female teachers rated their skill level lower than male teachers did. This may reflect a more honest assessment on their part, rather than discrete skill differences, however it accompanies the differences noted in the teacher attitude section. There were three topic statements that recorded significant differences: the designing and delivering of instructional activities that integrate technology; developing instructional units that integrate learning outcomes from the technology IRP; and posting student work and other resources on the World Wide Web.

This suggests that a differentiated in-service program for female teachers may be appropriate. It appears obvious, from an examination of the data, that female teachers may have entirely different learning needs. A one-size fits all approach to professional

development may not address many of the fundamental skills that female teachers have identified as needing improvement.

Teacher practices.

This section was quite difficult to analyze. I wanted to see where teachers placed themselves on a constructivist/traditionalist continuum. The research suggests that teachers who believe in project-based or other constructivist-compatible practices are better able to integrate technology effectively into their instruction (Becker, 1998; Dwyer, 1994; Sandholtz et al., 1996). I found that for myself, embracing a project-based approach to instruction and learning was emancipating. It enabled me to rekindle my passion for teaching and find new meaning in my professional life. However, I am forced to look back at my key question: Does the effective integration of information technology into the school curriculum require classroom teachers to change their teaching styles and strategies? I am not sure that I have an answer for this. The sample chosen for this study does not accurately reflect the teachers in the school district; however they are representative of the teachers who view technology as important to the educational process. Were they drawn to the use of technology in their classrooms, like moths to a flame, because of their philosophical beliefs or did their use of technology require them to change their beliefs about teaching and learning?

It appears from an examination of the data that the vanguard group leans towards a constructivist pedagogy, particularly in the use of technology. I agree with Sandholtz et al. (1996) that the most effective teachers are those who balance their instruction between construction and instruction, so as to provide the most benefit for all learners. Secondary teachers were more traditional than the elementary teachers, which is not surprising given

the constraints of the secondary curriculum. Elementary teachers seem to have more control over their learning environment and can adapt their instruction to meet the needs of the student. Secondary teachers appear to measure their students' success more on quantity of knowledge rather than quality of knowledge. These significant differences reflect the polarity of the two systems rather the teaching abilities of individual teachers.

Role of the teacher.

Several themes emerged that were closely related to perceptions recorded in the previous section. Constructivist practices such as: individual projects; students helping one another; students teaching each other; and multiple activities going on at the same time in the class were occurring more frequently compared to three years ago. Teachers indicated on the survey that they believe computers had a major role in these changes. There was a corresponding decrease in the use of some traditional teaching practices: using the textbook as the primary source for planning a unit; and planning a lesson using the principles of direct instruction. Miller and Olson (1994) believe that a teacher's prior practices and philosophy have more influence on how the technology is used than the technology itself. This may account for some of the differences between the elementary and secondary teachers. There is evidence that teachers tend to teach as they were taught, and the importance of subject matter at the secondary may dictate a direct instruction approach (Sandholtz et al., 1996).

The open-ended responses were interesting to read (see Appendix E). Much of the emphasis that the teachers expressed cannot be easily transcribed from their hand-written notes to a word-processed document. Big, bold lettering with heavy underlining makes a point that is difficult to duplicate in this document. Even without a visual context, the

messages are clear and easy to understand. A dollar sign repeated several times and underlined makes a strong point.

The lack of funding to support the introduction and integration of technology was one of the main themes present throughout the comments. Teachers cannot see how they can keep up with the rapid pace of technological innovation as they are faced with decreasing school district budgets. The lack of funding is critical in four areas: the acquisition of hardware; the upgrading and purchasing of software; maintenance and support for the technology; and provision of training opportunities for teachers to develop the necessary skills. Not enough time to implement technology, to learn about new software and upgrade their skills is closely related to the cost issue. I am not sure it can even be separated.

When asked what technology skill they would like to learn in the next year, the teachers responded with a list of topics so disparate (see Appendix E) that only individualized staff development would be appropriate. This is in keeping with a constructivist approach to learning and may provide a basis for modeling suitable instructional strategies for teachers to emulate.

Future Directions

There were several design problems associated with the survey instrument. Three- four- and five-point scales were used rather than a single Likert five-point scale. Making valid comparisons between the various factors was severely limited by this error. In addition, the scale I used for comparing the amount of time teachers devoted to constructivist or traditional practices was unwieldy, leading to problems with an accurate analysis of the responses. Several of the survey items were poorly worded, leading to

possible misinterpretations by the respondents. A careful rewriting of this survey instrument based upon the results gathered so far should address these concerns.

The data provides a jumping off point for the next step, a more detailed examination of the teaching practices and ways to support and enhance the use of technology for educational purpose. Ultimately teachers decide what happens within their classrooms and most would be willing to adopt and adapt new ideas if they are shown to be effective in helping students to learn. The next stage of the research is to isolate those strategies that have been successful and devise strategies for sharing them with other teachers in the district. Technology can be a catalyst for change if the necessary conditions are in place.

As with most survey research, its value lies with the intended use of the results. The conclusions to be drawn from this data can only be applied to a select group of teachers in the school district; no inferences can be made that will apply to the majority of teachers. Having said that, I am pleased with the results gathered. They give quite a detailed picture of the attitudes, skills, practices and perceptions of the role of the vanguard group of educators in the school district. This is extremely important as the vanguard group include the leaders that will guide the district into the technological future. Their perceptions are valid, they have passion for the use of technology and the dedication to follow through and see their dreams about implementing technology come to fruition.

Like Alice, I can't go back to the beginning of this study because I was a different person then. My question remains unanswered but that is fine. It started me on a journey that will continue beyond the pages of this paper.

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Appendix A

Research Participation Consent

Dear Colleague:

I am conducting a study of the effect of implementing technology on teaching style and the role of the teacher. The purpose of this study is to ascertain whether the effective integration of information technology into the school curriculum requires classroom teachers to change their teaching styles and strategies. I would like you to participate in this study.

As part of the research you will be asked to complete the enclosed questionnaire.

All information will be handled in a confidential and professional manner. Your participation is strictly voluntary and you are under no obligation to participate in any way. You also have the right to withdraw from the study at any time.

If you choose to do so, please indicate your willingness to participate by signing this letter in the space below, and returning this form to me in the envelope provided.

I appreciate your assistance in this study. If you have any questions, please feel free to call me at 250-489-5208. Also feel free to contact the supervisor of my study at the University of Lethbridge, Dr. Rick Mrazek at 403-329-2452 and/or any member of the Faculty of Education Human Subject Research Committee if you wish additional information. The chairperson of the committee is Dr. Richard Butt. (403-329-2434)

Sincerely,

Douglas Hogg
250-489-5208

Implementing Technology Study
Douglas Hogg, University of Lethbridge

I agree to participate in this study. I understand that all personal information will remain confidential, and that I can withdraw at any time without prejudice.

_____ _____

Name Date

_____

Signature

Appendix B

Letterhead

October15, 1999

Dear Colleague:

As part of my Master's program at the University of Lethbridge, I am undertaking a research project that will examine the changing role of the teacher as technology is introduced to the classroom. As we approach the new millennium there are many new challenges facing educators, foremost of which is the effect that computer technology will have on teachers and students.

As a leader and proponent of technology in School District No.5, your views and responses to the enclosed survey are very important. I am asking that you take a few moments to complete the survey and send it back to me.

I will be sharing the final report with the District Technology Committee when it is published. Your participation in this project will assist me in developing a detailed knowledge base about how educators in School District No.5 view the changing role of the teacher.

Thank you for your time and participation. I look forward to receiving your responses.

Douglas Hogg

250-489-5208
dhogg@cyberlink.bc.ca

Appendix C

Letterhead

November 15, 1999

Dear Colleague:

Last month you received a letter and survey asking you to take part in a research project that is looking at the changing role of the teacher as technology is introduced to the classroom. I have not yet received your completed survey and am hoping you will consider becoming a part of this important research.

Please take a few moments to complete the survey and send it back to me in the self-addressed envelope. As a leader and proponent of technology in School District No.5, your views and responses to this survey are very vital.

Your participation in this project will assist me in developing a comprehensive knowledge base about how educators in School District No.5 view the changing role of the teacher.

Please review the enclosed documents and consider taking part in the survey. I look forward to receiving your responses.

Douglas Hogg

250-489-5208
dhogg@cyberlink.bc.ca

Appendix D

INFORMATION TECHNOLOGY AND TEACHER ROLE SURVEY

All information that is collected in this study will be kept confidential. While the results will be published, you are guaranteed that you will not be identified in any report of the results of the study. Participation in this survey is voluntary and you may withdraw at any time.

When you have completed this questionnaire, please place it in the self-addressed envelope that has been provided and put it in the school district internal mail (courier) system.

Thank you for your time and co-operation.

Part A. Teacher Profile:

Please answer each of the following questions by checking the appropriate information, and or filling in the blanks.

1. What grade(s) or level do you teach?
   - Primary ..... ☐
   - Intermediate..... ☐
   - Jr. Secondary ..... ☐
   - Sr. Secondary ..... ☐

2. How many years have you taught?
   - 0-5 Years..... ☐
   - 6-10 Years ..... ☐
   - 11-15 Years..... ☐
   - 15+ Years..... ☐

3. What is your gender?
   - Male..... ☐
   - Female..... ☐

4. What academic degrees do you have?
   - B.A/B.Sc./B.Ed ..... ☐
   - M.A./M.Sc/M.Ed..... ☐
   - Ed.D/Ph.D. ..... ☐

5. Approximately how many technology workshops, seminars or in-service programs have you taken in the last 2 years?
   - None..... ☐
   - 1-5..... ☐
   - More than 5..... ☐

6. Do you have a computer at home? Yes ☐ No ☐

7. Do you have Internet access at home? Yes ☐ No ☐

Please circle your answer for each question.

1	2	3	4
STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE

Part B.		**Teacher attitudes towards Information Technology:**	**SD**	**D**	**A**	**SA**
1.	a)	I feel comfortable learning about and using computer technology.	1	2	3	4
	b)	I would like to integrate computer technology into my classes more often.	1	2	3	4
	c)	I am comfortable helping other colleagues with computer related technology.	1	2	3	4
	d)	I take personal time to learn, practice, and use computer technology.	1	2	3	4
	e)	I am informed and keep abreast of current trends in Information Technology.	1	2	3	4
	f)	There is school based administrative support for using technology.	1	2	3	4
	g)	There is district-based encouragement for using technology.	1	2	3	4
	h)	I will use technologies and software that have been proven to improve educational practice.	1	2	3	4
	i)	I see little benefit to my teaching responsibilities or to my students from the use of computer technology and software.	1	2	3	4
	j)	Technology helps me do things in my classroom I would not have been able to do without it.	1	2	3	4
2.		There is adequate technical support for the maintenance of computer hardware and software.	1	2	3	4
3.		Adequate provision has been made for preparing me to use computers and computer software in my classroom.	1	2	3	4
4.		A district staff development focus should be on learning how to integrate technology into the classroom to take advantage of the power of technology.	1	2	3	4
5.		My teaching is more effective and efficient because of technology.	1	2	3	4
6.		I collaborate and share more with colleagues, because of the demands of implementing technology	1	2	3	4
7.		As my teaching duties increase, I find myself cutting corners.	1	2	3	4
8.		I have increased professional control of my teaching role.	1	2	3	4
9.		One day motivational workshops give me the skills to teach effectively with technology.	1	2	3	4
10.		Hands-on workshops give me the skills to teach effectively with technology.	1	2	3	4

The following scale is to be used for the next set of questions on the survey.
Please circle your answer for each question.

1	2	3	4	5
NONE	MINIMAL SKILLS	BASIC SKILLS	INTERMEDIATE SKILLS	PROFICIENT

Part C. Please assess your Information technology skills:

1.	I use technology to enhance classroom instruction.	1	2	3	4	5
2.	I can design, deliver and assess student learning activities that integrate computers/technology.	1	2	3	4	5
3.	I develop instructional units that integrate the learning outcomes from the Information Technology IRP.	1	2	3	4	5
4.	I can create a simple word processing document and print it.	1	2	3	4	5
5.	I can operate a multi-media computer with a printer.	1	2	3	4	5
6.	I can use imaging devices such as a scanner, digital camera, and video camera with computers and software.	1	2	3	4	5
7.	I can use presentation software such as HyperStudio or PowerPoint	1	2	3	4	5
8.	I use advanced features of word-processing software to develop professional looking products such as newsletters and notices.	1	2	3	4	5
9.	I can send and save attachments in e-mail.	1	2	3	4	5
10.	I can browse the Internet.	1	2	3	4	5
11.	I can download text, sounds, pictures and programs available from the Internet.	1	2	3	4	5
12.	I can use at Internet search engines (such as Yahoo, Excite, Lycos, Alta Vista) to locate educational information.	1	2	3	4	5
13.	I can troubleshoot basic hardware problems.	1	2	3	4	5
14.	I use the computer to prepare student report cards.	1	2	3	4	5
15.	I use drill and practice applications with students.	1	2	3	4	5
16.	I can use an interactive multi-media encyclopedia on CD ROM.	1	2	3	4	5
17.	I can post student work, teacher resources and other material on the World Wide Web.	1	2	3	4	5

Please describe your teaching style by indicating the frequency that you use the following approaches or strategies. Responses to each pair of questions should total 100%. Circle your answer for each question.

1	2	3	4	5
20%	40%	60%	80%	100%

		Percentage of Time				
Part D.	**In my classroom:**	**20**	**40**	**60**	**80**	**100**
1a.	The learning activities are teacher centered and highly structured.	**20**	**40**	**60**	**80**	**100**
1b.	The teaching activities are learner focussed and interactive.	**20**	**40**	**60**	**80**	**100**
2a.	The teacher assumes role of fact teller and expert.	**20**	**40**	**60**	**80**	**100**
2b.	The teacher assumes role of facilitator and sometimes expert.	**20**	**40**	**60**	**80**	**100**
3a.	The student assumes role of listener and learner.	**20**	**40**	**60**	**80**	**100**
3b.	The student assumes role of collaborator and sometimes expert.	**20**	**40**	**60**	**80**	**100**
4a.	The emphasis is on learning facts and replication.	**20**	**40**	**60**	**80**	**100**
4b.	The emphasis is on the learning process, problem-solving, and inquiry.	**20**	**40**	**60**	**80**	**100**
5a.	Student success is demonstrated by the quantity of knowledge.	**20**	**40**	**60**	**80**	**100**
5b.	Student success is demonstrated by the quality of knowledge.	**20**	**40**	**60**	**80**	**100**
6a.	Assessment is via norm, criterion -referenced, and multiple choice.	**20**	**40**	**60**	**80**	**100**
6b.	Assessment via student performance/demonstrations and portfolios.	**20**	**40**	**60**	**80**	**100**
7a.	Technology is used for drill and practice, basic skills and reinforcement.	**20**	**40**	**60**	**80**	**100**
7b.	Technology is used for communication, collaboration, information access and creativity.	**20**	**40**	**60**	**80**	**100**
8a.	Learning is competitive.	**20**	**40**	**60**	**80**	**100**
8b.	Learning is co-operative.	**20**	**40**	**60**	**80**	**100**
9a.	The instruction focuses on specific study content.	**20**	**40**	**60**	**80**	**100**
9b.	The instruction is interdisciplinary and thematic.	**20**	**40**	**60**	**80**	**100**
10a.	The student adapts to the learning environment.	**20**	**40**	**60**	**80**	**100**
10b.	The learning environment adapts to the student.	**20**	**40**	**60**	**80**	**100**

An important part of this study is learning how the role of the teacher has changed with the introduction of technology. The following questions relate to your teaching practices and use of computers for the past three years.

E. The Role of the Teacher

1.How important were computers in your teaching in each of the past three years?

	Not Important	Important	Very Important
a) This year (1999-2000)	☐	☐	☐
b) Last year (1998-1999)	☐	☐	☐
c) 1997-1998	☐	☐	☐

2. Are you using computers more or less frequently in these ways?

	Less Frequently	Same	More Frequently
a) Using the computer for class preparation	☐	☐	☐
b) Assigning students to use computers	☐	☐	☐
c) Requiring students to use computers for projects	☐	☐	☐
d) Using computers for non-school activities	☐	☐	☐
e) Trying out new software/hardware	☐	☐	☐

3. Compared to three years ago how much do you use the following practices?

	Less Frequently	Same	More Frequently
a) Plan a lesson using the principles of direct instruction	☐	☐	☐
b) Have multiple activities going on at the same time in the classroom	☐	☐	☐
c) Use the textbook as a primary source for planning a unit	☐	☐	☐
d) Let student interest influence the lesson topics	☐	☐	☐
e) Evaluate students through their products instead of tests	☐	☐	☐
f) Allow myself to be taught by students	☐	☐	☐

4. How much of a role have computers played in the changes you noted above?

a) No role (computers had no part in the changes)..... ☐
b) A minor role (in most cases)..... ☐
c) A major role (in most cases)..... ☐

5. Compared to three years ago, how often do you give the following assignments?

	Less Frequently	Same	More Frequently
a) Students teach or help each other	☐	☐	☐
b) Students work together in groups	☐	☐	☐
d) Students work on their own projects with minimal direction	☐	☐	☐
e) Students answer questions from the textbook	☐	☐	☐
f) Students review and revise their own work	☐	☐	☐
g) Students take comprehensive notes	☐	☐	☐

6. How much of a role have computers played in the changes you noted above?

a) No role (computers had no part in the changes)..... ☐
b) A minor role (in most cases)..... ☐
c) A major role (in most cases)..... ☐

The following questions are open-ended. Please use the back of the page if you require more space.

7. Draw diagrams showing how you organized your classroom three years ago compared with what it looks like today. Describe in your diagrams how you arrange student seating, the location of technology and where you spend your instructional time.

8. Has integrating technology into your curriculum changed the way you teach? Explain.

9. Do you have educational concerns related to the implementation of technology in your school or classroom?

10. Would removing computers from your classroom have an impact on how you teach? Explain.

11. What skill related to technology would you most like to learn in the next year ? (Examples: web design, video editing, graphic manipulation or?)

Appendix E

Responses to open-ended questions.

8. Has integrating technology into your curriculum changed the way you teach? Explain.

Yes, it has allowed me to focus on student learning through project-based activities, which gives flexibility for me and more motivation to learn indirectly by students.

Yes, more Internet use for research.

Yes, it is easier for me to allow students to pick up a project and run with it, on a machine.

There really hasn't been much integration so I'd have to say that it hasn't changed the way I teach. I suppose the 40 minutes we currently spend on computers a week in my classroom; my teaching is changed as everyone seems to be doing something different.

Yes, I found opportunities to use the Internet to enhance learning. Adventure Everest On-line, setting up a web site, connecting to various sites.

Technology is a tool I use. I use computers in language Arts; low end word-processing is an outcome for my students. For teaching it has allowed me to be more efficient.

Yes, allows finished products to reflect effort more than skills.

I use computer-generated materials. Students do more project-type (research) tasks.

Not really, I've always used slides, overhead, videos, films and the like to present a variety of content, instruction. Computers though allow for <u>more</u> possibilities. We can look things up on the net when we're debating, researching, or finding related links to the instruction. It allows more flexibility in project presentation, group work and individual work.

I spend more time on the word processor. I also spend more time at a computer marking handed-in assignments.

We use the Internet more frequently as it has up to date business research. Teaching business classes – we require all documents to be word-processed.

Yes, more research possibilities; easier to correct student errors and improve student's work.

Students can do more independent work. Have to watch for more copying.

Our department has pushed for more and more changes as money was available. The change has been driven by increases in hardware, networks and software available.

No – I teach technology, only the content (multi-media, presentation, authoring as well as just programming)

No, departmental budgets are too small to purchase equipment to integrate
It allows me to have more independent groups working simultaneously in the classroom than before.[italics added]

9. Do you have educational concerns related to the implementation of technology in your school or classroom?

There is a lot of bad software out there and I am concerned that teachers will use it.

I am concerned that secondary teachers are unaware of the methodology(s) needed to integrate E.T. into classrooms.
I am concerned that inadequate support will result in teacher frustration and will result in closed minds.

How should the money be spent? Texts, books, library, people, maintenance.
I feel that technology has not improved content, research skills or work of students.
Too much driven by industry (bandwagon)
Unsustainable growth.
No thought to future needs created y current practice.

Appropriate use of computers/tech.
Appropriate Internet access
Is the hardware and software going to be adequate?

Taking a long time – Teachers will need a lot of schmoozing to get up to speed.

Yes, There has not been any real training for staff and schools have not solved problems that arise from different formats.

Schools cannot keep up with the technology. Kids have more access at home.

Yes, getting high end machines in the areas that require them and not having them just being used for word processing and other basic uses.

Never enough time to learn new software. Trouble getting hardware/software problems fixed.

I have concerns that educational technology relates only to computers and not other forms of technology (ie/ digital cameras, video-editing suites)

- Cost
- Adequate time for system upkeep
- Value/cost of "educational" software
- Ethical concerns over Internet research (student plagiarism, etc)

Lack of access to computers for a whole class.

Yes, in addition to time needed for "regular" tasks, multi-media takes more time and skill. I'm learning all the time, usually from jumping right in. There's no consideration for time as far as that goes – most teacher prep happens outside of school hours anyway so, if you're lucky you can find someone to tutor you or help. The occasional workshop helps, but there never seems to be enough time. You can't always find the "parts" needed (cables, etc) when you need them. There's never enough money to buy things in addition to materials you need for your courses. E.G. in art supplies are expensive and a $1200 budget barely makes do. Upgrading technology is costly. Technology gives students more learning flexibility. As a school we are trying to find out more about money, what we have in the school already, what we need. Change is happening, but technology always happens faster. Seems like a vicious circle at times.

Very hard to convince other teachers to take risks with technology – they are afraid the students will know more than they do. Equipment is still largely out of date and not multi-media.

Incredible initial cost and maintenance costs, mean the transition should be by request for support rather than District wide.

Too much emphasis is on technology for students. At the elementary level the 3R's should be our concern.

Yes.
- need for teachers to receive in-service.
- need for adequate resources, etc.

YES, YES, YES – It's not happening because the technology is not there. Our school still operates with a lab of Apple IIe's, so I don't ever bother to take my class there. I feel quite comfortable using Mac software and would gladly use a

lab of Macs with my class. The lab of 6100's is supposed to be coming. I need further training with additional technologies.

- maintenance and ease of use

Yes.
a) support for teachers (in-house, scheduled time)
b) technical support to maintain computers, hardware/software
c) number of working machines per class
d) ratio of students:computers

Technology needs to be seen as a tool in attaining learning objectives – not an end in itself. Students can waste more time on a computer than without one if they are not using it for a legitimate educational purpose.

No – other than the slow pace of change over the past 20 years. [italics added]

10. Would removing computers from your classroom have an impact on how you teach?

Yes – the idea of children using technology for creativity, and producing clear, concise documents would be not happening as readily.

Yes – it would be disastrous to the educational environment in my room and the quality of learning.

Yes – No Internet access would greatly decrease reference use. We use it all the time for on-line databases.

What computers? They are IIe's or Classics, so really aren't utilized much.

Don't have any in our classrooms yet.

Yes, I am currently trying to integrate the machines into my teaching, so it would certainly not be available as an option. I also use the computer for my own preparation, etc., so I COULD NOT BE WITHOUT IT!

Yes. It would be a step back in time. Inability to use word processors, internet, etc., would mean an inability to keep students up-to-date and to prepare them for the world.

- yes it would have an impact. It is a tool I use to help me teach. Everything from marking, reports, report cards, lesson plans and many more things.

Yes, since 60% of my teaching material is from a computer or is involved with a computer.

I only have one computer in my classroom. It is used largely for teacher related work. If there were no computers, I would adapt (back to the old hard copy-filing cabinet system). Once again I would not be able to find anything.

Yes, I believe removal of the computers would have an impact on the way I teach. I've just started to learn what I can do teaching using a computer! I find more often that we are utilizing the computer for all kinds of task activities.

I mainly teach PE – no impact. At this point there would not be a lot of impact from my Science class.

I teach in four different classrooms – 4 different subjects. Only one of these is in a computer lab (or has ready access to enough computers) In this room, I would use other resources instead of computer software (more printed material).

No, I have no computers in my classroom.

Yes – especially in a computer class like Business Computer Applications or Business Information Management. Also need to have technology to "integrate" in other business courses.

Yes. My IRP demands I use them. Would have to meet PLO's through video productions and I'm far more comfortable with computers and their basic animation possibilities for students.

No impact on teaching. I would bring hard copies of things from home instead.

Yes, Technology is the door to information that we can't afford otherwise. The computer is as common today in homes as the TV was in the 60s and 70s. The versatility makes it a tool for all to use.

Not yet. I actually had more use of C.A. I. 8 yrs ago than I have now. I have less access to computers now.

- No more info tech courses = need for a new job.
- I am dependent on printed materials, not hand written materials. [italics added]

11. What skill related to technology would you most like to learn in the next year? (Examples: web design, video-editing, graphic manipulation or ?)

- network management
- CAI design using WebCT or other tools

Operating system troubleshooting, Win95/OS8/Win98
More programming
Networking

Learn more about PCs so I can be somewhat knowledgeable on both platforms.

All of these – time becomes a factor – the changes in software seem to outstrip the time to keep up.

Web page design
MIDI studio

Web design
Creating better multi-media slide presentations for art history and analyses components.

Access Databases
Microsoft Publisher (become more familiar with the software)
Video Tele-conferencing. I would like an introduction. Apparently we have one at the CCLC for school use.

I would like to learn video-editing to run my video production class but have been unable to receive equipment capable to do so.

Trouble-shooting
Basic Mac repairs

Using a digital camera and video-editing.

I'm understanding that technology in this survey relates mainly to computer related. How to use the computer pen and tablet we have in the art room!
Make more use of the digital camera in promoting student artwork. I guess this would also mean learning more about web design to put the info on the school's site.

Web design.

Java scripting.

Graphic manipulation.

I would like to learn video-editing in the next year. How to add a video to HyperStudio document.

-Use of HyperStudio.
-Web design skills.
-improved scanner skills.

Web design.

Scanner, putting info on school home page, network theory,

Digital video-editing and special effects including virtual reality.

Web page design and e-mail attachments.