

COMPUTERS FOR PRIMARY STUDENTS:
TEACHERS' BELIEFS ABOUT CLASSROOM COMPUTER USAGE
IN PRIMARY CLASSROOMS

by

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ABSTRACT

The purpose of this study was to investigate teachers' beliefs about computer usage for primary students. Specifically, this study examined (a) the beliefs primary teachers hold about developmentally appropriate uses of computers in primary classrooms, (b) how these beliefs compare with their descriptions of their pedagogical practices, (c) how these beliefs resonate with teachers' beliefs about how primary students learn in general, and (d) how teachers' beliefs and pedagogical practices compare with the recommendations made by early childhood education institutions. A multiple case study with a qualitative approach was conducted. Four female primary-grade teachers who have between 10 to 30 years teaching experience in primary classrooms participated in two semi-structured interviews. Overall, teachers held relatively similar beliefs about developmentally appropriate uses of computers, particularly that computer uses should be age appropriate and integrated into the curriculum. Teachers' overall beliefs about the developmental appropriateness of computer uses were continuous with their beliefs about how primary students learn and with the recommendations made by early childhood education institutions. On the other hand, there were both continuity and discontinuity between teachers' espoused beliefs with their descriptions of their pedagogical practices. Thus, holding shared beliefs about developmentally appropriate computer uses with the community of practice and early childhood education institutions does not necessarily assure that teachers' pedagogical practices are consistent with their espoused beliefs. Suggestions on how to support teachers in the implementation of developmentally appropriate practice in their classroom computer uses are made.

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CHAPTER ONE: INTRODUCTION

Problem Statement

Since the emergence of the first computer to the public market in 1977 (Pantiel & Petersen, 1984), computer use has spread widely. At present, people use various forms of Information and Communication Technology (ICT) to complete daily tasks. The availability of computers in schools has also increased rapidly, as is reflected by the dramatic augmentation of reported available computers in schools. In Canadian schools, one computer was available for every seven students in 2000, and 80% of the school computers had Internet access (Statistics Canada & Council of Ministers of Education, Canada, 2003). In 2003-2004 academic year, one computer was available for every five students in Canadian schools, and 92.7% of the school computers were connected to the Internet (Statistics Canada & Council of Ministers of Education, Canada, 2004).

Despite the increasing number of computers in schools, it is still unclear as to whether computers significantly change classroom instruction and learning processes; thus, leading researchers to question the value of investing a high proportion of school budgets for ICTs (Cuban, 2000; 2001; Healy, 1998). Although teachers report heavy use of computers in the classroom, and that computers have made a difference to their teaching (Hadley & Sheingold, 1993), other research reveals that computers are rarely used for improving instruction in subject areas, and that most of the computer uses are for 'teaching to use computers' (Bryson & de Castell, 1998; Cuban, 1993) rather than 'teaching to learn with computer'. Furthermore, a survey that was distributed across the United States (Becker, 1994) discovered that only a small number of teachers used computers in a substantial way; thus, having computer access in schools does not necessarily mean ICTs are being used to enhance the pedagogical infrastructure of learning environments (Ungerleider & Burns, 2002).

Since ICTs have become a part of everyday life in the industrialized world, many children begin using computers at a very young age. Among four-to-six years olds in the United States, 70% have used computers, 27% have used them for one hour a day, and 56% have used computers by themselves. Among children aged six month to three years, 27% have used computers by themselves (Rideout, Vandewater, & Wartella, 2003).

Early childhood is a critical developmental period (Gestwicki, 1995; Hildebrand, 1986; Zigler, Finn-Stevenson, & Hall, 2002). Longitudinal studies have shown that enrolling children in high-quality preschools, child care programs, and primary-grades supports their later success (Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002; NICHD Early Child Care Research Network, 2004, 2005; Schweinhart & Weikart, 1997). Based on these research findings, The National Association for the Education of Young Children (Bredekamp, 1987; NAEYC, 1997; NAEYC & NAECS/SDE, 2003) has recommended the importance of "developmentally appropriate practice" to support child development. To provide "developmentally appropriate practice," The National Association for the Education of Young Children (NAEYC) advocates that professionals consider three dimensions of knowledge that focus on learning and development processes in children. These three dimensions also act as the foundation for the decisions professionals make about the well-being and education of children. These dimensions of knowledge include issues regarding (a) age appropriateness, (b) individual appropriateness, and (c) cultural appropriateness of the activities, materials, and experiences provided for young children (NAEYC, 1997). In their position statement about "developmentally appropriate practices" for early childhood programs that serve children from birth to age 8 (Bredekamp, 1987; NAEYC, 1997), the NAEYC describes specific strategies for promoting "developmentally appropriate practices" as well as specific examples of

developmentally appropriate and inappropriate practice. For example, for six-to-eight years olds, hands-on activity and experimentation are referred to be more appropriate than "fatiguing mechanical seatwork" (Bredekamp, 1987, p. 6). While this position statement was intended to provide guidelines for early childhood professionals, some concerns have arisen about the notion of "developmentally appropriate practice." For example, the "developmentally appropriate practice" principles were pointed as only applicable to a specific group of children, which was the typical developing, white, middle-class children (Carta, 1995). This led some people to question whether the principles recommended by the NAEYC would be applicable to other groups of children, such as children with disabilities and children from other cultural backgrounds. In response to this matter, the NAEYC incorporated the culture element into its revised position statement about the "developmentally appropriate practice" in 1997 (Hyun, 1998).

With regards to the effort to promote developmentally appropriate practice for young children, the fact that an increasing number of children are using computers at a very young age is a concern for parents, educators, and early childhood practitioners. While most parents (72%) believe that computer use is beneficial for their children's intellectual development (Rideout et al., 2003), educators and researchers are divided in their beliefs about the ways computers influence child development and learning processes. For example, some concerns have been raised concerning the possibility of computer experiences limiting the sensory, interpersonal and cognitive development of children (Cordes & Miller, 2000; Ferguson, 2005; Healy, 2004), and that children's engagement in intense computer use will reduce their physical activities (Borja, 2003). On the other hand, arguments have been made that computer use promotes literacy skills (Englert, Manalo, & Zhao, 2004; Gore, Morrison, Maas, & Anderson, 1989), and

cognitive and social development (Clements, Nastasi, & Swaminathan, 1993; Freeman & Somerindyke, 2001; Haugland, 1992; Svensson, 2000) in children.

Keeping in mind that the use of ICTs has been a controversial issue in the field of early childhood education, the NAEYC (1996) has asserted a position about the use of ICTs with young children. The NAEYC suggests that the computer, as a tool, is similar to other educational tools that can be beneficial if used in a developmentally appropriate manner, that is, when professionals consider the age appropriateness, individual appropriateness and cultural appropriateness of the educational tools for children. Furthermore, the NAEYC (1996) has stressed the important role of teachers for providing appropriate ICT applications, and for promoting developmentally appropriate uses of educational software, so that children can benefit from classroom computer uses.

Since the role of teachers is central for integrating ICTs into the curriculum, a number of studies have been conducted in order to investigate the ways teachers mediate the use of ICTs. Research findings indicate that teachers' experience with computers (Braak, 2001), perceptions about computer implementation (Gilstad, 1995; Washington, 2003), computer efficacy (Teo & Wei, 2001), attitude (Michaels, 1990), and computer training (Beyerbach, Walsh, & Vannatta, 2001; Shapka & Ferrari, 2003) affect their usage of computers in their classrooms. Gender is another factor in computer use among teachers. Bryson and de Castell (1998), for example, reported that most computer coordinators, in British Columbia elementary schools, were male, despite the fact that most elementary teachers were female. Other factors such as school environment (Teo & Wei, 2001), collegiality among users, the availability of resources, class size, and school support (Becker, 1994) are also important in promoting an effective teaching environment with computers.

Research also indicates that teachers are not sufficiently prepared for the responsibility of infusing ICTs in classroom activities (Collis et al., 1996). Although teachers have been encouraged to integrate ICTs in their classroom activities, they are not provided with adequate time and resources to learn its most practical uses (de Castell, Bryson, & Jenson, 2002). In promoting ICT use, schools tend to allocate most of their budgets for computer hardware (63%) and upgrading software (20%) rather than providing training (17%) for teachers (Wiener, 2000). Moreover, a survey conducted by the International Association for the Evaluation of Educational Achievement (IEA) indicates that most computer training for teachers focuses heavily on the technical aspects rather than the pedagogical aspects of computer uses (Collis et al., 1996). This condition might impede teachers from using computers effectively, since, as Papert (1993) suggests, "much more than 'training' is needed for teachers to develop the ability to benefit from the presence of computers and to bring this benefit to their students" (p. 74).

Integrating ICTs into the curriculum involves curriculum planning and decision making by teachers. Teachers' beliefs about computers and educational software applications play an important role in facilitating the ways in which they use computers (MacArthur & Malouf, 1991; Shields & Behrman, 2000). In the area of early childhood education in particular, there is a concern about the developmentally appropriateness of the computer use for young children. Little is known about early childhood teachers' beliefs about the developmentally appropriate use of computers for young children, and how these beliefs compare with the beliefs of early childhood education organizations and the teachers' pedagogical practices. This forms a gap in the area of computer use in the early childhood setting, which this study addressed.

The following question guided this study: What are the beliefs that primary teachers hold about computer usage for primary students? Specifically, this study

investigated teachers' beliefs regarding the ways that children learn in general, and by means of computers, in particular. As well, it looked at primary teachers' beliefs about the ways that computers should or should not be used in primary classrooms. Overall, this study examined teachers' beliefs about the developmentally appropriate use of computers for primary students, how these beliefs compare to the recommendations made by early childhood education organizations, and how these beliefs compare with their pedagogical practices. This study was expected primarily to contribute to fill the critical gap in the area of computer usage in early childhood education by comparing teachers' beliefs about the developmentally appropriate use of computer with the beliefs of early childhood education organizations, and the teachers' pedagogical practices. Furthermore, based on its findings, this study was expected to identify important themes that might be needed for teacher training that is aimed at improving classroom computer uses for primary students.

Literature Review

The literature review first discusses research concerning teachers' beliefs in general and their relation to their pedagogical practice. Second, it will review research reports concerning classroom computer usage in general, followed by elementary classroom computer usage in particular. Third, it will discuss studies about teachers' beliefs about classroom computer usage and the relationship between these beliefs with classroom computer activities provided by teachers. Finally, the literature review will conclude with a description about the purpose of and the rationale for the study.

Teachers' Beliefs

Various terms have been used when referring to teachers' beliefs. Beliefs in general have been defined by Goodenough (as cited in Margerum-Leys & Marx, 1999) as "implicit or explicit propositions which are held to be true and are accepted as guides for assessing the future, are cited in support of decisions, or are referred to in passing

judgment on the behaviour of others" (p. 3). Teacher's educational beliefs in particular include their "belief[s] about students and the learning process, about teachers and teaching, about the nature of knowledge, about the roles of schools in society, and about the curriculum" (Levitt, 2001, p. 2). Other terms have also been used to refer to teachers' beliefs, such as, teachers' cognition: "teachers' self-reflections; beliefs and knowledge about teaching, students, and content; and awareness of problem-solving strategies endemic to classroom teaching" (Kagan, 1990, p. 419); teachers' epistemological world view: "teachers' collective beliefs about the nature and acquisition of knowledge" (Schraw & Olafson, 2002); and teachers' thought processes, which consist of teacher planning, teachers' interactive thoughts and decisions, and teachers' theories and beliefs (Clark & Peterson, 1986).

The Relationship between Teachers' Beliefs and Their Pedagogical Practices

It has been assumed that teachers' beliefs play an important role in determining their own behaviour (Clark & Peterson, 1986). The beliefs teachers hold serve as a guide for what classroom activities they choose to select, and what they consider to be important factors for facilitating the learning and development of their students (Pajares, 1992). Studies exploring the relationship between teachers' beliefs and their pedagogical practices have revealed diverse findings. First, some studies support the assumed consistency between teachers' beliefs and their pedagogical practices. For example, teaching practices have been reported to reflect teachers' epistemological beliefs (Kang & Wallace, 2004). Teachers' beliefs have also been found to correlate with teachers' knowledge and students' problem-solving abilities (Peterson, Fennema, Carpenter, & Loef, 1989). On the other hand, other studies have disclosed discrepancies between teachers' beliefs and their pedagogical practices. For example, most teachers have been reported to value student-centred and contextualist classroom practices, but in fact they

use mainly teacher-centred and transmission practices (Levitt, 2001; Schraw & Olafson, 2002; Simmons, Emory, Carter, et al., 1999).

The discrepancies among research findings about the relationship between teachers' beliefs and their pedagogical practices can be seen in light of Clark and Peterson's (1986) model of teacher thought and action. They state that teachers' thought processes influence and, in turn, are influenced by their actions and observable effects. Here, teachers' thought processes include teacher planning, interactive thoughts and decisions, as well as the theories and beliefs they hold. Teachers' actions and the effects of these actions refer to the classroom behaviour of teachers, the classroom behaviour of students, and student achievement. These two factors (i.e., teachers' thought processes and teachers' actions) are also influenced by external forces: constraints and opportunities. The existence of environmental constraints and opportunities may explain why teaching practices are oftentimes inconsistent with teachers' pedagogical beliefs. While teachers may hold some idealistic views of teaching and learning, the decisions they make about classroom practices may be driven by external demands, such as the curriculum; thus, constraining them from practicing in a way that is more consistent with their beliefs. For example, even though some teachers value student-centred classroom practice, the limited time and resources available in the classrooms, combined with the availability of resources for covering and meeting the curricular demands, might prevent them from applying a student-centred classroom practice. In the integration of ICTs into the curriculum in particular, K-12 teachers, teacher education students, and teacher education faculty reported several constraints, including a lack of clear expectation about the integration of ICTs, a lack of feedback given to teachers about their use of ICTs, and a lack of rewards and recognition related to teachers' use of ICTs (Schaffer & Richardson, 2004).

Classroom Computer Uses

As computers became more widespread in schools, it would be reasonable to infer that administrators, and others responsible for "implementation," believed that computers would "naturally", by their mere presence, create a learning environment that was more effective, efficient (Giacquinta, Bauer, & Levin, 1993), and student-centred (Hadley & Sheingold, 1993). Research findings to support this belief, however, are inconsistent, as exemplified by studies conducted by Sandholtz, Ringstaff, & Dwyer (1997) who found that using computers did change learning processes, and Becker (1994) and Cuban (1993) who did not find any change in learning processes. A meta-analysis on studies about classroom computer uses concluded that the mere existence of computers themselves will not change the learning process unless there is a change in the instructional method (Ungerleider & Burns, 2002). In order to fulfill ICT's promises for education, other factors must be considered, such as teacher's technical expertise, classroom computer access, and the teaching philosophy of the instructor (Becker, 2001).

Considering the important role of teachers for facilitating the use of computers in enhancing learning processes (Collis et al., 1996), researchers have investigated teachers' perspectives on the ways computers have influenced their teaching. While most teachers (88%), in a study conducted by Hadley and Sheingold (1993), believed that the computer had changed their teaching, another study found that only one out of six teachers used computers in a substantial way (Becker, 1994). Both these studies came from American nation-wide studies and were based on self-reports. Similarly, another study which incorporated classroom observation and interviews with both teachers and students found that only a small percentage of teachers actually changed their teachings substantially through computer usage, and that the role of computers was more often to sustain, rather than to alter, the teaching practice. Particularly, teacher-centred instruction (e.g.,

lecturing) continues to be the norm even though it was expected that computer would change the instruction toward student-centred instruction (Cuban, Kirkpatrick, & Peck, 2001). These findings suggest an inconsistency between teachers' self-reports and their actual use of computers in classrooms. It is also interesting to note that the frequency of computer use is often employed as the main indicator of the exemplary or substantial use of computers (Becker, 1994, 2001). This might give an incomplete portrait of computer use. Using computers for a long time does not necessarily reflect and lead to positive outcomes for students' cognitive development. In fact, computers can be used for things that are not relevant to academic purposes. This is well illustrated in the Canadian Education Statistics finding about the computer access at home and at school reported by Canadian teenagers. Even though more than 75% teenagers reported frequent computer access, defined as "almost every day or a few times each week" (Statistics Canada & Council of Ministers of Education, Canada, 2003, p. 82), only 25% reported frequent computer usage to support learning school materials, while 20% reported that their computer usage was never aimed to learn school materials.

Computer Use in Elementary Classrooms

Although computer access in schools is increasing, research on computer use among elementary schools has documented that computers are only limitedly used (Bryson & de Castell, 1998, Wilson, Notar, & Yunker, 2003). One study reported that elementary teachers did not use computers until it was mandated (Garrison & Bromley, 2004) – a school policy that led to other problems in the study. Other studies have noted that computers were used in a limited way by elementary teachers; that is, they used computers primarily for administrative purposes such as preparing report cards, rather than instructional purposes (Schnackenberg, Luik, Nisan, & Servant, 2001, Wilson, Notar, & Yunker, 2003). Based on the research findings in this area, it seems evident that

Cuban's claim (1993), that no substantial change in instruction or pedagogy has occurred, despite the infiltration of computers in classrooms, holds true in elementary classrooms.

Given that consensus on an ideal way of using computers in elementary classrooms has not yet been established (Garrison & Bromley, 2004), elementary teachers introduce computers in a variety of ways. First, teachers introduce computers as an additional activity, after coursework and assignments have been completed (Wilson, Notar, & Yunker, 2003). Second, teachers use computer access as an instrument for controlling student's behaviour. Some teachers reward or privilege students who have been perceived as behaving appropriately during class time to use the computer (Garrison & Bromley, 2004, Olson, 1986, Wilson, Notar, & Yunker, 2003). Since this privilege serves as a function of students' behaviour, students' computer access might be suspended – as a punishment – when they do not behave well in class (Garrison & Bromley, 2004). Third, some teachers introduce computer activity as a choice during students' free time (MacArthur & Malouf, 1991). Fourth, teachers integrate computers in the curriculum. This includes using specific educational software to help in instructing existing subjects in the curriculum, such as to practice reading, spelling, and math (MacArthur & Malouf, 1991), and introducing computers as a new or separate subject in the curriculum (Olson, 1986).

The way teachers introduce computers influences the climate of the classroom. The following two studies, for example, illustrate two methods of introducing computers and the different classroom environments that were observed in the classrooms. In a longitudinal 3.5-years study (Garrison & Bromley, 2004) where classroom computer use was mandatory, teachers were reported as applying very strict control over students' use of computers. The classroom computer use operated in a reward-punishment system. That is, it was granted for students who the teacher perceived as behaving properly, and limited

for students who were perceived as misbehaving. Due to this added pressure in the classroom, some "problematic" behaviour patterns were reported. For instance, some students pretended they did not understand what they were supposed to do, and some students were reported "bothering" other students while they were working with computers. Another study, conducted in special education classrooms, discussed situations where teachers were given a choice as to whether they chose to use computers in their classroom (MacArthur & Malouf, 1991). Teachers were reported to try to fit computer activities into the curriculum, either as a part of learning other subjects (e.g., language and math), or as one of several options that students could choose during the classes free-time activity. Several teachers also provided students with autonomy to choose among the available educational software. Computer activity was reported as the most frequently chosen free-time activity reported by a teacher in the study, and students appeared to be enthusiastic about working with computers.

Teachers' Beliefs about Classroom Computer Uses

Computers are used in a limited way in classrooms, and teachers play important roles in planning classroom computer uses. These facts have stimulated studies about teachers and their computer-related characteristics. One important factor in teachers' decision making about classroom computer usage is their beliefs about computers and pedagogy (MacArthur & Malouf, 1991). The beliefs teachers hold serve as filters to screen incoming information (Pajares, 1992). For example, teachers' beliefs about how suitable a particular educational software is for students will guide them in choosing software and making decisions on the manner in which they allow their students to use the software. An interview with a teacher revealed that "computer uses depend on the instructor's teaching and learning goals" (Cuban, 2001, p. 815). Teachers tend to choose different software for different students. For instance, they are much more likely to use

drill-and-practice software for students identified as "low ability" (Becker, 2001). Also, teachers with different instructional perspectives will choose software that is consistent with their perspective (Becker, 2001; Niederhauser & Stoddart, 2000).

Several studies have also reported teachers' beliefs about computers and their concerns about classroom computer usage. Most teachers in these studies focused on the motivational aspects of computers. Students appear to enjoy working with computers, such as computer-mediated writing (Bryson & de Castell, 1998) and word processing (MacArthur & Malouf, 1991). Computers are also perceived as having the potential to improve self-esteem, increase motivation, compensate for disabilities, and foster computer literacy for special education students (MacArthur & Malouf, 1991).

The concerns teachers have about implementing computers in their classrooms include both technical and pedagogical concerns. The key factors impeding teachers from using computers effectively are due to a lack of time and resources (Bryson & de Castell, 1998; Garrison & Bromley, 2004; MacArthur & Malouf, 1991). Integrating computers into the curriculum involves a great deal of planning (e.g., reviewing educational software) and decision making, which is time consuming (MacArthur & Malouf, 1991; Schnackenberg et al., 2001). Additionally, adding computer activities forces teachers to limit other activities – something that dissuades them from using computers (Garrison & Bromley, 2004). Besides the time constraint, research has also shown that there is not enough technical and pedagogical support and direction for integrating computers into the curriculum (Schnackenberg et al., 2001). On the technical side, teachers report a lack of training and expert support (MacArthur & Malouf, 1991), as well as the limited availability of educational software (Schnackenberg et al., 2001). Having computers in the laboratory instead of in the classroom is another problem that hinders the integration of computers into the curriculum. On the pedagogical side, teachers report that they are

not certain about how to incorporate computer usage in their lessons and learning objectives appropriately for each grade level (Schnackenberg et al., 2001). Teachers also report a lack of clear expectation, a lack of feedback, and a lack of rewards and recognitions in their use of ICT (Schaffer & Richardson, 2004).

The Relationship between Teachers' Beliefs and Classroom Computer Uses

Several studies show that teachers' beliefs correlate with classroom computer uses. For example, based on a large scale survey with 4000 teachers as respondents, Riel and Becker (2000) concluded that teachers with constructivist beliefs use computers in meaningful ways more frequently than other teachers. Teachers' beliefs about the educational values of software applications and the Internet also serve as key factors in their decision to use or not use computers in their teaching (Shields & Behrman, 2000). In a multiple-case study with special education teachers, MacArthur and Malouf (1991) found that the overall educational goals and beliefs of teachers, about the role of computers for educating children with special needs, influenced the way computers were used in the classrooms. For example, teachers who viewed computers as increasing student motivation tried to introduce computers in a fun way, and teachers who believed that students need structured computer activities spent more time planning such activities.

Other research has revealed that teachers' beliefs tended to be somewhat abstract, and not necessarily connected with specific strategies for classroom practices (Hinostroza & Mellar, 2000). When confronted with real situation problems, teachers might behave differently from the behaviours they had indicated as being part of their belief system. For example, teachers in one study believed that teacher-centred and student-centred activities were equally important. However, when they were given specific choices for using computers, they tended to choose teacher-centred approaches more frequently than student-centred approaches (Wang, 2002).

In summary, research has shown that teachers' beliefs affect their pedagogical practice to some degree. Even though discontinuity has been found in some circumstances, these beliefs have been reported as an important factor in guiding teachers' classroom practice. With regards to primary classroom computer usage where there is little guidance and no consensus about the developmentally appropriateness of primary classroom computer usage, it is important to uncover primary teachers' beliefs about this matter. Considering the importance of teachers' beliefs about computers on actual classroom computer use, this study investigated the nature of teachers' beliefs about computer use for primary students. This study primarily explored teachers' beliefs about the role computers played in children's learning, the ideal ways for primary students to use computers, and the conceptions teachers had about the types of computer activities they deemed suitable for primary students.

Purpose and Rationale

Integrating ICT into the curriculum involves curriculum planning and decision-making by teachers, whose beliefs about computers play an important role in the computer use in their classrooms (MacArthur & Malouf, 1991; Shields & Behrman, 2000). The purpose of this study was to investigate teachers' beliefs about computer usage for primary students. Specifically, this study explored primary teachers' beliefs about the developmentally appropriate use of computers in primary classrooms. This study also examined how these beliefs resonated with teachers' beliefs about primary students' learning in general, how these beliefs compared to the recommendations made by early childhood education organizations, and how these beliefs compared to teachers' pedagogical practices.

The Organization of this Thesis

This thesis is organized as follows. In chapter one, I have described the problems and the research questions that guided this study, along with a review of previous research concerning the use of ICTs for primary students. The next chapter will cover the method that this study used, including definition of the terms that will be used in the rest of the thesis, the procedure for data collection, data analysis, and the criteria for assessing the quality of the study. Chapter three will present the findings of the study in a descriptive format, whereas chapter four will be devoted to further highlight and discuss important themes that emerged from the findings in the context of schooling and previous research. The last chapter will conclude the study, and discuss the implications of the study.

CHAPTER TWO: METHOD

This study took a qualitative approach to exploring the beliefs teachers held about computer usage for primary students. As Strauss and Corbin have stated (1999), qualitative methods can reveal "any phenomenon about which little is yet known" (p.19). Since little is yet known about early childhood teachers' beliefs about computer usage for primary students, a recent study has recommended conducting qualitative research that involves early childhood teachers to uncover their beliefs about computers (Lynch & Warner, 2004). Therefore, a case study on teacher beliefs about computer use for primary students was conducted.

A case study approach is important for investigating questions that deal with real life settings, where the researchers have little control over the settings (Yin, 1994). In this study, teacher was the unit of analysis. This study took a multiple-case study design, which has been reported to be more robust (Yin, 1994). A multiple-case study design follows a replication perspective and enables researchers to do cross-case analysis.

Definition of Terms

Teacher's belief is defined as their "belief[s] about students and the learning process, about teachers and teaching, about the nature of knowledge, about the roles of schools in society, and about the curriculum" (Levitt, 2001, p. 2). Primary classroom refers to Kindergarten to grade three levels of elementary school. Classroom computer usage is defined as the uses of computers within the classroom setting (i.e., what teachers are using the computers for). Computer usage may include its use in the classroom or during computer sessions in the computer laboratory. In this definition, computers may include both desktop and laptop computers that are used with primary-grade students. ICT comprises a wider range of technologies, including computers, software, network and connections to the Internet.

Collection of the British Columbia (B.C.) Ministry of Education and Early Childhood
Education Institutional Documents

Since there is no consensus yet about computer usage in primary classrooms, it is valuable to review the position of early childhood education institutions on this issue. As part of the study, a collection of the B.C. Ministry of Education and early childhood education institutional documents concerning their positions regarding primary classroom computer usage was gathered. The B.C. Ministry of Education documents included "The Primary Program: A Framework for Teaching" (2000), the Integrated Resource Package (IRP) K to 7 documents for various subject areas, including information technology (1996b), applied skills (1995a), science (1995c; 2005), English language arts (1996a), fine arts (1998a), social studies (1998b), personal planning (1999), and the guide for evaluating, selecting, and managing learning resources (2002). The early childhood education institutional documents included primarily the NAEYC position statements about "Technology and Young Children: Ages 3 through 8" (1996) and developmentally appropriate practice (Bredekamp 1987; NAEYC, 1997; NAEYC & NAECS/SDE, 2003). An overview of the B.C. Ministry of Education and the NAEYC policy discourse regarding developmentally appropriate use of computers will be presented in the findings section.

In addition, I also reviewed the policy statements from other early childhood institutions that did not specifically focus on the computer use per se, but offered guidelines related to developmentally appropriate use of computers for young children. These included the position statements made by the American Academy of Pediatrics (1995; 1999; 2001; n.d.), the National Association of Early Childhood Specialists in State Departments of Education (NAEYC & NAECS/SDE, 2003), the joint statement of the American Academy of Pediatrics, the American Academy of Child and Adolescent

Psychiatry, the American Psychology Association, the American Medical Association, the American Academy of Family Physicians, and the American Psychiatric Association (2000), and the American Diabetic Association (2000). These statements will be presented in the findings section in juxtaposition with excerpts from teachers' belief statements.

Ways to Assess Teachers' Beliefs

Beliefs are not observable; they can only be inferred from people's statements, intentions, and actions (Pajares, 1992). Studies have shown a variety of ways to assess teachers' beliefs, both quantitatively and qualitatively. Teachers' beliefs can be assessed by means of questionnaires with closed-ended (Riel & Becker, 2000) or open-ended questions (Lonka, Joram, & Bryson, 1996), structured interviews (Peterson et al., 1989), semi-structured interviews (Kang & Wallace, 2004; Margerum-Leys & Marx, 1999; Pratt, 1992), stimulated-recall techniques (Levitt, 2001; Neale, Smith, & Wier, 1987, as cited in Kagan, 1990), and/or observations (Kang & Wallace, 2004; Simmons et al., 1999). Rather than applying only one method of assessment, some studies have reported their uses of multi-method evaluations of teachers' beliefs (Levitt, 2001; Peterson et al., 1989). Having multiple data sources enables researchers to triangulate the data; thus, strengthening the validity of the studies (Kagan, 1990).

In this study, semi-structured interviews were conducted to reveal teachers' beliefs about computer use for primary students. A semi-structured interview typically consists of a list of themes and questions to be covered, yet the interviewers are permitted to change the sequence of the questions as well as to probe beyond the prepared questions based on the interviewee's answers (Berg, 1995; Kvale, 1996). In this study, using semi-structured interviews provided a structure to guide the conversation in order to reveal the teacher's beliefs, and at the same time provided the flexibility to engage in the teacher's

stories about their beliefs.

Participants

In accordance with the purpose of the study, to investigate teachers' beliefs about classroom computer usage in primary-grade levels, there were several criteria for subject inclusion. First, the study focused on primary teachers who had full-time access to computers in their classrooms. Having full-time access would give teachers unlimited chances to use computers with their students. Second, the study involved primary teachers who have incorporated computers in their primary-grade classrooms for at least two years. This criterion followed the research finding about the role of teachers' computer experience on their classroom computer uses (Braak, 2001). Third, the study included primary teachers who have facilitated the classroom computer usage themselves, either with or without assistance from other personnel. This criterion was incorporated to ensure to involve classroom computer uses.

Four female primary teachers from four different schools in three different districts of the Lower Mainland of British Columbia participated in this study. Three schools are located in suburban areas, whereas the other one in an urban area of British Columbia. The participants were Ann and Beth (grade-one teachers), Claire (a grade-two teacher), and Donna (a grade-one-two-split teacher). These teachers have 10 to 30 years experience teaching primary grades, and have been using computers in their classrooms for at least two years.

Apparatus

A Sony WM-GX 221 and a Califone audio-tape recorder were used to record interviews with teachers. Each interview was recorded by two audio-tape recorders, resulting in two sets of interview tapes. For the first set of tapes, blank audio cassettes of 90-minute duration were used. Based on Bernard's (1994) suggestion that researcher

should not use thin tapes (120-minute) because thicker tapes are more robust for transcription purposes, 90-minute tapes that were used for this study were of medium quality and were able to record each one-and-a-half-hour long interview. The second set of tapes used blank audio cassettes of 110-minute duration. Besides providing a back-up for the first set of tapes, using 110-minute duration tapes ensured that the whole interview was recorded, including the gap between the end of the first side and the beginning of the second side of the 90-minute duration tapes. A computer with Cool Edit 96 and Dragon Naturally Speaking speech recognition software was used to encode the interview audio-cassettes into digital audio files, to help with the transcription process.

Procedure

To guide the research, a case study protocol was established (see Appendix A). This helped increase the reliability of the study, especially since this study used a multiple case design (Yin, 1994). In order to find primary teachers who met the selection criteria, purposive sampling with snowball technique was used. This technique is appropriate for finding information-rich cases (Creswell, 1998) and has previously been employed in a study to find schools and teachers who were active computer users (Warschauer, 2000). The following procedure illustrated the snowball sampling technique that was used in this study.

To recruit potential participants, individual meetings with computer coordinators in several districts were arranged. Through these meetings, I uncovered which schools or teachers in the Lower Mainland of British Columbia were actively using computers in their primary class curriculum. A research blurb describing the purpose of the study was sent by e-mail to these coordinators. Based on their recommendations and contact assistance, information concerning the study was disseminated to teachers. Interested teachers contacted me by e-mail or phone.

Next, I met with each interested teacher. The purpose and procedure of the research were presented to the teachers. Teachers were also informed about the total duration of the interviews (up to three hours). During this visit, questions related to the criteria of inclusion were solicited and teachers who met the criteria were invited to participate in the study. After receiving agreement for teacher participation, the principals were contacted to ask for their permission. Permission was then be requested from the school district. Next, the teachers and I set up the schedule for data collection.

Interviews

The data collection process consisted of two interview phases. First, to assess teachers' beliefs about computer usage for primary students, a semi-structured interview lasting approximately one and a half hour was conducted with each teacher. Two copies of the consent form were distributed at this initial interview. One copy of the consent form was left with each participant. The interviews were recorded on audio tapes, and I took field notes, after receiving the teachers' permission. Teachers were informed that they were free to withdraw at any time from participating, and that they were free to ask the interviewer to stop the recording at any point during the interview.

The initial interview covered 26 questions about teachers' beliefs about computer usage for primary students and what teachers actually did for their classroom computer usage. The interview protocol for revealing teachers' beliefs about computer use and their descriptions about their actual classroom computer usage was based on Margerum-Leys and Marx' (1999) interview protocol about student-teacher's beliefs about computers. This protocol was adapted for the purpose of this study. Since the original study was conducted with student-teachers as the participants, some questions were reworded to suit the participants of this study, primary teachers. Some examples of the questions are: (a) Beliefs about computers: What do you see as the role of ICT as part of your classroom

environment? What do you see as the role of ICT as part of your curriculum? (b)

Pedagogical practices: What software is available for your students? Which software is most frequently used? How is it used most frequently? The complete interview questions are listed in Appendix A.

The second interview was conducted within one week after the first interview. It was once again audio tape-recorded. This interview covered 26 questions about teachers' beliefs about computer usage for primary students and teachers' beliefs about primary students' learning in general. Some themes from the NAEYC's recommendations about developmentally appropriate practice (Bredekamp, 1987) were used to reveal teachers' beliefs about the appropriateness of the use of computers for primary students. Some questions suggested by Dan Pratt to reveal teachers' beliefs (1992, 1998) were adapted to investigate teachers' beliefs about primary students' learning. Additionally, during the first week of interview, the Maclean's Magazine published an article about the controversy of computer uses for children (Ferguson, 2005). This article seemed to provoke discussions among some teachers and principals about the use of computers at the schools. Therefore, some themes from the article were used in the second interview to engage teachers in a discussion about the developmental appropriateness of computers for primary students. Some examples of the questions are: (a) Beliefs about developmental appropriateness of computers: What would be developmentally appropriate ICT uses for primary children? How would teachers provide learning environment that is developmentally appropriate for primary children? (b) Beliefs about primary students' learning: How do primary students learn? What is unique about how primary students learn? (c) Excerpts from Maclean's Magazine (Ferguson, 2005): There have been contrasting opinions about using ICT with primary students. For example, some people argue that, "if schools failed to integrate computers into the curriculum, we'd be missing a huge part of children's life - it

would be like not including physical education in the school day." On the other hand, some other people argue that, "computers and the Internet can distract kids from homework, encourage superficial and uncritical thinking, replace face-to-face interaction between students and teacher, and lead to compulsive behaviour." What do you think about these arguments? The complete interview questions are listed in the Appendix A.

Even though the interview questions were grouped into two phases of interviews, the nature of the interviews as semi-structured interviews gave me the flexibility to change the sequence of the questions to adjust it with the flow of my conversation with the participants. For example, even though the questions about developmental appropriateness of computer usage were primarily covered in the second interview protocol, I brought these questions into my conversation with the participants during the first interview when I felt that it was appropriate with our discussion. Moreover, having the flexibility to change the interview questions based on the nature of my interviews allowed me to ask probing questions to clarify or understand teachers' stories in more detail. For example, when Ann illustrated that she valued the use of computers for writing with primary students, I wanted to understand deeper her beliefs that underlied this statement even though the interview protocol did not cover this question. Thus, I asked her in more detail, what were the values of using computers for writing in primary classrooms, and how would writing at the computer differ from writing with pencil and paper.

Transcription

Prior to the transcription process, I converted the interview tapes into digital audio files by means of Cool Edit 96 software. I also used this software to remove noises from the audio files, to play and navigate through the audio files, and to slow down the pace of the speech during the playback when necessary. I transcribed the interviews verbatim

with the help of Dragon Naturally Speaking speech recognition software. During the transcription process, I first listened to a short section of the interview tape, and then reiterated the conversation into a microphone. The software then converted the conversation into texts. Simplified transcription symbols provided by Silverman (1998) were used (Appendix B). To maintain confidentiality, all research data was stored in a locked filing cabinet. All computer files associated with the data were password-protected and all names were altered into pseudonyms.

Data Analysis

The data source in this case study involved (a) a collection of B.C. Ministry of Education policy documents, and position statements published by significant Early Childhood Education institutions (the NAEYC, the American Academy of Pediatrics, the National Association of Early Childhood Specialists in State Departments of Education, the American Academy of Child and Adolescent Psychiatry, American Psychology Association, the American Medical Association, the American Academy of Family Physicians, American Psychiatric Association, and the American Diabetic Association) regarding "appropriate" computer usage for primary students, and (b) interview data about teachers' statements regarding their beliefs about primary students' learning in general, their beliefs about computer use in primary classrooms, and their descriptions of pedagogical practices. Data analysis was conducted first for each individual teacher to provide descriptive information about each teacher's beliefs. Each teacher's statements regarding her beliefs about primary students were analyzed and compared with her descriptions of pedagogical practices as well as with the policy discourse of the B.C. Ministry of Education and Early Childhood Education institutions. The individual case results were then being compared with each other to draw cross-case conclusions and to look for general patterns throughout the cases.

After analyzing the data, a report was composed using a linear-analytic structure (Yin, 1994), starting with describing the problem, followed by a literature review, methods, findings, and conclusion. The case study findings covered the description of each individual case and the cross-case description. As appropriate, some excerpts from the B.C. Ministry of Education or Early Childhood Education policy documents will be presented in juxtaposition with excerpts from the participants' interviews in the individual case description.

All names were altered into pseudonyms to ensure confidentiality. This included changing the names of the teachers, the schools, and other possible mentioned parties during the data collection.

Criteria for Assessing the Quality of the Research Design

In order to assess the quality of the case study, several criteria recommended by Yin (1994) and Stake (1995) were used. Among the four criteria suggested by Yin (1994), three were applied in this exploratory multiple-case study: construct validity, external validity, and reliability. Construct validity, defined as "establishing correct operational measures for the concept being studied" (Yin, 1994, p. 33), was achieved by means of triangulation and member checking. External validity, defined as "establishing the domain to which a study's findings can be generalized" (Yin, 1994, p. 33), was achieved through the replication conducted from one case to another in this multiple-case study. Reliability, defined as the repeatability of the research procedures (Yin, 1994), was achieved by means of using the case study protocol. The following section further describes the actual steps that were taken to achieve the criteria described above.

Triangulation

Among the four types of triangulation proposed by Denzin (Seale, 1999), this study used the data source triangulation and investigator triangulation. Data triangulation

involves "using diverse sources of data, so that one seeks out instances of a phenomenon in several different settings, at different points in time or space. Richer descriptions of phenomena then result" (Seale, 1999, p. 54). For the data source triangulation, each participant was interviewed twice, so that the interview data was taken at two different points in time. This allowed the researcher to see if the case remains the same (Stake, 1995). Having a chance to go back to my participants for the second interview gave me an opportunity to probe further some themes that emerged during the first interview, to clarify and confirm my understanding of the interview process. For example, during the first interview, Donna illustrated the importance of exploration for primary students, including exploring new computer software. To confirm this statement, during the second interview I asked her more detailed questions about her beliefs about exploratory computer activities, such as when would be an appropriate time for explorations, and how she organized exploratory activities in the computer lab. These probes during the second interview helped clarify my understanding about Donna's argument about exploration. In addition to conducting the interviews at two different points of time, the photographs I took from the samples of the classroom work provided evidences of pedagogical practices described by teachers, which served as another source of data triangulation.

Investigator triangulation referred to the process where other researchers reviewed the same phenomenon. This can be achieved by presenting the researcher's interpretation of the case to other researchers or experts to allow discussion about alternative interpretations (Stake, 1995). In this study, I presented the study in a thesis committee meeting, in which discussion will take place about the research findings.

Member Check

Member check is another way to triangulate the researcher's interpretation, where the researcher has an opportunity to verify her interpretation of the research findings

(Stake, 1995). A strong version of member check, defined as evaluating the research report (Seale, 1999), was conducted after writing the report. The case description of each participant was sent electronically or by mail to the participant. The participants were then asked to review the draft and confirm whether the report actually reflected their own beliefs about primary students' learning and their reported pedagogical practices. The participants confirmed that the case description represented their beliefs and pedagogical practices. Some examples of their comments are, *"I do believe you have presented a good picture of my beliefs and what I do,"* and, *"I think you have captured my views fairly succinctly."* Some edits were suggested by the participants for their belief statements, including removing repetitive words (e.g., "you know," "uhm"), replacing informal words with formal words (e.g., replace "kids" with "children," "gonna" with "going to"), and clarifying their statements (e.g., from "it's just surprising, what kind of words end up being sexual" to "it's just surprising, what kind of words *in searches* end up being sexual"). According to Yin (1994), having participants reviewed the research report draft helped to evaluate the researcher's interpretation over the interview transcripts, and, in turn, helped to achieve the construct validity of the study.

Cross-case Analysis

A multiple-case study design allowed a cross-case analysis, where the researchers check the correspondence of findings from one case to another (Yin, 1994). Any correspondences between the themes found in cross-case analysis generated a general theme of primary teachers' beliefs about computer usage for primary students. While looking for correspondence between cases, I also analyzed unique situations that might create the differences between one case and another.

CHAPTER THREE: FINDINGS

Overview of Early Childhood Education Institutional Policy Discourse and Recommendations

The Position of and the Recommendations Made by the NAEYC

In its position statement about "Technology and Young Children: Ages 3 through 8" (1996), the NAEYC summarizes its beliefs regarding the use of ICT for young children and provides recommendations for appropriate ICT use. In general, the NAEYC believes that as a tool, ICTs can be both beneficial and misused, and it is the teacher's role to judge the age appropriateness, individual appropriateness, and cultural appropriateness of the use of ICTs. The NAEYC further describes its position by explaining (a) the potential benefits of ICTs and (b) the recommended strategies for using ICTs appropriately.

With regards to the potential benefits of ICTs, the NAEYC stresses the potential positive impacts of developmentally appropriate software for facilitating children's cognitive and social abilities by extending and supporting traditional materials and encouraging creative play, mastery learning, problem solving, and conversation (NAEYC, 1996). In order to promote developmentally appropriate ICT use, the NAEYC recommends some strategies to be considered. First, appropriate ICT use will occur as ICTs are integrated physically, functionally, and philosophically into the daily routine of regular learning environments. Second, teachers need to promote equal access to computers, so that they will be accessible to all children regardless of their gender, race, and social class. Third, ICTs should incorporate diversity and promote social value. Educational software should come in multiple languages, and be multicultural and useful for multiple age groups. As well, the software should not be gender biased. Teachers should also avoid using software that contains violence. Fourth, teachers need to

collaborate with parents in discussing appropriate uses for ICTs. And finally, the NAEYC points out the need for providing in-depth training of ICT use for teachers (NAEYC, 1996).

Compared to some researchers (such as Borja, 2003; Healy, 2004), the NAEYC carries a more optimistic view about the potential benefits of computer use rather than viewing computer use as being potentially dangerous and detrimental to early childhood education. The NAEYC points to the developmentally appropriate computer use as the key factor that allows children to benefit from the computer use. However, the NAEYC provides only little guidance about what developmentally appropriate computer use is. Compared to the other position statements made by the NAEYC (such as Bredekamp 1987; NAEYC, 1997; NAEYC & NAECS/SDE, 2003), the NAEYC's position statements about "Technology and Young Children" (1996) tend to provide only general suggestions about the developmentally appropriate practice. In contrast with a large number of specific examples the NAEYC provides about developmentally appropriate practice versus developmentally inappropriate practice in their other position statements (Bredekamp, 1987; NAEYC, 1997), the NAEYC covers only few examples about developmentally appropriate practice as well as developmentally inappropriate practice in computer usage for young children. As a consequence, this might provide an incomplete foundation for teachers to put these recommendations into practice. Furthermore, before the NAEYC exerted its definition about the developmentally appropriate practice and gave specific examples in its first position statement in 1987, the term developmentally appropriate practice was often misinterpreted (Carta, 1995). The same phenomenon may happen with NAEYC's position statement about ICT, where only general recommendations as opposed to specific guidelines and examples about developmentally

appropriate use of computer were given. This may result in misinterpretations when the recommendations are situated into practice.

The Position of and the Recommendations Made by the British Columbia (B.C.) Ministry of Education

Along with the NAEYC's perspective about ICTs, in the primary curriculum document, "The Primary Program: A Framework for Teaching" (2000), the B.C. Ministry of Education also states that developmentally appropriate use of ICTs can enhance learning, extend human capabilities, transform ways of thinking, and that computers can be used as creative tools for students. The B.C. Ministry of Education also suggests the need to evaluate software applications for age suitability, biases and stereotypes. Again, this position provides somewhat general suggestions about computer usage for primary students. Even though teachers are encouraged to incorporate ICTs in the classrooms, there is little guidance about specific criteria for evaluating the appropriateness of ICT use in the classrooms. The B.C. Ministry of Education does, however, provide some specific suggestions about the possible uses of ICTs in the curriculum, which will be described in the following section.

For the primary curriculum, the B.C. Ministry of Education published an Integrated Resource Package (IRP) for Information Technology K to 7 (1996b), and Applied Skills K to 7: Technology Education Component (1995a). In both documents, the B.C. Ministry of Education stressed that as an integrated area, it is not necessary for teachers to write a report about ICT as a separate subject. However, teachers should make written comments about ICT-related components in the report cards when they are reporting on other subject areas. These two documents are no longer used in the primary curriculum, as the ICT-related components are integrated into the other subject areas in the more recent IRPs.

The use of ICTs is mentioned in several sections of the current K to 7 IRPs, elementary curriculum documents published by the B.C. Ministry of Education (1995a; 1995b; 1995c; 1996a; 1996b; 1998a; 1998b; 1999; 2005a). Each IRP for grade K to 7 provides general recommendations regarding ICT use as follows: (a) the use of ICTs is mentioned as one among several instructional strategies suggested for teachers. These strategies serve as examples that can be modified further to suit the student needs. (b) Teachers are encouraged to use educational technologies and are advised to evaluate the nature of various media and its advantages as learning resources. (c) The necessity of integrating the information technology curriculum into all subjects is stressed in order to promote students' computer literacy and to prepare them for the information age. The B.C. Ministry of Education also suggests several outcomes that students will be expected to achieve through ICT integration.

Besides the general recommendations about the use of technology, each IRP varies in its ICT-related contents. There are three kinds of suggested computer usage, which are: (a) suggestions about computer-related materials, e.g., "Our Wonderful World" multimedia is recommended as a learning resource for Social Studies grade K to 1 (British Columbia Ministry of Education, 1998b, p. 17), and "One Two Tree" CD-Rom about trees is recommended as a learning resource for Science grade 1 to 3 (British Columbia Ministry of Education, 2005a, p. 357), (b) recommendations about computer-related instructional strategies, e.g., one of the suggestions for the Personal Planning grade 2 to 3 is to "ask students to use computer 'draw' or 'paint' programs to create facial expressions that reflect a variety of feelings" (British Columbia Ministry of Education, 1999, p. 30), and (c) suggestions about Information Technology-related prescribed learning outcomes for some subject areas. For example, one of the prescribed learning outcomes for grade K to 1 English Language Arts is that "students will employ a variety

of effective processes and strategies, including the use of electronic technology, to generate, gather, and organize information and ideas" (British Columbia Ministry of Education, 1996a, p. 22).

In addition to the mandated IRPs, some Information Technology prescribed learning outcomes are also listed in "The Primary Program: A Framework for Teaching," a document recommended (but not mandated) for primary teachers as a framework for an integrated primary curriculum. For example, in the field of social and emotional development, one of the prescribed learning outcomes for kindergartners and first graders is to "demonstrate a willingness to work co-operatively when using information technology tools" (British Columbia Ministry of Education, 2000, p. 208).

Despite the fact that the Information Technology component has been integrated into subject areas and that teachers are encouraged to embrace these components, the decision to use ICT depends on the teacher. Since there are a large number of prescribed learning outcomes in each subject area, teachers must decide which outcomes they will choose to cover in their own classrooms.

Considering that the B.C. Ministry of Education and the NAEYC's documents concerning the use of ICTs serves the purpose of providing guidance for teachers in their uses of ICT, it is important that these documents are current with the rapid growth of technology. However, both institutions do not seem to keep their recommendation current. For example, the NAEYC's position statement about ICTs was published in 1996 and has not been updated in the last nine years, while the B.C. Ministry of Education's curriculum is revised every eight years (British Columbia Ministry of Education, 2005b).

Overview of the Participants and the Schools

All participants took their post-baccalaureate in teaching technology. Ann and Beth are particularly recognized as computer expert teachers in their districts, and they have delivered various computer-related workshops for other teachers in their districts. Compared with other schools in their districts, the schools wherein the participants work are well-equipped with computers. Throughout the three districts, it is common to have a computer in elementary classrooms in general, but primary classrooms do not necessarily have a computer or an Internet access. However, all of the four teachers have at least one working computer that is connected to the Internet. Three of the schools even have some extra facilities, which consist of at least 10 sets of mobile wireless laptops that can be signed out and used in the classrooms. One of the districts has mobile wireless laptops, where teachers can request to use a class set of laptops in their classrooms for a six-week period. The number of working computers available in the classrooms ranges from one to five computers. Some of these computers are owned by two of the teachers themselves (see Table 1 for more detail information).

Individual Case Description

This section is organized as follows: First, background information about each teacher is described, followed by their beliefs about primary students' learning, computers, and developmentally appropriate computer uses for primary students. As appropriate, excerpts from the B.C. Ministry of Education documents or early childhood education institutional policy discourse will be presented in text boxes in juxtaposition with excerpts from each teacher's interview. Next, teachers' descriptions of their classroom computer uses will be presented in order to illustrate the ways their beliefs about learning are related to their pedagogical practices. A summary of each case description will also be provided.

Table 1. Background information of the participants and their schools

Name Condition	Ann	Beth	Claire	Donna
Teaching experience	35 years (25 years in primary)	30 years in primary	25 years in primary	10 years in primary
Class taught	Grade one	Grade one	Grade two	Grade one-two split
Computer lab platform	Microsoft Windows (PC)	Macintosh	Macintosh	Macintosh
Computer lab times	Twice a week	Twice a week	Once a week	Once a week
Working computers in the classroom	5 out of 6 PCs*	2 iMacs	1 out of 2 Mac computers	2 PCs* 1 iMac
Internet connection in the classroom	2 computers	2 computers	1 computer	1 computer (Mac)
Wireless laptops for classroom use	Available upon request at the school districts level	Available upon request at the school level	Available upon request at the school level	Available upon request at the school level

* Some of these computers are owned by the teachers.

Ann

Background Information

Ann is a grade-one teacher. She has been teaching for 35 years, 25 of which were spent teaching primary (Kindergarten to grade 3) grades. As a primary teacher, she

taught kindergarten students for approximately 15 years, and in the last 10 years she has been teaching either grade one, grade two, or grade one-two split. The school where Ann teaches is a K-7 school in a suburban area in the Lower Mainland of British Columbia. About 350 students are enrolled each year at the school.

In her district, Ann is regarded as a "computer expert." As noted by the computer coordinator in her district, Ann has contributed to the school district ICT Learning Support Team for four years, and that her expertise in the use of ICT with young children has been widely recognized through her presentations in both local and international conferences. Her willingness to learn computers on her own, combined with the formal training in a post baccalaureate program in teaching technology, have improved her expertise in using computers with students. She has given a number of workshops for teachers across various generations of computers, ranging from using Apple IIe with students in the 1980s to using the Internet with students in the 2000s. She has delivered workshops for teachers on how to use a wide variety of programs with students. For example, she teaches teachers how to use Microsoft Excel, PowerPoint, and Inspiration, as well as how to make movies, how to develop web pages, and how to use the district report card program.

Ann has also been involved in the committee for choosing appropriate software for the district. She sat on the committee for adapting the IRPs and Primary Program documents to fit her district versions; that is, particularly adapting the Ministry recommended software or resource materials from the Macintosh versions into equivalent software or materials on the Microsoft Windows platform. Her accomplishments in using computers with primary children were acknowledged when she was awarded a Prime Minister award for teaching excellence. This award was granted for her use of ICTs with her students in various projects integrated into the curriculum, including her use of ICTs

for reading and writing projects and her grade-one project about community that integrates various aspects of the curriculum. Additionally, she went to an international conference to present her grade-one project about community that won a competition.

Beliefs about Learning

Beliefs about primary children's learning. Ann likes teaching primary children because:

they're learning so much, and they're just starting to pick up words and particularly the reading part of it. They're starting to figure out numbers... that's why I like that age, I thought they were learning so much. They're like sponges at that age... They are so excited about everything they learn, and they seem to pick up so much so fast.

Ann incorporates many different activities to help her students experience new things to facilitate learning. For example, Ann explains how she:

...brings a lot of things into the classroom, like I had a snake egg here the other day, and snake skin... When we are doing insects, the kids have my little bug collectors and they're bringing in insects at recess or lunch... So, there's so much stuff going on all the time.

According to Ann, primary children learn through hands-on activities, seeing and experiencing things. She explains that the use of concrete objects is very important in helping primary students learn, because students at these grade levels need to experience the real object first to be able to understand the concept being taught. She thinks that later on, when the students have mastered the concept, they will be able to use more abstract materials. Ann further explains that the most important thing is to make sure that she is using the materials in the right order, that is, to use the concrete materials first, and then

when students have mastered the concept, they can practice using more abstract tools, such as using computer programs to practice their skills.

"Children learn by doing, their actions helping construct their personal knowledge. Involvement in learning increases, as does long-term retention. Active, exploratory learning works as well in mathematics as it does in science" (Steen, 1991, in British Columbia Ministry of Education, 2000, p. 149).

Box 1. Active learning

Beliefs about the roles of primary teachers. Ann believes that a teacher's primary role is to ensure that the children develop academically, socially, and physically. She explains that (a) academically, teachers need to be sure that the activities provided in the classroom will engage students' higher level thinking skills and problem solving strategies; (b) socially, children need to learn to work collaboratively with others, exchange and discuss ideas, and compromise with others; (c) physically, children need to develop their motor skills. She says:

oh my gosh, you are everything in a primary classroom. Primary role, I guess it is to make sure that the kids develop, the social skills needed to work in a group, and the academic skills that are going to have them move forward, the physical skills if they have fine motor problems and so on. All those areas are important.

"Children from babyhood through primary grades— and beyond—need to be cognitively, physically, socially, and artistically active" (NAEYC & NAECS/SDE, 2003, p. 7).

"Children learn best when they are physically, intellectually, and emotionally engaged" (British Columbia Ministry of Education, 2000, p. 32).

Box 2. Domains of child development

According to Ann, to help children develop in all of these areas, teachers need to continuously assess their students, find out how well they are doing in certain areas, and what they need to further develop their skills. She explains that teachers should design

appropriate activities carefully by pre-selecting the materials, choosing the best tool for each of their goals, varying the activities, and keeping the activities fun.

"Effective teaching uses information gained through a comprehensive plan of assessment and evaluation to make thoughtful, informed instructional decisions and to design interventions as required" (British Columbia Ministry of Education, 2000, p. 75).

Box 3. The importance of assessment

Beliefs about Developmentally Appropriate Computer Uses for Primary Students

Ann believes that the learning objectives could still be met even in the absence of computers in the primary classroom. However, she emphasizes that the computer is a part of children's world. Therefore, she believes that children need to learn how to handle computers properly; that is, to use them in an educational manner rather than merely use them as toys. Ann thinks that:

...the biggest thing is again that computers and technology are in the world out there, it's very much a part of the kids' world. So why should it not be part of the school as well?... Whether we choose to teach it or not in our classroom, it's part of their world. And they need to know how to use it properly, like being able to evaluate Internet materials and... not getting caught up in inappropriate sites ...

Ann thinks that integrating computers in the school curriculum can help students learn to use computers as a tool for supporting their learning, so that *"they get the idea that it is a tool that you can learn from, it isn't just a place to play games... it's not a toy, it's a tool."*

In Ann's opinion, the computer in the school system is only one of many tools to help deliver the curriculum. She believes that as a tool, the computer can have both positive and negative impacts on primary children and teachers, depending on the way it is used. The following section illustrates Ann's beliefs about the impacts computers can have on primary students and teachers.

According to Ann, computers in the classroom can have positive implications for teaching and learning. For teachers, Ann stresses the great impact the Internet has for providing resources for teacher planning. In addition to using computers to gather information, she also thinks that it is beneficial for teachers to integrate computer use into the curriculum and use it as a tool for meeting the learning objectives. She explains that when they are used in this manner, computers will help teachers deliver the curriculum as well as bring positive impacts for students. For example, Ann explains that:

...whether you use it with your kids or not, I think teachers should be using it so much for teacher planning, cause there is so much good stuff out there, for that. Using multimedia, such as PowerPoint or WebQuests or video to create and present lessons can make a much more powerful learning situation for students. And then... to continue that further.... to creating interactive learning lessons using PowerPoint or web-based programs that your kids can use ((as a tool to help achieve learning outcomes)).

Ann describes some of the positive implications of computer use for students when she states how:

It's very motivating for kids, right? And if you get kids who are not strong writers, who physically can't write very well, computer is an excellent tool for them, for writing. It is a very visual thing for them, right? So, I think those are probably the big benefits.

"Technology has the potential to assist young children in their learning in many ways. For example, it may allow students to focus on words and ideas rather than the mechanical aspects of writing (Jones and Pellegrini 1996). For some children, however, word processing seems to interfere with their writing processes (Dahl and Farnon 1996)." (British Columbia Ministry of Education, 2000, p. 24).

Box 4. The potential of technology to assist children's learning

In addition to her opinion about the value of using the computer as a motivating learning tool, as a tool for helping students to write, and as a tool for catering to those who learn better visually, she discusses how computer use in the classroom also helps children practice what they have learned and provides students with up-to-date information.

In Ann's opinion, in terms of practicing what the students have learned, the unique contribution of computers to the classroom lies in its multilevel nature. She thinks that with computers, teachers can reach more students with various skill levels, and provide "*a good source of individual help for some kids*." For example, Ann may ask some students to practice their phonics skills on the computers, while other students, who do not need phonics practice, work on other activities. For her special needs student, who is not verbal, Ann may put him at the computer to watch some video clips about bugs or insects. And when there are gifted students in the classroom, she may assign them special projects (such as WebQuest) at the computer.

Ann points out that the computers can be a source of motivation, because she thinks that students are interested in computers. She illustrates that when working at the computer, some children can do more than they would do with pencil and paper. She suspects that this happens because the materials at the computers are more appealing both visually and auditorily:

You might have kids who are not motivated with books or through pen and paper and pencil, but, who will certainly do a lot more when you put them at the computer. And I find that particularly with things like, practicing words or, or doing of, like phonics practice kind of thing, like I said if you gave them a worksheet, that is very boring. But they'll do the same kind of thing on the

computer, and not find it boring at all. Cause it's colourful and bright and they can click on things and right?

Ann further explains that computer activities can also be rewarding because they provide another medium for learning. She believes that having this variation can alleviate students' boredom because:

...it's flashier on the computer, right?... the pictures and colors and so on, may be a little flashier. I don't think they like it better, but it is a different way, so they don't get so bored with one way of doing something, right?

Ann also believes that computers can help children in their writing, especially for children who have difficulty writing with pen and paper because their fine motor skills are not fully developed. She observes that when children use the computer for writing, the computer becomes a good writing tool for them. Ann describes the use of Talking First Word as an example. She explains that this program includes a topic bank, where children can pull out pictures from the topic bank to see how to spell them. For example, when her students want to know how to spell grasshopper, they can look for the grasshopper picture at the topic bank, and see how it is spelled. Once they found the word that they need, the students can click on it to insert it into their writing. Ann illustrates that besides inserting texts, students can also insert images from the topic bank as illustration to support their writing (see Figure 1).

According to Ann, another advantage of writing with computers is that students:

have to press the space bar to make the space. It is more obvious that they need to make a space than when they are doing their writing, they might not leave spaces. I just teach them to leave spaces by having them physically pressing the space bar to make a space.

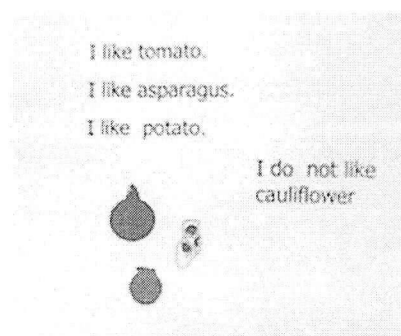


Figure 1. An example of a student's work created with Talking First Word¹

She explains that in this way, it is easier for the teacher to see whether children have made conscious effort to leave a space between words, whereas when children are writing on paper, it is not that obvious.

Ann believes that using computers to access the Internet can provide students with more up-to-date information. She thinks that compared to books, which require more time to produce, the Internet can provide the most recent information. She values this immediacy of information because it helps teacher and students acquire information very quickly. She notes that:

The other thing about ICT in a busy classroom like this is, you can get very up-to-date information, right? If you want to find an answer to that question really fast, that's the place to go. It's instant and very up to date, the newest stuff.

Ann believes that besides the positive impacts, computers do have potential negative impacts for teachers and students. First of all, she is concerned about the use of computers as rewards for students who finish their work. She thinks that this will give a false idea to the children that computers are toys as opposed to educational tools. She believes that when teachers use the computers:

¹ The figures throughout the case descriptions are photographs of the classroom work shown by the participants, which I took during the interviews.

as busy work for the kids, when you say if you get your work done then you can go to the computers, as a reward... it is like a toy when you've done your work you can go play with the toys, right?... I think it is a negative thing, because it gives kids a wrong idea about what computers are all about.

Second, Ann points out that computer use can be detrimental to children when they are not supervised and when the time spent on the computer or the Internet is not limited. In particular, Ann emphasizes that:

...another negative thing is letting them go wherever they like or do whatever they like, because the Internet is a scary place... there is no way you want to just turn them loose and, I think doing searches with primary kids is very dangerous.

She explains that when searching for information on the Internet, accessing and accidentally opening sites that are irrelevant to the purpose of the search, such as pornographic material, becomes easy. To cope with this problem, Ann prefers to pre-select the relevant and appropriate information on her own and give the links to her students. Moreover, Ann explains how:

...with young children, you can teach them to evaluate the sites. And also the other thing, there is a lot of advertising on some sites, and young children are just learning to click on links, and the advertising is usually colourful and bright. One of the things I do teach my kids, cause there are some good sites that I like them to go to that do contain some advertising on them, is that we don't click on those links. I also teach them how to back out of a site that they get into accidentally.

Third, Ann thinks that sitting at the computer for lengthy periods of time can be harmful to children both physically and socially. She particularly thinks that the negative physical impacts of using computers can be worse for children than for adults, because the equipment is not designed for children:

...usually our chairs are too big for the little ones, and their feet don't touch the floor. It's a matter of correct posture and if they are sitting there too long, it is not good for them. And the same with their eyes if they're sitting too long, staring at the screen... physically... it's kind of hard sometimes on kids. So that's why we shouldn't keep them at it too long.

Ann also thinks that spending too much time at the computer can hinder the development of social skills and social interaction in children because they are isolated when they are using the computer. She points out, however, that this is more a concern at home rather than at school. She explains that at school, children do not use the computer long enough to be influenced by these negative effects; at home, however, children might use computer much longer:

It is all in how it's being used and I think some parents tend to use it as a babysitter, just like they use TV as a babysitter. I think you find this more at home than you would find this at school. But I think it's certainly true at home.

Ann believes that the access children have to computers should be limited so as to avoid both the physical and the social problems that might arise from extended computer uses. She believes that using the computer for 30 minutes a day is sufficient for children.

"The AAP offers the following recommendations:... Pediatricians should encourage parents to adhere to the AAP Media Educations, including making thoughtful media choices and co viewing with children, limiting screen time (including television, videos, computer, and video games) to 1 to 2 hours per day... avoiding violent games in homes where they may be observed or played by young children, and keeping children's bedrooms media free" (AAP, 2001, p. 1224).

Box 5. Recommendation for limiting screen time

According to Ann, since computers can be both helpful and detrimental to children, teachers must be current on the appropriate methods for using computers with

children; this includes familiarity with the software, as well as knowing how to use it properly:

...the thing is, that teacher has to be fairly knowledgeable about their software that they have, and the best ways to use it. It involves some teachers' knowledge about the technology and being able to troubleshoot problems that might occur.

The following section describes Ann's beliefs about how teachers can provide developmentally appropriate computer use for primary students.

According to Ann, the appropriateness of computer use is an important consideration in using computers with young children. She believes that as one tool among many, computers also need to be evaluated based on several criteria: (a) their role in delivering the curriculum, (b) their function compared to other tools or activities, (c) their appropriateness to the nature of primary students' learning, and (d) their effects on students. The following section describes these criteria in more detail.

First, Ann believes that, since the role of the computer is to help deliver the curriculum, teachers need to evaluate whether using the computer aligns with the curriculum, that is, whether using the computer can be integrated into the curriculum. She explains that teachers should treat the computer as a tool rather than a subject, in order to focus on the curriculum. She describes that when a teacher is using computer as a tool to deliver the curriculum, the teacher will be able to do more at one time: deliver the curriculum and provide students with computer skills.

"As part of the teacher's overall classroom plan, computers should be used in ways that support these existing classroom educational directions rather than distort or replace them. Computers should be integrated into early childhood practice physically, functionally, and philosophically" (NAEYC, 1996, p. 2).

Box 6. Integration of computers into the classroom

Second, Ann believes that prior to using educational tools to help achieve a specific learning outcome, teachers need to find the best tool for a specific goal. For example, Ann explains that there are times when she prefers to use the overhead or the blackboard rather than the computer, and this preference is based on the learning objective she has for her class.

"Effective teachers use a variety of resources. Doing so enables them to address diversity within the classroom and meet the various developmental needs of young children. Resources include computers, software, on-line services, video, CD-ROMs, audiotapes, and manipulatives, as well as non-fictional and fictional books. When effective teachers choose resources for particular purposes, they consider the advantages of various types of media, knowing that some students learn better from one medium than another. They also take account of the fact that some topics may be best taught using a specific medium" (British Columbia Ministry of Education, 2000, p. 79-80).

Box 7. The use of various media

Third, regarding the nature of primary students' learning, Ann believes that children need to interact with real objects prior to using abstract materials. She thinks that teachers need to expose students to concrete materials and ensure that students understand the concepts prior to practicing their skills with the computers, which are more abstract. She explains that:

...we would use them ((the counting manipulatives)) for adding, we would use them for subtracting. You've got 10 real objects. Then physically, take away 2, how many do you have left?... On the computer a learning program might have flashcards and some of them will say, 10 take away 2 is what?... But that's abstract. With the counting manipulatives, they can have 10, they can take 2 away, and see what they've got left. Some of the better computer programs might use pictures of objects and show some crossed out, which is not quite so abstract.

"Curriculum facilitates children's construction of knowledge through their interactions with materials, each other, and adults. Curriculum promotes experiences in which children's thinking moves from the simple to the complex, from the concrete to the abstract" (NAEYC & NAECS/SDE, 2003, p. 30).

Box 8. Curriculum and children's thinking

Ann thinks that using manipulatives is particularly important in math, and also important for learning new concepts:

When I'm teaching them about something, we're using all the manipulative stuff. Right? Before they ever try and do it on the computer, I don't actually send them to the computer to do something unless we've done a lot of work using the real thing first. Especially this age group, this age group needs the hands-on stuff.

"The term "manipulative" refers to materials that a student interacts with in a tactile manner. These materials facilitate understanding by providing the student with the opportunity to practise and demonstrate abstract concepts" (British Columbia Ministry of Education, 2002, p. 27).

Box 9. A Recommendation about the use of manipulatives

Besides considering the order of the materials, Ann also thinks that it is necessary to adjust the computer activities to suit the ability level of the students. For example, Ann points out that the software used:

...has to be fairly concrete. I know it's not ((the computer is not)) a concrete medium, but, the pictures have to be good pictures, good illustrations. It has to have, easy large text, and it has to suit what the children can understand at that age. Right? I don't do much writing on the computer with them in the fall cause they can't do it at that age. This time of year ((June)), they can, that's why we're using Talking First Word. That's why we're doing Storybook Weaver now. I

wouldn't use that program in September because there is no way, it's way beyond them.

Finally, Ann believes that teachers need to evaluate the appropriateness of the computer use in terms of its impacts on students. They have to be mindful of both the positive and negative implications of computer use on primary children, and design activities in such a way as to maximize the benefits for students and minimize the possible negative impacts.

"Developmentally appropriate software offers opportunities for collaborative play, learning, and creation. Educators must use professional judgment in evaluating and using this learning tool appropriately, applying the same criteria they would to any other learning tool or experience... Choosing appropriate software is similar to choosing appropriate books for the classroom—teachers constantly make judgments about what is age appropriate, individually appropriate, and culturally appropriate" (NAEYC, 1996, p. 1).

Box 10. The importance of evaluating software

Criteria for choosing software. As part of evaluating computer-related materials for primary students, Ann describes the importance of teachers to educate themselves about computer software. Ann describes several criteria that she uses in choosing good software: good software is open-ended, uses multimedia, has multiple levels, requires children to think, and reinforces appropriate social skills.

Ann explains that the nature of open-ended software is that *"you can use it so many different ways, it is not restricted, you can do only one thing with it. You can maybe do a multitude of things with it."* According to her, some examples of open-ended software are Talking First Word, KidPix, and PowerPoint, where students can create many different things; an example of software that is not open-ended is "Spider," an electronic book that allows students to read about spiders only.

Ann believes that open-ended software is particularly useful because it enables children with different levels of experience or ability to use the software. She explains that the open-endedness of the software is helpful for both students and for the school. For students, she thinks that they are able to practice at a level that is suitable for them and practice the skills they need to develop. For schools, she believes that having software that can be used by all students (K-7) is cost effective:

If a child is still at the stage where he has to draw everything and can't write, you can use it. If a child is writing books and making ((books)), he can do it, all in the same program. Right? If a child wants to make a movie, he can do it... it's multimedia. He can add sound, he can add pictures, or he can just draw the pictures, depending on what level he is at.

Ann believes that valuable software for education is the one that requires the children to think instead of just clicking and playing.

It has to involve some thinking. I think that's the biggest thing. When they have to think about their responses in the program, then they are learning something from it. And they don't get so caught up in the sound and the graphic, which can distract kids quite often in some games.

Ann does not favour software that is too flashy or distracting (i.e., too much visual and auditory stimulation), and software that reinforces competitiveness. Her concern is that children will get caught up in winning or losing rather than learning the skills. She explains that rather than thinking prior to responding to the software, children would want to do things as fast as they could to win more points.

Ann believes that software for children should also reinforce appropriate social skills. She believes that software that contains violence is inappropriate for children because it teaches inappropriate social skills by promoting violence. She further says that

this includes not only software that contains violence toward humans, but also towards animals. She notes that:

That's the other thing that's inappropriate, of course, is if they show violence. Anything where they have to kill somebody or put somebody in jail, or hit somebody.... Where it's teaching them inappropriate social skills actually. Those to me are very unsuitable programs. And even if it is where they have to hunt the animal or kill the animal, you're not teaching them much about animal conservation and so on. I think you have to be aware of what attitudes the kids might be getting from this.

"Children control the computer software, and, instead of being passive viewers of what appears on the screen, with the computer they become active decision makers about what takes place on the screen. Software programs that empower children to freely blow up or destroy without thought of the actual consequences of their actions can further the disconnection between personal responsibility and violent outcomes" (NAEYC, 1996, p. 4).

Box 11. Violent software

Classroom Practices

Class taught. When the interview was conducted, 23 grade-one students (14 boys and 9 girls) were in Ann's class. Ann also had a teaching assistance in her class to help with her student who has Down's syndrome.

Computer facilities. There are six computers in Ann's classroom, which consist of four computers with 486 processor, a computer with 386 processor, and an older computer. Five computers are working well, and two of them are connected to the Internet. Most classrooms at her school have only one or two computers, but Ann has more because of her expertise, and because she owns some of the computers. Ann notes that other teachers at the school do not want to use these old computers because the computers sometimes have problems; however, she is able to troubleshoot problems that

may arise with the computers. The computers in her classroom have older versions of Microsoft Windows (1998 or 1995). At the school district level, there are some class sets of mobile wireless laptops available. These computers can be signed out to a class for a whole six-week period so that every student in the class can use one laptop everyday during this period. To have these laptops, teachers must apply for them, and priority will be given to teachers who have not had the turn to sign out these laptops. Last year Ann had these laptops in her classroom, so that her students could use these computers everyday to work on a WebQuest project, but this year other teachers have the priority to use them.

In line with Ann's beliefs that teachers need to use computers as a tool and choose the software that matches their goals, she has a collection of software that she uses for various learning objectives. This includes word-processing software, alphabet and phonics software, Internet browsers, math software, drawing or graphic software, and a number of topical readings based on the curriculum (see Table 2 for examples). The software belongs to either the school or Ann. The most frequently used software is word-processing software and Internet browsers.

The use of themes. Throughout her teaching, Ann likes to use themes to integrate various subjects. She points out that by using themes, students will be able to "*tie all their knowledge together,*" and learn more at the same time. Also, she notes that the materials will be more interesting to students. She illustrates that she integrates the computer uses into the class themes, by designing computer activities and selecting materials that are related to the theme. Below is Ann's description of her classroom computer uses.

Table 2. Types of software available for Ann's students

Type of software	Examples of software
Word processing	Talking First Word, Microsoft Word, Storybook Weaver, and KidWorks
Reading	Swift Phonics for Kids, Multi-Media Alphabet, and ABC 123, WiggleWorks, and Reader Rabbit
Math	Mathamagica, Math Blaster, Math Rabbit, and Troggle Trouble™ Math
Drawing or graphic	Colour Magic, Tux Paint, KidPix, and Inspiration
Internet browser	Internet Explorer, Netscape Navigator and Composer
Topical readings	Magic School Bus, The World of Bugs, and The World of Animal

Classroom computer uses. According to Ann, her students use computers extensively, both in the computer lab and in the classroom. She notes that for at least a quarter of the school day, some of the classroom computers are being used by at least a portion of the students in her class. Ann points out that the students' computer use is fully supervised, and that she only allows her students to use the computer when she is around so as to ensure that the students are not engaging in inappropriate computer activities. The following section describes her classroom computer daily and weekly uses, consecutively.

Daily uses. Ann reports that every morning her class starts the day by checking the weather report online. To start, she describes that the whole class makes a prediction about what they think the weather will be like that day. Ann notes that this encourages students to think first. She further describes that students will indicate their opinions of that day's weather compared to yesterday's weather by physically showing their opinions

with their thumbs: thumbs up means warmer, thumbs down means colder, and thumbs to the side means that the weather is the same as yesterday; after that, two students will look up the weather report on the Internet, and then report back to the group by completing the daily weather report calendar (see Figure 2). Ann explains that this activity is an example where she teaches children how to use the Internet to research up-to-date information and compare this information with their own thinking.

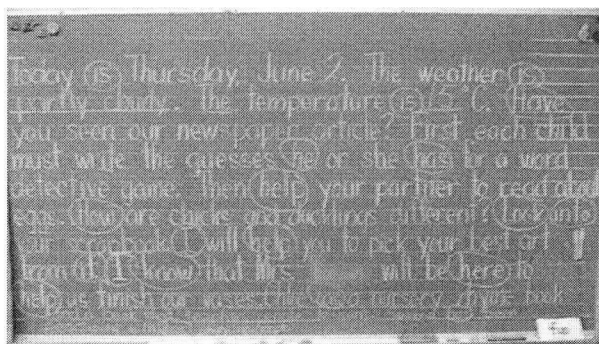


Figure 2. Calendar activity with weather report

Ann illustrates that while the class proceeds with the calendar activity (see Figure 2), three students read electronic books related to the current class theme; for instance, when the theme is about insects, the readings can be about spiders, butterflies, or bugs. She notes that after they finished reading, the students would check their names on the student list to indicate that they have read the given book. Ann points out that when everyone has read the assigned material, she will change the readings and the reading cycle will recommence. This reading activity is an example of how Ann's classroom computer uses are integrated into the curriculum, where she chooses the materials that are related to the themes that the students are working on.

Ann explains that during the class reading time, the class first reads together as a large group; next, the students go into their small groups, and one of the groups goes to the computers. Ann shows that to arrange the schedule for small group activities, she has a pocket containing cards that indicates different activities each group will do at different

time of the day (see Figure 3). She notes that typically each group will get a turn to work on the classroom computer for a given subject every five days.

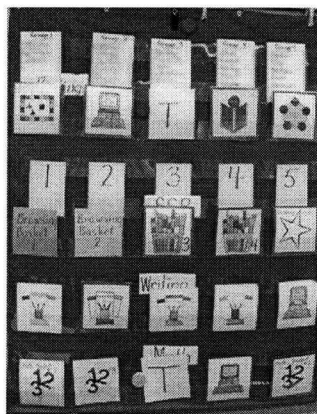


Figure 3. The schedule pocket for group activities

Ann explains that when students are reading at the computers, she will vary the level of the software used, based on the group's reading ability. She notes that this is something that is only done for the reading activities, where a difference in reading abilities exists. She points out that by doing it this way, she can match the activities with students' level of abilities.

Ann describes that after recess, the students have time to write. She illustrates that she starts the class by explaining what the students are going to work on that day; next, the students work in small groups based on the schedule. Ann explains that four groups of students will do their writing at their desks, while one group will go to the computer to do their writing with the computers. After lunch, it is time for math. Ann describes how the same pattern occurs, where she starts by giving the instructions to the students as a whole group, teaching the material for the day, and then dividing the students, based on the schedule (see Figure 3) to practice either at their desk, with math manipulatives and counting objects, or at the computer.

Weekly uses. According to Ann, besides the daily computer activities, computers are used during computer lab time and during centre times. She reports that the students

have computer lab times twice a week; each computer lab session is 40 minutes in length, and the students' activities depend on the class themes. She also illustrates that during centre time or the free choice activity, which is held twice a week, the classroom computer is opened to the students. She notes that during this time, students can choose their own activity, including browsing the Internet. Ann explains that when students access the Internet, they are allowed to browse their school website that was made by her, to assure that students only go to safe sites.

Pedagogical practices. Ann explains that during computer time, usually each student works individually at the computer; however, when the students are learning a new program, are on the Internet and discussing things on the Internet, or are having the centre time, she will instruct her students to work in pairs. Ann notes that this is a way that she uses to encourage students' social interactions while they are using the computer; thus, alleviating her concern that computers isolate students and do not promote social interaction.

Ann explains that the computer activities vary throughout the year depending on the class themes and the students' abilities, to match the activities with the students' level of development. The following section describes Ann's explanation about the way she matches the computer use with the students' needs throughout the different times of the year.

Ann describes that at the beginning of the academic year, she does not use the computers in the classroom much; when the computers are used, the activities involve basic skills that do not require much reading. For example, she says that students would play alphabet games such as Chicka Chicka Boom Boom, drawing with Colour Magic (see Figure 4), or learning to type their name with Talking First Word.

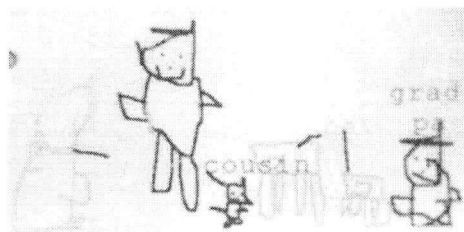


Figure 4. A student's drawing about family created with Colour Magic

Ann reports that as students start to develop their reading and writing skills, they do more reading- and writing-related activities at the computer. She describes that the students start to go to the Internet during Halloween, for example, to find information about the biggest pumpkin in the world; during Christmas time, they access the Internet more often to visit the Santa site.

There is a website called the North Pole, it shows the village and they can click on the barn and see what's going on in the barn, and they can click on Santa's mail room and see what the elves are doing there, they click on the toy room, and see what's going on there, there is reading involved and writing. There is even a place where you can click and e-mail a letter to Santa. I give the children specific tasks to do as they explore the site.

Ann further notes that in January, when the children are more able to use the keyboard and manipulate the mouse, they start to learn new programs, such as Storybook Weaver to do more writing, and Inspiration to make webs. For example, she explains that when the class theme was about insects, students would write about insects with Storybook Weaver, and when the theme was about community, students would make webs about community helpers. Figure 5 shows one of the students' work that was created with Storybook Weaver, and Figure 6 shows one of the students' web created with Inspiration.

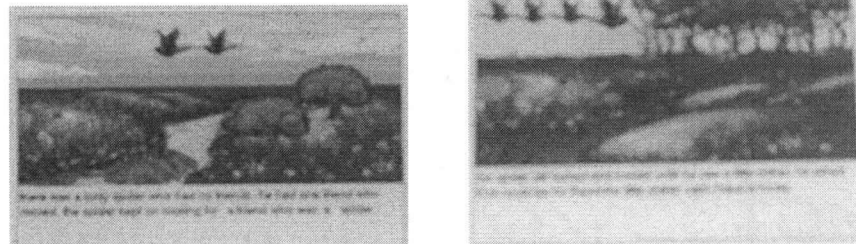


Figure 5. Two pages from a student's book created with Storybook Weaver

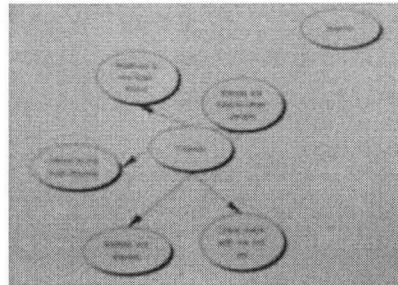


Figure 6. A web about friends created with Inspiration

WebQuest. One of the computer activities that Ann would like to use more with her students involves WebQuest. WebQuest is an Internet project that incorporates both online and offline activities, where students are given a task along with resources for doing research. One of the WebQuests that Ann created for her primary students was about building a community. She explains that in this project, the students' task is to build a new town. To complete this task, students are provided with resources, such as links to several city websites, information about various kinds of jobs and places (see Figure 7), and a sample of a town's map (see Figure 8).

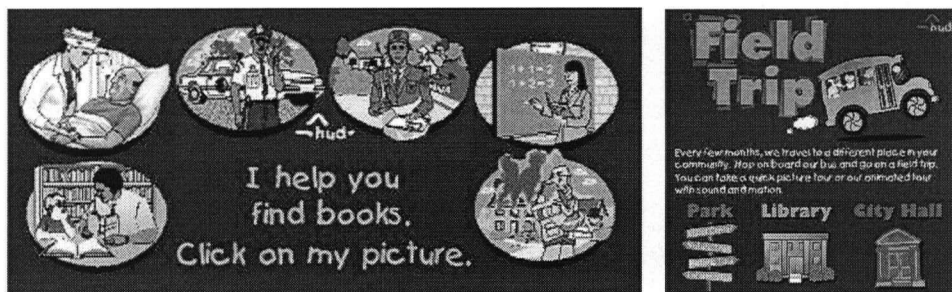


Figure 7. "What's my job?" and "Field Trip" resources (<http://www.hud.gov/kids>)

According to Ann, the value of using WebQuest is that it always opens with a big question that they will break down into smaller questions; thus, promoting higher level thinking and problem solving skills. In addition to this, she likes the idea that students collaborate with others to complete the project, and that all the resources they need are accessible on the WebQuest site; as such, students do not have to navigate the Internet themselves, and risk encountering inappropriate materials.

Summary. Ann sees the computer as a part of children's world, and she believes that teachers should educate children to use the computer properly, and use it as a tool for learning. In her uses of computers with primary students, she explains how she makes effort to make the activities developmentally appropriate. She acknowledges both positive and negative impacts of computers on primary students, and emphasizes that the impact of the computers depends on how it is used.

Beth

Background Information

Beth is a grade-one teacher. She has been teaching primary-school students for 30 years, 20 of which were spent teaching grade two, grade two-three split, grade three, or grade three-four split. For the past 10 years, she has been teaching grade one.

The school where Beth teaches is a K-7 school in a suburban area in the Lower Mainland of British Columbia. About 400 students are enrolled each year at the school. According to the district computer coordinator, this school is among the best schools in the district in terms of the computer facilities and the teachers' computer skills. For example, the school is equipped with a lab of mobile wireless laptops, video production and editing equipment, and an LED TV monitor information system that allows students to check for daily announcements and events. Many teachers in the school, including Beth, have taken their post baccalaureate in teaching technology.

Beth has been using computers with her students since the 1980s, first with the Apple IIe, then Apple IIGS and later, with iMac computers. She usually brings home computer books from the library during weekends to learn about computers, especially when a new operating system is launched. During the early years of computer uses at schools, other teachers would visit her lab to see how she used computers with her students. Soon she was recognized as a primary computer expert in the district, and she began facilitating workshops for teachers about how to use various kinds of software with students. Some examples of the workshops she facilitated recently are "Learn KidPix in a Day," that was presented on a professional development day, and "Integrating AppleWorks into Your Primary Program," a 10-hour course that was presented over five weeks and attended by approximately 200 teachers throughout the district. In addition, she worked as a primary computer specialist teacher for five years.

Beliefs about Learning

Beliefs about primary children's learning. Beth finds satisfaction in teaching grade-one students in particular because of the level of growth that they show throughout the year. She notes that:

There is nothing like grade one. They come in and they're pretty much blank pieces of paper... They might know a few sight words but that's it. And, there is nothing like it, by Christmas they are all reading, they're so thrilled, they're so empowered, they feel so powerful, their parents say, "I can't believe they're reading, I can't believe they're reading." So... you get the most amount of satisfaction...

Beth describes the learning curve of grade-one students as being:

...a little bit of flat and then "zoom..." you take off... it's just great... for the other grades, it's just a small increment, you know, it is very very satisfying... It's nice to

be making a difference... most of us you know, go through life, we'd like to know we are making a difference. And getting young children off to a good start, that's a pretty satisfying job.

Beth believes that in order to learn, children need a lot of repetition to reinforce their learning, as she says that, *"you have to do it, do it again, do it some more... in that way you will build the skills necessary."*

"Development advances when children have opportunities to practice newly acquired skills as well as when they experience a challenge just beyond the level of their present mastery" (NAEYC 1996 in BC Ministry of Education, 2000, p. 38).

Box 12. The importance of practice and challenge for children's development

She finds that grade-one students have a limited attention span, especially at the beginning of the academic year. To keep children engaged, she thinks that teachers need to keep changing the activities:

...you need to stand up and you need to sit down... you need to go to the carpet, and you need to go back to your desk... you need to do some pencil things and then you put the pencil things away. You need to do some chalkboard things, you put them away... it's just because it's a long day and they are overwhelmed.

"Like all instructional activities for young children, those aimed at fostering their capacity to make connections will prove most effective if they take account of children's attention span and capacity for sustained focus" (British Columbia Ministry of Education, 2000, p. 153).

Box 13. The importance of taking account of children's attention span

In addition, Beth thinks that primary students are enthusiastic, quick to learn, and willing to take risks.

Beth supports the theory that states that there are different learning styles, such as visual, auditory, and kinaesthetic, and thinks that it is necessary to incorporate various

learning styles in the classroom. For example, she explains that for children who learn kinaesthetically, it is helpful to learn new concepts by providing the students with real objects. She explains that, once children have experienced real objects (e.g., counting objects), they build a three-dimensional reference, so that in the future they are able to do the same operation with abstract objects, such as computer programs. At this point, she believes that manipulative activities at the computer can help children learn just as well as with real objects. She explains that when children are doing manipulative activities at the computers:

...instead of shoving it with your finger... you're using it with the mouse... I mean, it's tidy... things are not falling all over the floor... for older children, it's, it's often quicker... cause they get very good with the mouse... even young children can be very quick with the mouse... I would say that there are times when the computer version is probably, is just as good... whether you go pushing it with your finger or whether you pushing it with the mouse, the idea is.., you're developing the same kind of understanding.

"Children vary in their learning styles, prior knowledge and experience, and abilities and rates of development... learners have greater abilities in some types of activity and learn more easily through one method than another... The responsibility to respond to learning differences remains largely with the classroom teacher... One useful model for education is Gardner's (1983; 1993) Theory of Multiple Intelligences. Gardner identifies several distinct types of intelligence, including linguistic, musical, logical-mathematical, spatial, body-kinaesthetic, interpersonal, and intrapersonal" (British Columbia Ministry of Education, 2000, pp. 38-39).

Box 14. B.C. Ministry of Education's position about differences in children's learning

Beliefs about the roles of primary teachers. Beth believes that teachers hold a huge responsibility in primary classrooms, particularly to teach grade-one students to read and write.

"Learning to read and write is critical to a child's success in school and later in life... the early childhood years - from birth through age 8 - are the most important period for literacy development... It is essential and urgent to teach children to read and write competently, enabling them to achieve today's high standard of literacy" (International Reading Association and NAEYC, 1998, p. 1).

Box 15. The importance of learning to read and write

Ideally, she feels that teachers should provide the necessary activities to fill these blank pieces of paper, and that teachers must be knowledgeable about where the children are at, and where they need to go. Beth stresses that teachers need to set up and evaluate goals, assess the children's abilities, and keep adjusting the goals to match the current abilities of the children. She explains that, *"working with very young children, your goals are changing because, you're constantly moving forward... there is ongoing assessment of the children and you, in both of how successful you're being and how successful are they being..."*

"Another key to success is assessment. Ongoing assessment of children's progress in relation to the curriculum goals gives staff a sense of how their approach may need to be altered for the whole group or for individual children" (NAEYC and National Association of Early Childhood Specialists in State Departments of Education (NAECS/SDE), 2003, p. 9)

Box 16. The importance of assessment

Beth believes that once teachers know their goals for the children, they need to make effort to achieve those goals by communicating their expectation to children, breaking down the skills into smaller instructions, and providing support for children. Beth explains that, in grade one in particular, children come with very limited skills, and therefore must be taught the most basic skills. She explains that teachers must break the

skills down into smaller chunks, so that the children will be able to follow the instructions and learn the necessary skills more effectively:

...with teaching, it's always a matter of, if you expect them to do it, and you've broken skills down small enough, and you've given them support, they will do it. They will... if they can't, you've probably missed something. You've probably missed breaking it down... people forget sometimes, you have to teach absolutely everything ((to grade-one students)), and you have to make sure that, they understand...

In addition to breaking down the skills, Beth also believes that teachers need to support students, particularly at the beginning of the year, so that children will learn the skills. She notes, however, that later on, students should be able to take greater responsibility for their own learning. An example of the support that Beth provides for her students is in preparing them to use the computer lab. She illustrates that students need to login with their last name in the computer lab; however, grade-one students do not usually know their last name, and are barely able to spell them. To help them login, Beth gives each child a card with their last name printed on it. Prior to going to the computer lab, Beth has the children line up, and asks:

..."what's your last name starts with?..." so you get them ready... "tell me the letter you are going to type..." and every kid tells me their names... And so they type that... And then, you know what? You get to a point where it's, "you can't log on? I guess you won't get computers today..." slowly on you have to raise the expectation and transfer it. But if, a child is truly not able. No, you give them the help.

Beliefs about Developmentally Appropriate Computer Uses for Primary Students

Beth believes that computers in the classroom should complement what already exists in the learning environment, and reinforce children's learning. When comparing the method in which computers were used in the past, Beth prefers to use computers as they are used today because in the past, *"it really was using computers for computer sake ((e.g., to learn about a computer program, such as LOGO))... Whereas now of course... I really try to, use the computer, and use technology, to integrate into what I'm doing."* With regards to her effort to integrate computers into her teaching, she prefers to use the computers as a tool for improving what children can do in the absence of computers. However, activities at the computer should not merely be identical to those off the computer, for example, simply completing electronic versions of workbooks. Instead, she would rather use the computer to supplement workbooks and improve the learning processes. Beth thinks that the computer *"should either make it easier... or more exciting, or more interesting, or more efficient."* What follows is a more detailed description of Beth's beliefs about the impacts of computers on children's learning.

Beth believes that using computers can have positive effects for improving children's learning, such as building their literacy development through word-processing software, practicing math facts through drill-and-practice software, and supporting their art works through drawing software. In term of the use of computers in schools in general, Beth states that:

The idea of any kind of, information technology that you're going to use is to make the job easier in some way, sometimes that's because... the children can produce more, because you know, their fine motor skills are not well developed. Sometimes it's just because the product is better... sometimes it's because it's, just for pleasure. It just gives a nice project. So in developing pride, in workmanship...

for them to view themselves as a writer, because when they see that all printed out and they know they've done it, they do feel very much that sense of ownership and that they feel like an author, whereas you know, just in their book with pencil, it is not as fancy.

In particular, Beth thinks that using computers can reinforce children's literacy skills considerably by reinforcing the use of lower case, upper case, and finger space; providing the scaffolding to help students write more; making it easier for students to edit their work; and giving them a sense of accomplishment. When children begin to use the computer for writing, Beth reinforces the use of lower and upper case by teaching them to type their name:

...it starts with a capital, no problem, just press that shift key, you know, and you go. They have to find the letters... and of course the keyboard is all in upper case letters. And I know what my name looks like, and it's not in upper case letters, right? So you're just reinforcing, lower case to upper case...

Compared with writing with pencil and paper, Beth has noticed that students in her classroom write more at the computer, because *"the scaffolding, the structure, is there to make the writing easier."* Beth especially emphasizes the picture-word collection in KidWorks, an early word-processing program that can help children find the words they need for their writing. For example, students can write:

..."I," upper case, finger space, using the space-bar, "like," finger space, and go to this little box that's got nouns. And it's full of nouns. So they can get great sentences. We went to the verbs one. So it was, "I like skating. I like swimming."

Beth emphasizes how such a tool can help students find more words for their writing.

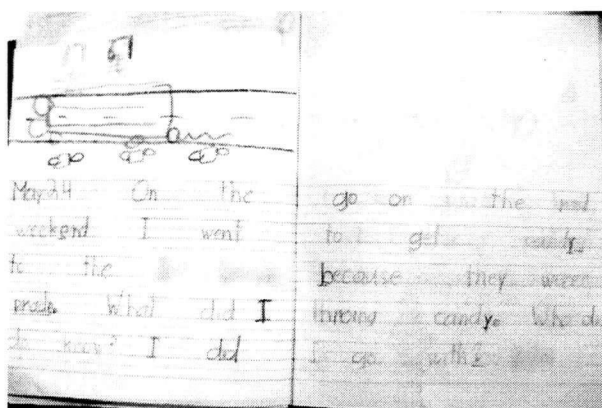
With the help of this picture-word collection, her students were able to write one page in one computer lab session, as opposed to when they write with pencil and paper, where:

...there is no way they can print a whole page of text in 40 minutes... physically, their fine motor is very poor, their attention span, just their ability to crank the words out. I mean they are very little children, they're five years old. They'll sit on the computer type the whole page and then they can read it. Because it's got all those little pictures, right? Now that is a perfect example, of a computer doing something, improving it, it's interesting, it's exciting, it reinforces learning.

"Technology has the potential to assist young children in their learning in many ways. For example, it may allow students to focus on words and ideas rather than the mechanical aspects of writing (Jones and Pellegrini 1996). For some children, however, word processing seems to interfere with their writing processes (Dahl and Farnon 1996)." (British Columbia Ministry of Education, 2000, p. 24).

Box 17. The potential of technology to assist children's learning

Beth notes that with the help of computers in scaffolding students' learning, her *"expectation, for the amount of work, and the quality of the work, is way, way higher in the lab."* She illustrates this by giving an example of a comparison between a student's writing at the computer and off the computer (see Figure 10).



Once upon a time there was a parrot. His name was Peek. He wanted to live on a ship.

One day Peek saw a pirate ship. When the pirates were on the island he flew in the ship. The pirates did not know that Peek was on the ship.

Peek likes to eat bananas. When Peek was eating he made a noise. The pirates heard him eating. The pirates looked all around. The pirates taught him to do pirate things. The pirates let him stay on their ship.

Figure 10. Comparison between a student's writing with and without the computer

She illustrates how both texts were produced within the same amount of time, and *"in both cases they are working very hard and staying on the job. You just can't beat it..."*

According to Beth, another advantage of using computers is that it is easier for students to edit their work, whether it is writing or drawing, at the computer. Beth finds that the students are more willing to edit their work at the computer because they:

don't really start editing until you make it an easy thing to do. Who wants to erase their work? You know, nobody. Whereas on the computer it's just... there is no pain involved in erasing on the computer. There is no pain, like physically you don't have to, and your paper doesn't get wrecked... they are so much more willing to edit whether you're talking about our drawing or whether you were talking about word processing, they're just so much more willing to actually revise their work.

Beth stresses the value of editing with computers by contrasting it with her previous experiences working with typewriters:

...when we finished a, a paper, we put it on a duo tang, we closed it and we handed it in. We did not do any revising... You proof read it for spelling mistakes and you're really angry if you found one cause you have get out that white tape... That's how much things have changed, right? Whereas... I actually find that little kids will revise. Cause you'll say, "Oh, well wait a minute, you need another character, or you forgot to tell me about this, and they are willing to do it because you know what? They don't have to sit and write it out.

Beth believes that students prefer to write at the computer rather than with pencil and paper. She describes that given a choice, her students would prefer to write a story at the computer rather than by hand, and they would justify their choice by saying, "well, it's tidier and it's faster and easier to fix, and if I change my mind... ((it is easier to change it))."

Furthermore, Beth highlights the sense of accomplishment that students feel after working with computers. She observes that students are very proud of being able to produce beautiful pieces of work,

and yet, the learning is there. They've learned the upper case, they've learned the finger space, they've learned the punctuation, and then they can read it. So, whereas with the hand writing, nobody else could read it. I can barely read it... it's a great way of, of making them view themselves as a writer, and view themselves as a reader. And it does it in a, in a very, easy and positive way.

Even though Beth believes that the computer can facilitate students' writing very well, she still thinks that it is necessary that students learn to write with pencil and paper, as she illustrates that:

...it would not be good to do all our writing on the computer, it just wouldn't... you're not a literate person if you cannot ((print))... they have to have the penmanship... they must however of course, learn to read, write with, a pencil and paper. But that is a much more laborious process. And it's also developmentally, for a young children, writing is a difficult skill to learn.

Beth thinks that computers also can facilitate children's drawing; for example, students can base their drawings on the stamps collection that is available in KidPix. Figure 11 shows her student's drawing that combines a KidPix dinosaur stamp for T-Rex head and the student's own drawing with KidPix for the body parts of T-Rex. Beth indicates that:

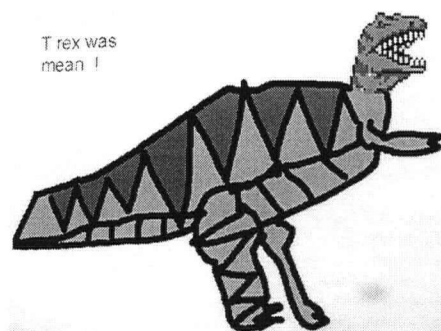


Figure 11. A student's drawing created with KidPix

...it is true that we could sit and draw them, but... this is a really good example... they had to change all these colors in here ((the body)) to match ((the head's color)) and everything... that's just so much more vivid... So, it's not just about the dinosaur, it's about the scale, it's about... perspectives, it's about some of those kinds of things.

In addition too all this, Beth also believes that the Internet can provide students with up-to-date information and provide answers to their questions. She emphasizes that:

...if you are thinking about the fact that we are trying to raise lifelong learners, the Internet is going to do it... these kids are definitely, that's what their life is going to be... it's all going to be wireless... you're just educating them for... a life skill that they're just going to need to know.

Besides the benefits that Beth believes students, in general, can have from using computers, she further explains how special needs students can also profit from using the computer. For example, the computer enables her special needs student, who is non-verbal, to communicate. She believes that, *"for her, of course, computers are going to play a huge role in her life... Because, she can't speak at all, and... she never will."* Beth also thinks that for these students, the computer is *"such a perfect fit for them... there is no question that the kind of technology that is available now and, and continues to evolve, is going to make a huge difference for their lives."*

Beth believes that computer use in the classroom is not detrimental to children as long as the teacher is cognizant of how to properly incorporate computers in the classroom. She does, however, acknowledge some potential negative impacts of classroom computer use, such as having physical problems, replacing children's physical activities and social interactions, encountering inappropriate materials, dealing with violent games, and being exposed to inappropriate social skills. The following section describes her beliefs about these potential negative impacts in detail.

Beth thinks that computer provides a rich environment that stimulates both the visual and auditory senses, so that children may remain at the computer longer than what would be considered appropriate for their attention span. She believes that spending too much time at the computer could be detrimental to the children because:

...it will supplant the other activities, and secondly... you just don't want them sitting at screens that much... Just because, I don't want them thinking that's the way the world works... But you know what? That is true about other things too... they're young children, and they should have something appropriate to their attention span... And the problem is that when you are plugged in to headphones and auditory stimulation, and visual stimulation, you would probably sit there for much longer than it's good for you... your senses are totally bombarded and immersed, aren't they?

She further explains that when children work or play too long at the computer, there is the possibility that they may reduce their involvement in other activities, such as physical exercise and social interactions. As well, she thinks that they may experience physical problems such as sore thumbs, wrist, back or neck.

Beth also believes that browsing the Internet increases the risk of children encountering inappropriate materials. She explains that the multilayer of information on the Internet is too much for children to handle, especially because:

...in some ways they don't have the maturity to, discern... it's just so easy to get into trouble on the Internet... even innocently... there is really gross stuff that you don't want little kids looking at... it's just surprising, what kind of words in searches end up being sexual... So, there is no question that children need to be protected... For a kid to get a visual of things that they really should not see, that's very harmful.

To keep students from accessing inappropriate materials, Beth controls the information made available to her students via the Internet. She usually searches the Internet for her students and makes the appropriate sites available to them. Alternatively, she saves all the Internet sites that the students need at the computers, so that students can browse the information offline, and they will not be able to go to any other sites.

Beth believes that software and sites that contain inappropriate behaviours such as violence can desensitize children to those behaviours. She suggests teachers to carefully think about the software they are going to use, because sometimes people are not aware of the violent aspect of a game until they take a step back and rethink about it. Beth provides an example of games that contains inappropriate behaviours and her objection to it:

...there is one where they steal cars... they're shooting cops, and then they're picking up prostitutes... it's a really gross game... and every now and then on talk shows people sit and talk about, "well there is nothing wrong with this game." Yes there is, yes there is. Because if you start doing that when you are too young and you do not have... the maturity, you know? I mean, you could say, "oh well they

know it is not real..." Sure they know it's not real. But you know what? You become desensitized to it.

"There are some in the entertainment industry who maintain that 1) violent programming is harmless because no study exist that prove a connection between violent entertainment and aggressive behaviour in children, and 2) young people know that television, movies, and video games are simply fantasy. Unfortunately, they are wrong on both counts... The conclusion of the public health community, based on over 30 years of research, is that viewing entertainment violence can lead to increases in aggressive attitudes, values and behaviour, particularly in children... Viewing violence can lead to emotional desensitization towards violence in real life... Although less research has been done on the impact of violent entertainment (video games and other interactive media) on young people, preliminary studies indicate that the negative impact may be significantly more severe..."

(The joint statement of the Impact of Entertainment Violence, American Academy of Pediatrics, American Academy of Child & Adolescent Psychiatry, American Psychology Association, American Medical Association, American Academy of Family Physicians, and American Psychiatric Association, 2000).

"NAEYC condemns violent television programming, movies, videotapes, computer games, and other forms of media directed to children. NAEYC believes that it is the responsibility of adults and of public policy to protect children from unnecessary and potentially harmful exposure to violence through the media... Up until age seven or eight, children have great difficulty distinguishing fantasy from reality, and their ability to comprehend nuances of behaviour, motivation, or moral complexity is limited... Exposure to media violence leads children to see violence as a normal response to stress and as an acceptable means for resolving conflict... Early childhood professionals should advocate for policy that eliminates violence and improves the educational value of media, and should use media constructively in their work with children" (NAEYC, 1994, p. 1-3).

Box 18. Position statements on media violence and children

Beth believes that the appropriateness of computer use depends on the teachers' computer skills. She notes that:

The teacher is the key... there is no question the teacher is the key... if you have skilled teachers with good ICT ((Information and Communication Technology)) skills, and, and knowledge, and desire to integrate, I think that... you're just flying,

you've got great things happening... you can think of lessons and assignments, then, then the kids will be having you know, a fabulous time with it...

"The teacher's role is critical in making certain that good decisions are made about which technology to use and in supporting children in their use of technology to ensure that potential benefits are achieved. Teachers must take time to evaluate and choose software in light of principles of development and learning and must carefully observe children using the software to identify both opportunities and problems and make appropriate adaptations" (NAEYC, 1996, p.2).

Box 19. Teacher's role in making decisions about ICT

Beth thinks that the skills teachers possess also influence the way they use computers with their students. Particularly, she thinks that *"the less skills that you personally have developed, the more you will rely on software that is going to just lay it out exactly"* as opposed to using more open-ended software. Beth observes that:

...unfortunately for primary teachers, the skill based for ICT is going to be lower... you would find less expertise among primary teachers... I think that some of it, is just the stereotypes of the sex, you find more women teaching primary... they might shy away from it... a lot of women don't like machines, right?

She illustrates her experience facilitating workshops where teachers *"come in and they are like, 'Oh I don't know what to do, and the kids know... what do I do? The kids know more about the computer than I do.'"* On the other hand, she does believe that primary teachers are willing to change. She has seen the improvements that teachers gain through the improvement of their computer skills. She says that, *"All you have to do is just get them going and you can use the children as resources." Teachers don't have to be experts and they could still do these things...* Beth encourages novice teachers to *"watch for Pro-D and get a mentor."* She also likes to offer herself as a resource and a *"catalyst"* for other teachers to use computers with their students. The following section describes

Beth's beliefs about how teachers can make computer activities appropriate for their students.

Beth believes that using computers is appropriate for any child, as long as it is appropriate for the learning outcomes for their grade level, and the contents of the materials are appropriate for the children. She explains that teachers need to consult with the curriculum in order to judge the appropriateness of computer use:

The learning outcomes that you're using as a teacher are appropriate for that grade, grade level. So if the lesson ((computer use)) matches your learning outcomes, then it's going to match the grade level... If it contributes to your learning outcomes then that is not a problem... will some children need support?
Yes.

In addition to that, Beth believes that teachers should select the materials that are appropriate for children. She emphasizes that, *"you wouldn't hand a book to a child that you hadn't looked really thoroughly. You know, you wouldn't. Even an encyclopaedia, even a newspaper."* She thinks this evaluation also needs to be done with Internet sites. She suggests that to protect children from the dangers of using the Internet, teachers must control and limit the information their students' access. For example, Beth usually avoids sites that have too many pop-ups and advertisements. However, in occasions where she needs to use those kinds of sites, she will teach students to stay away from clicking unnecessary links, such as pop-ups and advertisements, by saying:

"Look at this," cause it will say things like... "free Sponge Bob..." And I'll say, "What do you think? Do you think they're going to give that to you? Do you really think that's true? Or do you think they're just tricking you to get you to go to their website?..." so I spent some time just saying, "You know what? Do we

believe these? No. Are we going to click on them? No. Just ignore them, just totally ignore them."

"...young children under 8 years of age developmentally are unable to understand the intent of advertisements and, in fact, accept advertising claims as true... The American Academy of Pediatrics believes advertising directed toward children is inherently deceptive and exploits children under age 8 years of age" (AAP, 1995, p. 295).

"Industry standards should also limit advertising during children's programming in recognition of children's inability to distinguish the advertising from programming content... Program based advertising creates in children an insatiable desire for these single-use toys; children start to believe that they can't play without the specific props seen on television" (NAEYC, 1994, p. 3).

Box 20. Position statements regarding advertisements and children

Beth feels that it is important to limit children's screen time to approximately 30 minutes per day to avoid the potential negative impacts of spending too much time at the computer. She thinks that it is necessary to have the limit both at school and at home, but:

...it is far more detrimental for kids to be using computers at home, unsupervised... unwatched... I think that that's a serious issue at home. Kids have computers in their bedrooms. Even little children... I don't think that's appropriate at all...

"The AAP offers the following recommendations:... Pediatricians should encourage parents to adhere to the AAP Media Educations, including making thoughtful media choices and co viewing with children, limiting screen time (including television, videos, computer, and video games) to 1 to 2 hours per day... avoiding violent games in homes where they may be observed or played by young children, and keeping children's bedrooms media free" (AAP, 2001, p. 1224).

Box 21. Recommendation for limiting screen time

In addition to limiting children's screen time in general, Beth believes that teachers should limit the use of drill-and-practice software to allow more time for

engaging with more interesting activities and getting more satisfaction from creating beautiful products.

...my objection to that type of software, is not that it's not good, not that it doesn't get good results, not that the kids don't learn their stuff, but if you're doing that, you're probably not drawing dinosaurs, which is a lot more fun... I don't think you get much self-esteem from matching little letters and big letters as opposed to you get a lot of satisfaction and self esteem in those kinds of... good things that we talked about.

Beth realizes that some people question the appropriateness of using computers with young children. But she argues that even if we only think about developing children's sense of pride and accomplishments, the use of computer is valuable. She emphasizes that, *"we're trying to raise children, who have a real strong sense of self and feel competent. You know what? Computers do that so well..."* She further explains how her:

...very lowest child in here today, when we were practicing drawing dinosaurs on the chalkboard and a couple kids were like, "Oh, mine is not very good," "oh why don't you try the head again, erase it, try the head again..." and he is like, "Mine looks great, mine looks great!..." I said, "Wow" and I said, "What do you think it's going to look like on the computer?" ((and he said,)) "It's going to look even better."

Criteria for selecting software. Beth favours the use of software that is open-ended, software that can be adjusted to the ability level of the child, *"something that's going to grow with your child."* She believes that open-ended software is particularly valuable because:

you've got that ability for, for the software to really match the cognitive ability of a child... So it, it, it means that you can match it to their ability, and you can keep them interested, and you get more value, for your money...

In addition to that, the software also *"has to tie in strongly with the learning outcomes for the goal, for the years, you know, the grades that you're working with."* Beth gives some examples of open-ended software, such as AppleWorks, ClarisWorks, and KidPix. She finds that *"if you have the skills, boy you can do an awful lot with that. You really can."*

"Ideally, computer software should be designed to grow with children, offering more challenges as they learn new skills" (NAEYC 1996, p.1).

Box 22. NAEYC statement about computer software

Beth further compares the value of using open-ended software and drill-and-practice software. She views drill-and-practice software, such as *"Success Maker,"* as an electronic worksheet, that involves *"very low level thinking"* instead of critical thinking. She notes how, *"it really doesn't make a better difference, whether you do it on pencil, pencil and paper, or you do it on the computer."* However, she acknowledges the efficiency of using drill-and-practice software in that it eliminates the need to photocopy materials for the worksheets. Moreover, she describes that teachers do not need to mark students' work, because the software can provide instant corrections when they make mistakes.

In addition to her preference to open-ended software, Beth tends to avoid commercial software, such as Disney movies. She thinks that this kind of software will only be popular in a short period of time, and usually does not meet her criteria of good software for children. Beth also thinks that teachers should avoid software that contains violence and inappropriate social skills behaviours.

"Just like movies and television today, children's software is often violent and much of it explicit and brutally graphic, as in most of the best-selling titles for the popular game machines. But, often, violence is presented in ways that are less obvious. In all of its forms, violence in software threatens young children's development and challenges early childhood educators, who must take active steps to keep it out of their classrooms" (NAEYC, 1996, pp. 4-5).

Box 23. NAEYC's recommendation about violent software

Classroom Practices

Class taught. Nineteen grade-one students were in Beth's class when the interview was conducted. Beth also had a teaching assistant to help with her special needs student who had Cerebral Palsy. Because the student with special needs was non-verbal, she used Dyna Vox, an augmented communication device, to communicate with others.

Computer facilities. There are two iMac computers in Beth's classroom, both connected to the Internet. In addition to this, Beth describes that the school has 10 mobile wireless laptops, and will soon be acquiring an additional five, which can be signed out by teachers for classroom uses. She also notes that the school also puts some old Macintosh computers in the hall outside the classrooms.

According to Beth, the computer lab has various kinds of software, and each teacher has the privilege to limit their students' access to specific software. She explains that, by using "MacManager" program, each teacher can specify which software can be accessed by their students in the computer lab. Beth describes that her students have access to word-processing software, math software, and Internet browser software. In addition to these, Beth reports that she has her own CD collection of various topical readings and programs (see Table 3).

Table 3. Types of software available for Beth's students

Type of software	Example(s) of software
Word processing	AppleWorks, KidWorks 2
Reading	Reader Rabbit*
Math	Fizio Math, Math Circus Act 2, Checker's Village, and Eric's Solitaire
Drawing or graphic	KidPix Studio Deluxe, KidPix 4, and AppleWorks
Internet browser	Internet Explorer 5.1.
Topical readings	Dinosaurs*

* Software that belongs to Beth

Classroom computer uses. Beth explains that she uses themes in her teaching, and integrates computer activities to support the class theme; for example, the class theme at the time of the interview was dinosaurs. Beth decorated her classroom in accordance to the class theme, by putting dinosaur pictures on the wall, providing dinosaur books and CD's for children to read (see Figure 12). Beth describes some of her classroom activities and lesson plans that are related to dinosaurs; for example, students learned about the various kinds of dinosaurs, they did a number of different dinosaur-art activities, which were then posted on the wall or hung from the classroom ceiling (see Figure 12). She describes that in the computer lab the children also used the computer to draw different types of dinosaurs. Beth indicates that children's drawing at the computer "*would be classified as art, but it is reinforcing, the different characteristics, such as, meat eater versus plant eater...*"

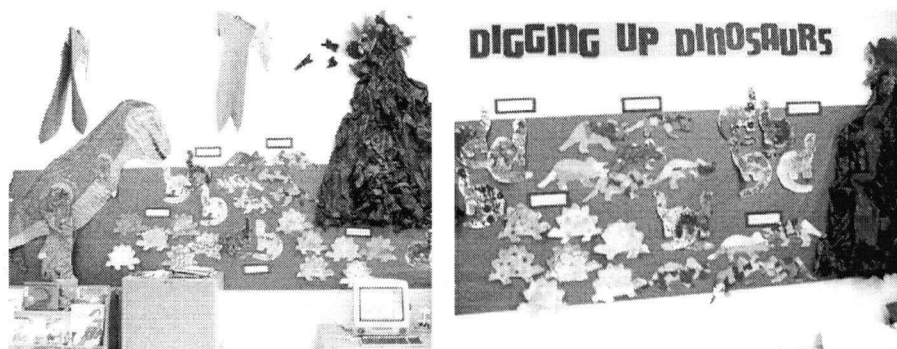


Figure 12. Beth's classroom decorated with the dinosaur theme

Daily uses. According to Beth, the computers in her classroom are used everyday, either as a resource for checking information on the Internet, as an optional activity for students who finish their work early, as part of the centre time, a free choice time during the last period of each school day. Beth explains that, if her students have questions about things they are learning about, they can ask her to find the answers from the Internet. She notes that, since students at the school do not do any Internet search until they reach grade two, she will look up the information on the Internet, choose the site, and then let her students, in small groups of four or five, take turns going to the computer to see the site. She explains that she uses the Internet *"a lot to solve, answer questions, things that before we would have been running to a book."*

Beth explains that, besides looking for information, she also uses the Internet to give students some examples or illustrations that might help them with their work. For example, she describes that before students are drawing or painting for art projects, she will show them pictures from the Internet, to give the students a clear idea of what the expectations are and what their work should try to emulate.

Beth illustrates that she allows her students to use the computer as an optional activity for the students once they have finished their work before recess, lunch time, or during centre activities at the last period of each school day. She notes that children can choose activities that they would like to do, because *"not everybody finishes at the same*

time," and further explains that during this free choice activity time, she notices that she starts seeing children's preferences in doing various activities. For example, she observes that some children spend more time at the computers, whereas other children prefer to build with blocks or work at the art centre.

Weekly uses. According to Beth, her students go to the computer lab at least twice a week for 40 minutes. Beth explains that when the computer lab is not being used by other classes, she will take this opportunity to use the lab with her students. For example, when another class goes for a field trip and does not use their computer lab time, she asks to use their computer block because she thinks that, *"there's so much stuff I could do"* at the computer lab.

Pedagogical practices. Beth illustrates that in a typical computer lab time, she first explains the task that the children will perform (such as writing a story or completing math questions); she then sets her expectations for that task, for example, by telling them, *"tell me when you've got 10 sentences done, and I'll print you... if they don't get the 10 sentences done, I don't run it through the printer. So there is that incentive..."*

Beth explains that that when students are finished with their main tasks for the day, she allows them to have *"dessert,"* whereby the students are free to choose any program they want to use for the rest of the computer lab time. She notes that even though children are free to choose any program, they usually choose to go back to the previous lessons. For example, they like to use the math drill-and-practice program or KidWorks for *"dessert:"*

They just love it. It's like, "Yeah! I got 100" because the program keeps track of how many questions they've done, it's like "Oh, I've done 100, oh I've done 200..." they're very enthusiastic. When I start typing with the word processor, KidWorks... Oh, that's all they do for weeks and weeks and weeks in here. They

go back to lessons that I've previously done... which is great, that's reinforcing those skills...

Beth describes that she employs four strategies to help students with their activities in the computer lab: First, she asks her students to do some prior thinking before they go to the computer lab so that they are prepared to work once they have entered the computer lab. Second, she varies the nature of her instructions, starting with very directed instructions when the students are learning a new program, and giving less directed instructions once students have mastered it. Third, she breaks the instruction into small chunks. Fourth, she encourages students to interact with each others. Below is a description of each strategy in more detail.

First, Beth thinks that the computer lab time is valuable, and she usually tells students that, *"we don't get in here very often, so you really have time to stay on the job."* Beth illustrates that, to make effective use of the computer lab time, she helps students prepare for the computer lab activities by asking them to do some prior thinking. For example, she describes that when the class is going to draw Stegosaurus, she asks them to spell Stegosaurus, to think about the colour they would like to make their stegosaurus, and reminds them about stegosaurus' characteristic (see Figure 13).

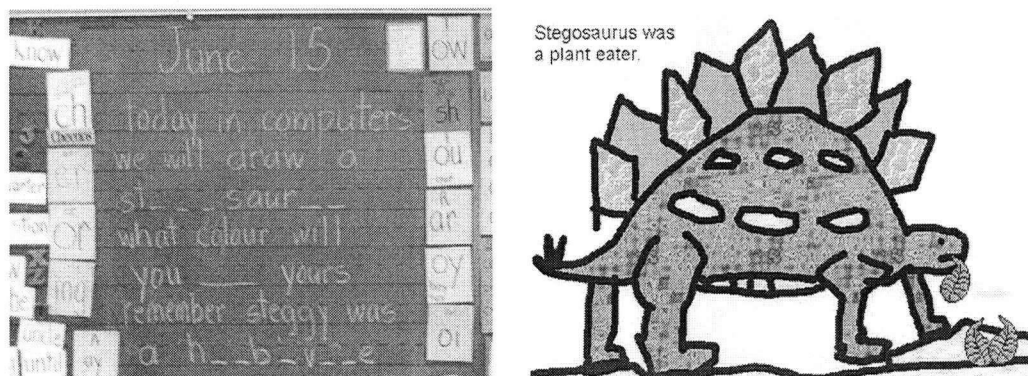
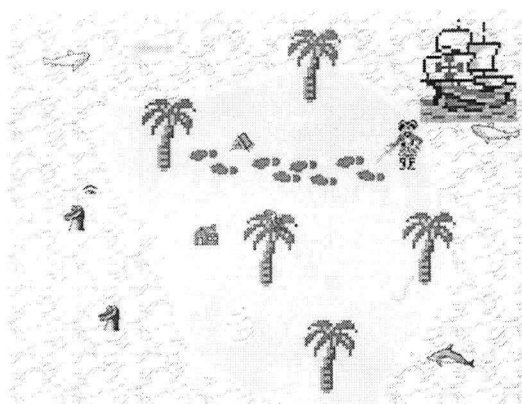


Figure 13. Calendar activity and a student's drawing created with KidPix

Beth explains that when the students were going to create a slide show, she asked them to think about the text and the picture they wanted to put on the slides, and where they could find the picture from the stamp collection; when the students were going to write a story, Beth helped them do some prior thinking by giving them a small piece of paper on which students have to write down *"the characters, the setting, the problem, the solution"* so that they can start writing once they login to the computers. Beth also explains how she uses students' drawings to facilitate their writing. For instance, she illustrates how she asks students to write a story based on the pirate maps they had created in an earlier lesson. She would say that, *"if I see some skulls and some palm trees on your map, I want to read about that in your story"* (see Figure 14).



Once upon a time there was a parrot. His name was Peek. He wanted to live on a ship.

One day Peek saw a pirate ship. When the pirates were on the island he flew in the ship. The pirates did not know that Peek was on the ship.

Peek likes to eat bananas. When Peek was eating he made a noise. The pirates heard him eating. The pirates looked all around. The pirates taught him to do pirate things. The pirates let him stay on their ship.

Figure 14. A student's drawing with KidPix and the story based on it

Second, Beth reports how she varies her instructions throughout the year. Beth explains that when she teaches a new program, she designs the computer activities in a very structured and directed way, where each student is doing exactly the same thing. For example, she illustrates that when the students first used the KidPix for their penguin slide show, everyone typed the same text, such as, *"penguins live at the South Pole;"* after typing the text, Beth directed students to work on the pictures, such as inserting penguin stamps and drawing icebergs (see Figure 15). She notes that, *"it's much easier to teach a program with very directed skills... afterward, it's, go, do what you want."*

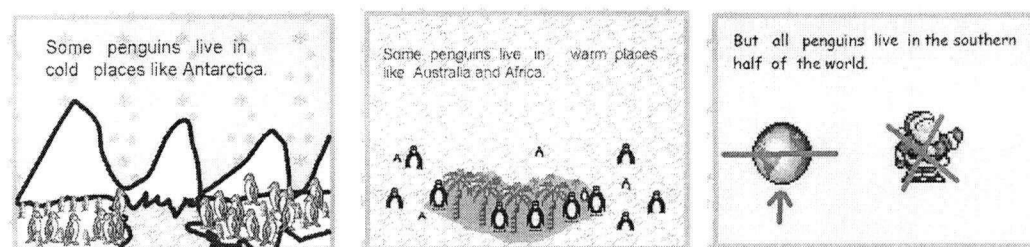


Figure 15. A student's slide show about Penguins created with KidPix

She notes that later on, when students have mastered the skills, they can choose to work on the task on their own. She explains that she keeps:

...trying to add something new. I keep trying to stretch their skills... each lesson has got, something that is my main goal but it is also reviewing and building... So I'm teaching two separate things. I'm teaching them how to use the program and how to use, all the different components of the program and, I'm also using it to reinforce the learning that I'm trying to achieve.

Third, Beth illustrates how she breaks down her instructions into small step instructions. For example, she notes how in teaching children to draw a dinosaur, she will break down the instruction of drawing the whole dinosaur picture into its smaller parts, such as drawing a leg. She will say "scoop, scoop, straight, straight, now put on the foot" (see the red marked leg in Figure 16).

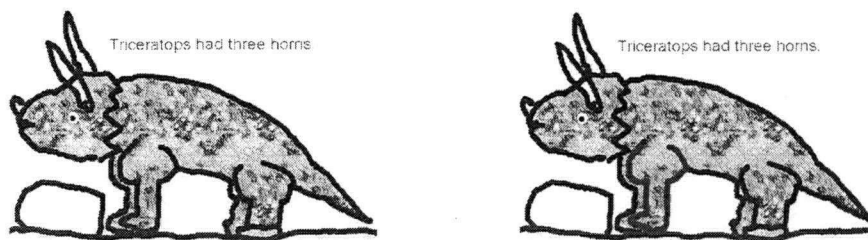


Figure 16. A triceratops picture created by a grade-one student with KidPix

Fourth, Beth describes that during the computer lab times, she encourages her students to interact with one another. She likes students to use each other as resources and explains that:

The lab is not a quiet place... I encourage children to use each other as references... I quite often will encourage them to actually look around, or have everybody tuck in the chairs and we just walk a circle. And everybody can look at everybody's stuff, and then they back to work... it's good because... they'll say, "Oh, I want to do that..." then... everybody gets a new piece of paper... "Apple-N," a new piece of paper...

Summary. Beth is a computer-expert teacher who is experienced in using computers with her students. She finds that using computers with children is beneficial to their learning, but there are some risks, too. She does believe, however, that computers will not bring any harm to the children if the teacher exercises safe and appropriate computer use in the classroom. To judge the appropriateness of the computer use for students' development, she consults it with the learning outcomes listed in the curriculum for the associated grade level. In her classroom computer practice, Beth tries to help children learn by helping them prepare for computer activities, starting with directed instructions, gradually building on existing skills, breaking down the skills into small chunks, and encouraging children to learn from each other.

Claire

Background Information

Claire is a grade-two teacher. She has been teaching primary grades for about 25 years. She started using computers in the 1990s, initially to help her with writing report cards; and since she has had access to classroom computers, she has used computers with her students for about eight years. She notes that her classroom computer use has improved substantially after she completed her post baccalaureate in teaching technology three years ago. She is involved in doing the "Flat Stanley" Internet Project with her students, and has given a workshop about this project to other teachers in the district.

The school where Claire teaches is a K-7 school in a suburban area in the Lower Mainland of British Columbia. About 550 students are enrolled each year at the school. The school is noted by the district computer coordinator as having some of the best computer equipment and support staff in the district. The school has both a desktop computer lab and a mobile wireless laptop lab. An LED TV monitor information system is also available for students to check for daily announcements and events.

Beliefs about Learning

Beliefs about primary children's learning. Claire prefers to teach students at the primary level because of the enthusiasm and excitement students at this age level have. According to her, one unique characteristic of primary-grade students is that they are tactile; therefore, she believes that they need "more things where they need to be feeling, touching and doing. They learn best by doing... They need more visuals, more hands on experiences and they need to get up and move." Aside from this, she also thinks that primary students' attention span is much shorter compared to older children, so that teachers should not deliver a lesson longer than 20 minutes. Claire points out that:

I try to structure my lessons so that every child will have gotten up in at least once every 20 to 25 minutes. Students move between our different work areas: their desks, the group horseshoe table, and the carpet area. I would never have my grade twos sitting for an entire hour, or expect them to do a lesson without having some physical change of position, of movement or activity... you have to change your activities much more frequently with primary children than you do with intermediate students.

"Children learn by doing, their actions helping construct their personal knowledge. Involvement in learning increases, as does long-term retention. Active, exploratory learning works as well in mathematics as it does in science" (Steen, 1991, in BC Ministry of Education, 2000, p. 149).

Box 24. Active learning

Claire explains that she prefers to use concrete objects such as manipulatives, as well as hands-on activities and experimentations, as she thinks that children learn best by doing. When she is teaching a new concept in math, she will devote:

...a couple of days exposing them to the math concept through the use of manipulatives, games, and structured activities. I want them to develop a good understanding of the concept at a concrete level before asking them to work at an abstract level using pencil, paper, and math symbols.

For example, she illustrates that when she is teaching division, she asks students to take 12 units of their manipulatives and share them equally with three other children. She explains that after repeated acting out experiences she will then introduce the symbols and equations for the mathematical experience.

"Children require concrete experience with mathematics in order to become numerate. This concrete experience takes two forms: **1.** the use of manipulatives and physical materials that enable children to visualize concepts; and **2.** real-world situations in which the value of mathematics becomes evident to children and in which the numbers and operations are meaningful and relevant to their curiosity and interests" (British Columbia Ministry of Education, 2000, p. 152).

Box 25. The importance of concrete experience

Claire explains that when she teaches science, she prefers to engage students in experiments rather than lecturing to them. For instance, she describes the soap slide test that was performed in her class, where:

"Rather than prescribing a procedure, give students an opportunity to experiment with different approaches and then compare results with those of their peers... Piaget argues that 'children must do their own thinking autonomously to construct logico-mathematical knowledge ... because this knowledge must be constructed from within'..." (BC Ministry of Education, 2000, p. 154).

Box 26. Children construct their own learning

Claire believes that children do not learn well when they are anxious. She believes that, *"stressed children have all sorts of mannerism which interfere with them being able to do their work."* Claire further explains that in order to be able to teach a child effectively, teachers need to build a relationship with the child and help students not to be anxious. She explains that:

Until you have a relationship with that child and that child trusts you enough, you can't really teach them anything... so, when you get a new class you have to treat each student carefully, you have to treat all of them with respect, even if they don't treat you with respect. But you have to teach them your expectations... children will achieve what you expect them to achieve... if you expect them to act badly, they'll do that... If you expect better behaviour, they'll work towards that... if you tell a child they're dumb, they will be.

"Diamond and Hopson (1998) found that enriched environments influence the brain's growth and learning. An enriched environment for children: includes a steady source of positive emotional support... has an atmosphere free of undue pressure and stress but suffused with a degree of pleasurable intensity... presents a series of novel challenges that are neither too easy nor too difficult for the child at his or her stage of development..." (British Columbia Ministry of Education, 2000, p. 77).

Box 27. Enriched environments for the brain's growth and learning

When it comes to building trust in her classroom, Claire gives her students a lot of reassurance and support at the beginning of the year. As the year progresses, she

gradually teaches her students to be more responsible and independent. On the first day of school, she explains how

...everybody in this class makes mistake... the teacher will make a mistake, and the principal will make a mistake, everybody makes a mistake. It's okay to make mistakes. That's why we have erasers... When we make a mistake, we try to fix it. If you make a mess, then you clean it up. We learn from our mistakes. You have to accept your students at whatever level they are at when they come to you. You have to build a relationship with them... once they trust you and you know them well enough then you can raise your expectations and place more responsibility on them. But, you have to teach them that responsibility. Some things are your responsibility, some things are mine...

Beliefs about the roles of primary teachers. Claire believes that the role of a primary teacher includes planning and evaluation, that is, teachers have to know what they are going to teach, and what the children need to be taught. Claire stresses that the first thing to do at the beginning of the year is "establish where they are at... what is their level?" She explains that assessing children's abilities is important to help teachers plan their lessons. She believes that if teachers deliver a lesson at a level that is

...beyond where the students are at, they're not going to learn. And if you teach below their level, they're going to be bored with you. So you have to balance your student's learning level with the curriculum. You have to know your programs, you have to know your children...

Claire thinks that once teachers have planned the lesson, it is also important for them to set individual goals for each child. She believes that each child is unique, and consequently, it is important to address each of their needs, and set different goals for each child. Claire explains how children

have very different... learning style and different abilities... So even though they are doing the exact same lesson, they have different needs. I will have different expectations and often different seatwork activities for students with specific learning challenges. I try to challenge the capable students to stretch beyond the basics of the lesson.

"Teachers use assessment information to determine which teaching approaches are working, as well as adaptations needed for individual children who are having difficulty and for those needing increasing challenges" (NAEYC & NAECS/SDE, 2003, p. 24).

Box 28. Assessment and individual children's needs

Claire also feels that teachers hold higher responsibilities in the classroom than in the past. She notes that the increasing number of problems that children have and the inclusion of the special needs students into the regular classroom present more challenges for teachers. She observes that today's students have more language problems and more difficulties with processing oral and written language. She also explains that teachers are now dealing with more health-related issues in the classroom, such as diabetes and allergies. Moreover, with the inclusion of special needs students into the regular classroom, often without any teaching aid, Claire notes that her

teaching time deteriorates rapidly... If this child is having a melt down, you're dealing with that... You have an emotional outburst... a physical event... a diabetic child in crisis... all learning stops because you're dealing with those things... it totally affects you... it totally affects the students for the rest of that day... that is a big issue that you're dealing with, and it's really fatiguing and draining... so... you have a whole lot more pressure in the regular classroom now compared to years ago. Way, way, way more.

Beliefs about Developmentally Appropriate Computer Uses for Primary Students

According to Claire, the computer is not categorized as a basic element that children need to learn in primary grades. She believes that even if children do not learn about computers in primary grades, they will be able to catch up and learn about computers in later grades. Claire views computers as

...a bonus, it's a plus. It's not the meat... the computer is a nice frill bonus, it's not what I call a basic at the primary level... I can teach everything in my curriculum and my learning outcomes without the computers. However, I can complement it and enhance it with computers. With the Internet you can expose them to the world... Do they need that at primary? No they don't need it, it's a nice bonus.

However, Claire also thinks that computers are part of life, and therefore

To totally ignore it, you are ignoring a large part of what's going to be their lives, and their future. They're going to be exposed to it anyhow outside of the school, so you might as well, teach them how to use it as an educational tool.

Claire includes computers in her classroom and uses them to make her lessons more interesting and appealing, and to teach students how to use them, so that, *"should they have a computer at home, they will learn to use it as an educational tool, not just an entertainment source."* Furthermore, Claire views the role of the computers in her classroom as a way for students to present and practice what they have learned. She believes that, at the primary level, the role of computers is *"a presentation tool more than a learning tool,"* where students can show *"the knowledge they've acquired through their traditional reading and writing lessons."*

Besides using computers as a presentation tool, Claire prefers to use computers to help children practice the concepts they have learned rather than to teach new concepts. She says that:

...given a choice, I would use a physical, for example, for math I will certainly use manipulatives more than I would use a program to teach math. But, you could use the computer as your drill and practice. I wouldn't use the computer to teach the concept, but I would use it to practice the concept.

Claire believes that computers can be beneficial to both teachers and students. For teachers, she thinks that computers can be used to obtain information from the Internet and to communicate with parents and students. Claire uses the Internet as a medium for gaining information to complement, rather than plan, her curriculum. Additionally, she likes to implement fresh ideas from the Internet to "add some spice" to material she has taught in the past. As a tool for communicating with parents and children, Claire feels that, "it is great PR ((public relation)) with parents, parents just love it... it gives you something to relate to and talk about the children..." Claire gives out her district e-mail address to parents and finds that the use of e-mail is very good because it gives her the flexibility to respond at her convenience. She explains that it is a medium that allows her to address parental concerns after she has time to think about her response. For example, when a parent tries to discuss a problem with a teacher in front of the class,

...the whole class is there watching this discussion, you don't want to push the parents off and say that what they're saying isn't important. At the same time you know, this is not an appropriate time for this discussion... so you can just say... e-mail me, I will get back to you on it... You don't have to respond instantly... you can actually stop and think about your response. Parents often email me in the evening and I can diffuse a problem with a two-sentence email and therefore eliminate a morning parent meeting. It saves me time.

Moreover, Claire notes how parents can provide her with information about their children. For example, parents can *"tell you that... in case my child is acting a little strange today, here is the reason why. And... it's just helpful information."*

"Communication between home and school needs to be ongoing. While parents are the child's best advocates, parents and teachers work together toward a common goal — the development and educational growth of the child. They can share information about children in ways ranging from informal chats to written reports and planned conferences" (British Columbia Ministry of Education, 2000, p. 184).

Box 29. The importance of communication between home and school

In addition to communicating with parents, Claire also views e-mail use as a way to prepare students for their future, as she explains that:

...we don't write letters and notes any more, we e-mail. So you're preparing, and that's what education is... to prepare your children for their future... so you are preparing them for their future because there is no child here that's not going to be involved with the computers in their lives. And so, it is just one aspect of preparing them for the future.

Claire believes that using computers in the classroom brings several benefits for students in that it can reinforce their learning process, motivate them, help them to develop a sense of accomplishment, and act as an *"equalizer"* for students who cannot print well. She explains that computers can help reinforce the learning process by providing an alternative way for students to demonstrate what they have learned. She also thinks that computer can help students practice their writing and math skills, and provide an alternative technique to develop literacy skills. Claire illustrates her use of computers for presenting materials, when she assigns her students to make graphs, based on a survey, using AppleWorks. She explains that:

...like the graphs today... they were just going in there ((to the computer lab)) to make the presentation... they are not learning how to make graphs, they're learning how to make a beautiful graph on the computer... they're showing what they've learned... And it's a new, and a different way. Students get bored doing the same thing over and over again.

She further explains that the use of computers as a presentation tool can reinforce students' learning because it provides them with the repetition of the materials. Claire further explains that

...you can teach them all the same things in the classroom, but the computer... really makes it a nice presentation... and the kids will do anything on the computer... so as they are working on their slide shows, they are reviewing all the skills of the lesson, it's the repetition of the material. Here we're presenting it this way... now we are also presenting it in a technology way... we've gone over that same information... when you're teaching a new concept or a new theme, just that repetition also helps.

According to Claire, the use of computers can also help students practice their writing and math skills. Claire believes that particularly for writing, using computers helps by providing visual cues for the students. Claire describes the use of Kidspiration, graphic software for creating webs, helps students with their writing because it allows them to create a "web of ideas," with the topic sentence at the centre of the web and the supporting sentences as its branches. She thinks that Kidspiration is ideal for younger children as it includes a graphic library that provides visual cues for children which aid them in writing paragraphs. She explains that the use of visual cues is needed in primary grades, especially for students who cannot read and write very well and for students who

speak English as their second language, because it can trigger their ideas in writing.

Claire thinks that:

...there are always an element of children in your class that needs it ((visual cue)). It supports the learning... and for the average child or even the bright child, it just triggers things of what you can write about... for example, you're writing about this animal... what are the physical features of it?... they've got the picture there to relate to.

Claire believes that computers can be used as a tool to help children who have difficulties in printing or drawing because it helps them to create better products. She explains that when these children are working at the computer, the computer serves as an "equalizer" so that their product will look as good as that of other children. She says that:

...for a child who has a really hard time printing, when they are doing it on the computer, it just looks so nice. It is an equalizer. Then their work looks just as nice as everybody else's in the class. And that's a big benefit for a weak student to be able to hold up his work and say, "mine is just as good as everybody else's."

Furthermore, she notes that the professional look of the product, which comes with using a computer, raises children's sense of accomplishment and reinforces their ability to do well.

Claire believes that besides helping students who cannot print, computers can serve as a tool for helping students who have not yet mastered their reading skills even though they have been taught with other techniques. She explains that:

...if you get a grade-two child who still cannot recognize the letters of the alphabet and the sounds that go with them, despite having been through kindergarten and grade one, and having been exposed to all the traditional ways of teaching already. So by the time you're getting a child... who's that far behind at the grade-

two level, you are looking for a new trick in the... bag, And sometimes the computer does that for them...

Claire explains how she uses KidPix to help her students learn to read. First, she helps the child type a sentence of his or her own choice on the computer. The computer then reads this sentence repeatedly using a variety of voices, so that the student learns to read the sentence with the assistance of the computer. Claire believes that the advantage of using computers is that

...these kids will do anything on the computer.... even if it's a boring phonics, workbook... they'll do it if it's on the computer, but they're not going to do it in a book... so you can use it, as a tool for a child who hasn't... been successful... ((with)) other techniques.

Claire further explains that children are willing to stay on task longer at the computer because it is more appealing than traditional materials: *"it's got all the elements that the modern day child likes, which is, it's flashy, it's bright, it's noisy and has a lot of eye appeal... it relates to what they're getting from television."* To demonstrate how her students' work will look like on the computer, Claire explains how she uses KidPix 4 to create slideshows. She notes that the students are free to choose their own background, insert their own pictures, and create their own animation schemes to their slideshow (see Figure 18). For example, students can *"make the birds tweet and fly, they can make the bats fly, they can make the frogs hop... it's got all of those kinds of elements that really appeal to them."*

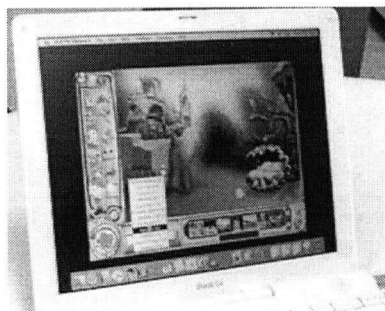


Figure 18. A screen shot of KidPix 4 in Claire's laptop

Claire believes that in addition to the positive impacts of using the computer in the classroom, the Internet helps to *"expose students to the world,"* so that *"they will know there is an answer to every question, they just search it."* Although Claire prefers to use books over the Internet, she acknowledges that using the Internet is cheaper than purchasing books and students can find information over the Internet that they may not be able to find in the library.

In Claire's opinion, computer use can have detrimental impacts on children, teachers, and schools. For children and teachers, Claire finds it chaotic when things do not work at the computer lab. She illustrates that the children get stressed out when the computer is not working, which in turn creates frustration for teachers. She points out that

The biggest melt down I've ever seen of students have been in the computer lab... they get a step or two behind and then they're way off... they get so anxious. So that is a big factor... they all want the one-on-one... and you're one-on-22, because we don't have assistants in the lab... so that is probably the biggest downfall of it. Another big problem is ((when)) the technology is not working correctly; the teacher has to know what isn't working and how to fix it instantly because there are 20 other students wanting your help.

Claire further explains how frustrations in the computer lab can create anxiety in the children. She has observed that the children who cry most frequently in the lab are usually

very bright and do not have difficulty learning, until they have a problem in the computer lab. Claire notes that:

Sometimes it's not their fault, it's the computer's fault. They of course assume it's their fault... sometimes it is their fault because they haven't been, paying attention or they haven't listened, or like all of us when we hit the computer, something weird happens and we don't know why... when all of the sudden... it goes away... they just fall apart on you... It is their emotional level... they are seven years old...

According to Claire, computers can also be detrimental to the physical development and social development of the children if it is used too much. Specifically, she explains that computer activities can reduce children's physical activities; as a result, children who do not get enough physical exercise develop illnesses. Claire finds that nowadays

....children no longer are physically fit. Diabetic children, when I started my career, we never had any diabetic kids in our classes. Now, almost every year you have one in your class. Lack of physical activity contributes to the development of diabetes. They should be outside playing and doing physical kinds of things, not sitting in front of the computer for hours and hours.

"Evidence is accumulating suggesting that type 2 diabetes is increasing in children and adolescents in the U.S... Lack of physical activity is strongly associated with the development of obesity, type 2 diabetes, and cardiovascular morbidity and mortality... Recommendations for increasing physical activity should include encouraging patients to do at least 30 min of physical activity daily, limit sedentary activity, and participate in sports... Decreasing sedentary activity, such as television viewing and computer use, has been shown to be an effective way to increase daily physical activity in children" (American Diabetes Association, 2000, pp. 383-389).

Box 30. The lack of physical activities and its associated illnesses

Claire suggests that children need to be limited in their computer access. She stresses that, "I certainly don't want a primary child spending more than half an hour, an hour a day on the computer, for sure not. I wouldn't like to see them spending hours and hours at it."

"The AAP offers the following recommendations:... Pediatricians should encourage parents to adhere to the AAP Media Educations, including making thoughtful media choices and co viewing with children, limiting screen time (including television, videos, computer, and video games) to 1 to 2 hours per day" (AAP, 2001, p. 1224).

Box 31. Recommendation for limiting screen time

Claire believes that spending too much time at the computer can have negative impacts on children's social development. She notes that when children use the computer, they tend not to interact with others. Additionally, she thinks that children can become addicted to computers, and choose to spend their time at the computers rather than doing other activities, such as playing with friends. However, she thinks that this is more a parental issue rather than a school issue, because

...there is no way that you have enough computer time ((at school)) that it's going to be compulsive behaviour. Not at a primary level... not the way we've got it setup anyhow. Cause you just don't have that much time on the computer... 40 minutes a week isn't going to do it... However, it certainly could be a home issue.

Claire further explains that whether or not a child is developing an addiction to the computer depends on the child's personality. She believes that it is possible for any child to develop an addiction to the computer; however, she thinks that some children are more susceptible to this addiction than others. For example, Claire notices that some children prefer to be alone. She has made these observations during free choice activities where children can choose what they want to do:

Every year you will have one or two children who will choose an activity where they are all by themselves in the corner doing whatever... and it would be exactly the same with the computer... we have had this situation where we used to have our lab open... and supervised at noon hours... And we found exactly that was happening... the children who are socially having difficulties would go into the computer lab and hide in the computer lab at lunch time and recess time to play on the computer and avoid the interaction with the other students out on the playground...

Claire further explains that frequently, children who choose to work individually at the computers during lunch hours are children who *"have difficulties making friends, sometimes they are very quiet, withdrawn children, generally not outgoing children. I think sometimes lonely children are not as lonely if they're on a computer..."*

Claire believes that children who lack social skills need help in developing their skills; therefore, teachers need to help them learn to interact with others. For instance, when Claire had a concern about a child's social skills, she would call the parents and give recommendations. For example, she would suggest that they invite some students to play with their child at home, and *"really limit the amount of time that the child spends on the computer or the television or... game boys or things like that."* She explains that this is meant to encourage activities that involve social interaction and limit activities where the child is in solitude and not interacting with others. Claire would also send the child to a special program at the school run by a speech and language development specialist, where the child will learn how to interact with others.

From the school's point of view, Claire feels that *"money wise the technology is a total drain on the system... it always needs to be upgraded and it's always needing repair. It is a big, big expense."* She explains how

...when our lab is down, it's because we upgrade it. And every time they upgrade the server... nothing works and every teacher has to be retrained... they put a different system on it and now we all have to learn different system, a different system of a whole lot of things. Most of us don't have the time to actually learn it...

Considering that the computers go obsolete fairly quickly, Claire further states that:

...if I was given the choice if I could have \$2000 laptop for each child or I could be given those same \$2000 to use for books and curriculum aids... I would get books and materials. However, that choice is never given to you... If I spent the \$2000 per child... on educational toys, books, maps... I would have that for the next 15 years. If I spent \$2000 on each child for the laptops I'll be very lucky if it's good for four years to five years...

She also prefers to use books because the children can have more interaction with books, such as, *"cuddle up the book... look at it... share it with somebody... interact with it,"* and, *"if it is your personal book, you can write on it...."*

Claire believes that using the computer is appropriate when the materials are grade level appropriate for the children. She thinks that a teacher needs to be knowledgeable about the "age appropriateness" of the materials, and is responsible for exposing students only to the appropriate ones.

"Specific software applications need to be evaluated in relation to content and age suitability, biases, and stereotypes, like any other type of resource" (British Columbia Ministry of Education, 2000, p. 81).

Box 32. The importance of software evaluation

She gives an example of the way she selects Internet sites for children:

...the text would have to be at the reading level that... they're able to read, it would have to be text that is appropriate for their grade level... the pictures are appropriate for... what you want to teach them... it gives them two facts on

something, not 10 facts... so it's the right amount of information... if it's too hard, they don't learn anything... If it's too easy they will lose interest. So, you want to find something that has a balance in there.

She further explains that teachers need to discern, *"is the information truthful, accurate, according to my knowledge?... how can I use this information with them?... does my class have the background skills to do it?"* She indicates that when she uses the Internet with her students, she would not *"read a page just for the sake of reading it."* Rather, she would assign some tasks to do with the information.

Claire thinks that it is necessary for children to master the curriculum first before they can make use of the computers for a specific learning outcome. She explains that:

...before a child can use a computer as a learning tool, you have to learn to read and write. And they learn to read and write by using books and papers and pencils and things like that. They don't learn to write on the computer. They, you know, can present what they've learnt on the computer... They've got to have the curriculum... before they can even use the computer in an educational fashion.

For example, when her students are writing a story or creating a web, Claire always asks them to do the task with pencil and paper first before typing it out on the computer. She chooses to do things in this way because, *"it's a challenge enough to use the technology so that if they are using the technology, you're teaching them how to use this technology. They have to know the information before they go in there."*

Claire believes that children need supervision when they are using the computer, especially when they are using the Internet. Claire does not allow or teach her students to surf the web without adult supervision or to do their own Internet searches, because *"as parents and teachers we agreed... let's guard them or protect them."* What she usually does when the students use the Internet is create a *"jump page"* that provides students

with links. Students can then click on each link to access the materials from the Internet. She explains that by using "jump pages," the students do not have to actually type any website address, and do not do any Internet search.

In order to make effective use of computers to achieve learning outcomes, Claire believes that it is important to have good computer lab facilities at the school as well as teachers with good computer skills. She explains that the biggest factor in the computer use is:

...the teachers' knowledge of technology themselves. You're not going to teach something you don't know how to use. The reason I took two years training in technology was simply because we did have all this technology equipment and I didn't know how to use it.

In her own experience, Claire feels that when she is not familiar enough with a program, she will not use it with the students. For example, she says that she has not used computers for math very much because she does not know good math software. Sometimes she uses math blaster, and indicates that students *"like the boom bang aspects of it, but the actual learning part of that isn't very evident."* Also, she has not used Inspiration and Kidspiration very much because she has not been *"confident enough in it to make it useful to my class at this spot"* and has not had time during the year to learn it. Thus, she plans to spend the summer learning the program and using it for the next academic year.

Criteria for selecting software. Claire thinks that good software for primary students should be *"easier reading, it would be less print to a screen, and bigger print. What they really like is the sound and the movement or the video kind of clips they can pull up."* She also explains that her school prefers to buy software that is, *"more multitask*

rather than get a program that does just phonics, or is... limited to one skill basically... we have gone with a program that... you can choose... a lot of the different skills."

Classroom Practices

Class taught. When the interview was conducted, 22 students were in Claire's class. Claire described that there were several students with learning difficulties, but there were no students with special needs; therefore, she did not have any teaching assistant during that year.

Computer facilities. Claire's classroom was equipped with two Macintosh computers. She notes that the computers are connected to the Internet, but this year the computers are not working properly. Claire describes that at the school level, the computer facilities include the computer lab and a set of wireless laptops that can be signed out by teachers to be used in their classrooms. Claire explains that since her classroom computers are having problems, she is allowed to keep one of the school's wireless laptops in her class during report card periods. She reports that in addition to using the laptop for writing the report cards, sometimes she also uses it with the students.

Claire notes that her students have access to a number of software in the computer lab, including word-processing software, alphabet software, drawing or graphic software, Internet browsers, and encyclopaedia. She further explains that in addition to the software in the computer lab, the library has a collection of software that can be signed out for classroom use (see Table 4). However, due to time availability, Claire feels that it is better to focus on a couple programs rather than many of them:

...if you are only in the lab for 40 minutes a week, you don't have time to teach them that much... if you use five different programs, it's, they learn them all a little bit, but not very well... Grade twos, you can't teach technology and curriculum at the same time in a computer lesson... I have to teach them the technology... then I

can put the curriculum into it... once they've got the technology... we can use it for... learning the curriculum.

Table 4. Types of software available for Claire's students

Type of software	Example(s) of software
Word processing	AppleWorks, Storybook Weaver*
Reading	All The Right Type (keyboarding), Kid Phonics*
Math	Millie's math house*, Math Blaster*
Drawing or graphic	KidPix 4, KidPix Studio Deluxe, Kidspiration, Inspiration, and TuxPaint
Internet browser	Safari and Internet Explorer
Topical readings	World Book 2004, Encyclopaedia of Nature*, Encyclopaedia of Science*

* Software available in the school library

Claire reports that she limits her students' use of computers to AppleWorks and KidPix. She explains that AppleWorks is the only word-processing software that the school has and is a standard program that comes upon a purchase of Macintosh computers, whereas KidPix 4 is:

...the program that we as a primary team decided that we would focus on at the grade one-two level... it does everything I need... you can incorporate the Internet into it, you can download pictures from the Internet into KidPix 4... you can have text, you can write, you can have graphics, it's got stories themes.

In addition to the software in the computer lab, Claire explains that the students can also use the encyclopaedia software in the library under the guidance of the librarian. The library also has a collection of software that can be signed out by teachers for classroom use.

Classroom computer uses. Claire describes that the computer use in the computer lab is scheduled once a week for a 40 minute period, which, according to her, is enough for her students. She describes that:

Personally I don't think they need that much more computers time... other than for individual tasks, for individual children, I don't want more than an hour a week on computers for the kids. I don't have time. I have to cover my curriculum... that's why... I don't go down to the computer lab without my lessons relating to curriculum...

Rules at the computer lab. According to Claire, at the beginning of the academic year she establishes computer lab rules for the children: The first rule is to avoid playing with the lab's spinning chairs, whereas "the number two rule? You cannot cry. I say you can put up your hand for help and I can't always help you right away. You sometimes have to wait, five whole minutes... but you can't cry..." Claire illustrates that when a child cries at the computer lab, she will ask the child to

...calm it down, I'm not gonna talk to you as long as you're crying. I will come back to you as soon as you stop crying, because if you're crying your brain...is so scrambled, it can't think. So as soon as it calms down, and you can think and we can figure out what the problem is. But not while you're crying... if you can't handle, the stress of it, you're just gonna have to stop, and just go for a walk or something.

Claire describes that the third rule applies to when children help each other in the computer lab, that is, "they can tell the person what to do, they can't do the actual typing." She explains that she establishes this rule to avoid having a

...Miss "know it all," do everything on this computer, and everything on this computer, and everything on her computer... you don't want a really powerful

student taking over for a weaker student, you don't want a weaker student just waiting for somebody to do it for them. And basically you want them to learn. And the only way they're going to learn is to do it... And even in evaluation you're going to have to evaluate something. How are you going to evaluate it if the child beside them did it for them?

Pedagogical practices. According to Claire, computers are typically used in the lab, but occasionally she signs the laptops out for use in her classroom. Claire explains that she begins the academic year by teaching her students basic computer operation to provide them with the background skills that they will need for the rest of the year. She illustrates that for the first half of the first term, she teaches them how to log on to the system and how to do basic operations such as saving their work. Claire further explains that when students have mastered the basic skills necessary to use the programs, she will then start relating the lesson to the curriculum.

In addition to using computers during lab times, Claire also reports that she uses computers to assign special projects for individual students. For example, she may ask her gifted students to work on a Web Quest project. She may also use the computer for special needs students, provided that there is a teaching assistant who helps the students. Basically, she notes that she may send students to work individually at the classroom computer if they are capable of working on their own at the computer for a 20 minute block without constantly interrupting her from teaching other students.

According to Claire, when a student produces outstanding work, she will ask the student to use the classroom computer to present or "*publish*" their work as an extra project and a reward. For example, Claire illustrates that when students were assigned to write about fairy tales, she first asked students to write the story on paper. Figure 19 shows a draft of her student's writing about "*The Three Little Whales and the Big Bad*

Shark," a twist on a fairy tale based on the story of the Three Little Pigs and the Big Bad Wolf. Figure 20 shows a student's writing about "*Little Red Riding Hood*" that was printed out with the computers, and "*published*" as a book.

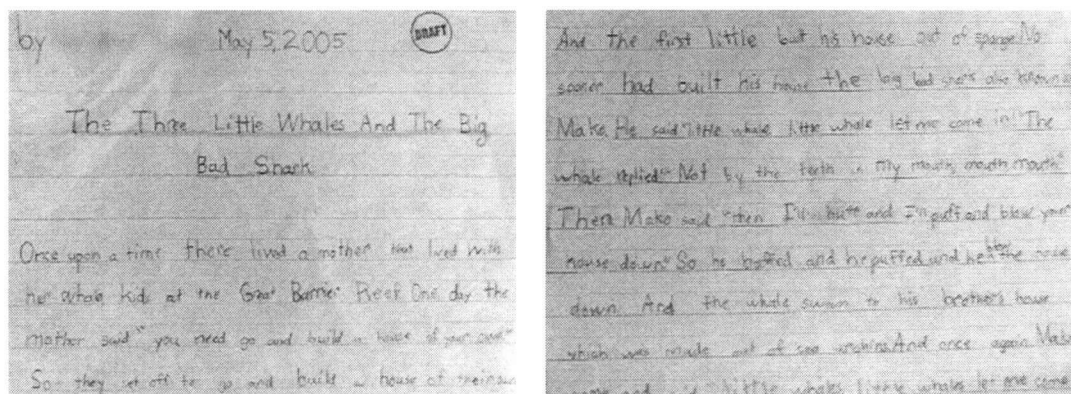


Figure 19. "The Three Little Whales and the Big Bad Shark" draft

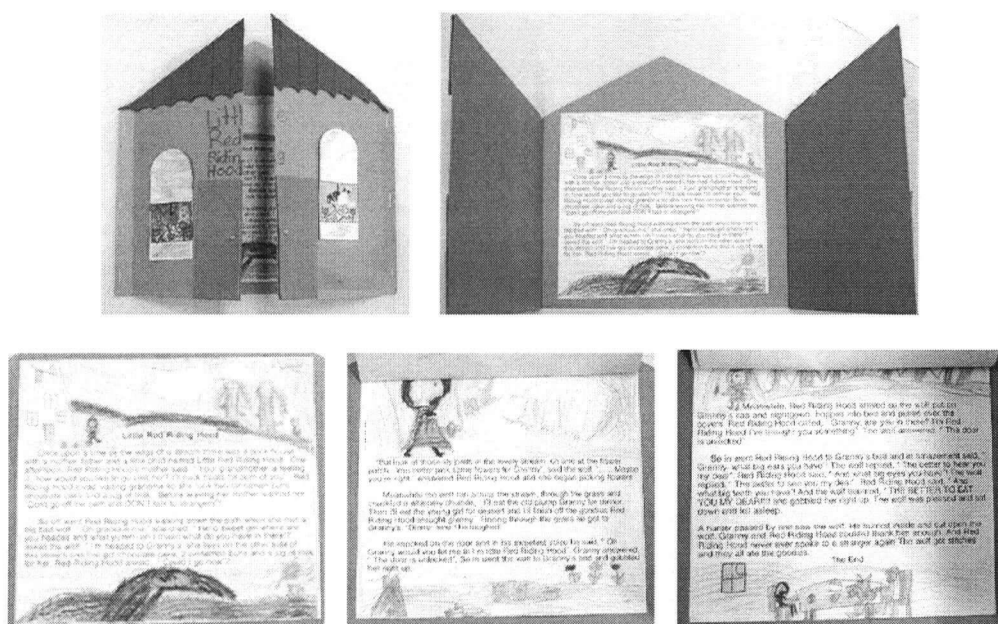


Figure 20. The "Little Red Riding Hood" book, created by Claire's student

Claire illustrates how she integrates computer and Internet uses into her lesson plans. For example, she describes that when the class theme was about Mexico, the students browsed some websites that Claire compiled, and they made slideshows about Mexico; another project where she usually incorporates the Internet is the "*Flat Stanley*" project. This project is based on a story about Flat Stanley, "*a little boy with a bulletin*

board fell on top of him. And he is flat... he can be folded up and put in an envelope and mailed. So he goes on all these different adventures." She describes how this project incorporates computer activities, such as e-mailing and Internet browsing, and off computer activities, such as drawing and writing. She explains that as part of the project, students first learn about the Flat Stanley story; then, they create a story board to retell the story (see Figure 21).

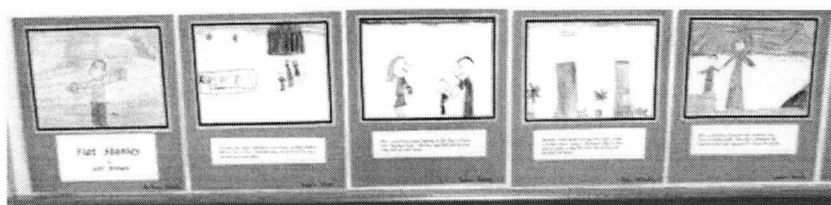


Figure 21. Flat Stanley story board

Later on, she explains that students will plan to create their own Flat Stanley; they will browse the Flat Stanley website (<http://www.flatstanley.com>) to see some pictures of other children's Flat Stanley stories. Then, each student creates his or her own Flat Stanley figures (see Figure 22).

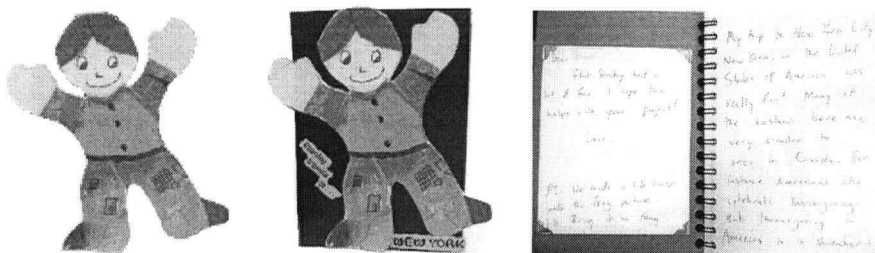


Figure 22. A student's Flat Stanley with the journal about his visit to New York

Claire explains how students decide, with their parents, who they should send Flat Stanley to, (i.e., to a relative or a friend who lives in another part of the world). First, the student will e-mail the prospective Flat Stanley host. If the prospective host agrees to host Flat Stanley, the Flat Stanley figure is mailed to him or her. Each student communicates with the host by e-mail during Flat Stanley's "visit." After a while, the host will mail Flat Stanley back, along with a story of Flat Stanley's visit to that place. For example, Figure

22 shows a journal about Flat Stanley's visit to New York. Depending on the person to whom Flat Stanley was mailed, there are a number of ways Flat Stanley's visit can be presented. For example, his story can be presented in the form of pictures, journals, or even websites. Typically the story will describe the places, the culture and the traditions of the people in that area. It will also include some pictures of Flat Stanley in the places he visited. Claire notes that upon Flat Stanley's arrival from various places, students will compile them and put them on the school wall (see Figure 23); they will also locate on the world map, places where their Flat Stanley visited (see Figure 24). This world map is posted outside Claire's classroom.

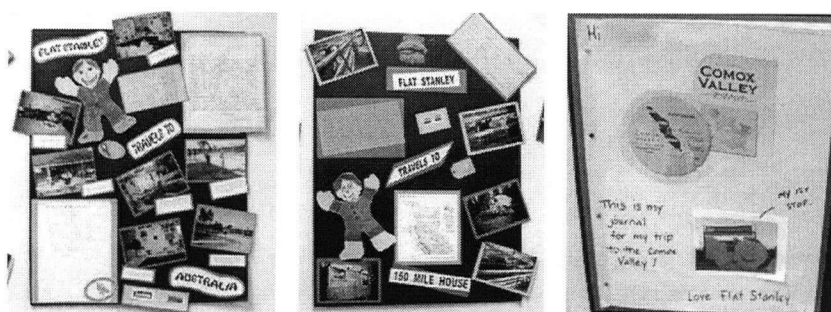


Figure 23. Flat Stanley postings on the school wall



Figure 24. "Where in the world is Flat Stanley?"

In addition to the use of computers at school, Claire explains how she encourages students to use computers at home, under their parents' supervision. Claire describes that when she is delivering a unit lesson, she usually sends students home with questions to think about. She notes that as a resource, she sometimes e-mails some Internet sites to

parents so that they can help their children look up answers. She explains that this serves as *"a bridge from school to home so when they go home there is some kind of communication."* According to her, students will learn how they can use the Internet to obtain information to complement the hands-on and experimentation activities that they have had in the classroom. For example, Claire explains that in the second phase of the soap experiment (see Figure 17), her students conducted a float test to see which soap would float and which soap would not float. Claire illustrates how she asked them to guess why certain soaps float, and when the students went home, she asked them to search for the correct answers on the Internet with their parents. She believes that because she encouraged students to make logical guesses, students were more engaged and curious to find out the actual answer and compare it with their guess. She notes that

...it takes ownership of a question when they have been involved in it... They want to go home to prove, to you that they were right. So they are more interested now... it gives them some connection to the question and some ownership to it and it just makes them, "yea, I wonder," just give them that spark to, to be involved in... all of the education is getting children involved and caring. Because if they don't care they won't, they don't want to do it. And they won't remember it...

Summary. Believing that children learn best by doing, Claire prefers to use hands-on and experimentation activities in her classroom. She believes that computers are not a basic element in primary grades, and children do not need more than one hour of computer use per week at school. Claire prefers to use books, paper, and pencil over computers; however, she also values the use of computers for remedial purposes, for practicing and presenting what students have learned, and for providing students with up-to-date information.

Donna

Background Information

Donna is a grade-one-two-split teacher. She has been a primary-school teacher for 10 years, of which two years were spent teaching Kindergarten, and the remaining eight years were spent teaching grades one, two, or one-two split.

Donna first learned how to use computers in the 1980's when she was working in a chartered accountant's office. In 1994 she decided to change careers because of her desire to work with children. As a mature student, she returned to university and took courses toward becoming a primary-school teacher. During her teacher education program, she learned more about using computers and decided to incorporate computers in her teaching in her last seven years as a primary-school teacher. She finished her post baccalaureate diploma in teaching technology two years ago.

The school where Donna teaches is a K-7 school in an urban area of the Lower Mainland of British Columbia. Approximately 400 students are enrolled each academic year and about 60% of the students speak English as their second language. The school is equipped with a computer lab and a set of mobile wireless laptops that teachers can sign out for classroom uses. The school also keeps old computers in the school hallway for student use.

Beliefs about Learning

Beliefs about primary children's learning. Donna believes that primary-grade students are enthusiastic about everything, and are not afraid to learn new things. She feels that children need to be introduced to various things while they are young and enthusiastic about learning, so as to provide them with the basic skills they will need in later grades. In primary grades, Donna wants students to think that learning is enjoyable,

...no matter what it is, whether it's reading a book or whether it is using a computer, or whether it is learning to manipulate the tools that they have in a gym... you want them to think of it as fun and that they want to do it. And you want them to have, a broad education... you're not wanting them to be specialist in anything at this age but you do want to introduce them to a little bit of everything, so that they can learn to develop skills... not really expertise but competency in things.

Donna believes that children learn best from modeling, interacting with others, and practicing the materials. Her guiding principle in teaching primary grades is that children need a model, whether it is from the teacher or the parents. She notes that her main rule of thumb is:

...model, model, model... And, "monkey see, monkey do." If they see me doing it then they want to do it... if I model how to write a sentence, they start writing sentences... if I'm not modeling all the behaviours... they don't get it... the most powerful way, anybody learns to do anything, whether it's in school or at home... is by copying, and this is possible if they have seen someone model the skill for them.

"Children benefit from the modeling of literacy by significant adults, particularly their parents... Children learn best when teachers employ a variety of strategies to model and demonstrate reading knowledge, strategy, and skills" (British Columbia Ministry of Education, 2000, p. 121, 127).

"Social responsibility is both 'caught' and 'taught.' Teachers model appropriate behaviours for them in the way they interact with children and other adults and through use of language" (British Columbia Ministry of Education, 2000, p. 105).

Box 33. The importance of modeling

In addition to modeling, Donna also believes that children *"really do learn best from each other, so I really lean towards programs where... the children end up interacting a lot with each other."* For example, in her *"Jim Stone Animated Literacy"* activity, Donna teaches students a song and a story, and then asks them to practice it, and teach it to other people at home. In her cooperative reading activities, she encourages students to recite a poem with each other. After they practice reciting a poem for a week, students have to read the poem to 10 different classmates, where:

...they're practicing their skills but they're having fun at the same time, and they're talking to each other civilly... they really are learning from each other. They'll correct each other and that is more powerful than when I correct them.

Even though Donna believes that it is good to have children work with each other, she also thinks that teachers should not do this all time, because *"otherwise you can't, truly assess the children. Because you don't know if they did it by themselves or if they did it as a team."*

"Interaction is at the heart of all forms of teaching, whether it be assisting individual students, engaging in conversations with students about their learning, or instructing small groups or the whole class. Likewise, learning experiences in which students interact, such as discussion, partner and group activities, collaboration and co-operative learning, harness the potential of social interaction as a tool for learning (British Columbia Ministry of Education, 2000, p. 47).

Box 34. Social interaction as a tool for learning

Donna believes that practice is essential for children to master the subject matter. She feels that it is important to use a number of methods for practicing the skills that children need to develop. For example, for practicing addition and subtraction to, it is important to use various methods, such as using manipulatives and drill-and-practice software. She thinks that manipulatives are very good to develop children's motor skills, but thinks that they are not more important than using other materials (e.g., computers).

She explains that, *"I don't one hundred percent agree that it's totally, made a huge difference in their brain.... I'm not a great believer in thinking that's ((using manipulatives)) super duper important."* She notes that:

...I have not found that children, who have worked with the manipulatives have truly learned the concept. I think that comes later... developmentally their brains just aren't getting the concept now... even with the adding, you can tell the way they're looking at it, the way they're doing it, they're just not totally getting it, they can solve the equations by either counting on or counting manipulative things, but I think the more that they practice, as with drills, that eventually, they will understand the concept behind what they are doing.

However, she thinks that for learning to count, it is best to use manipulatives to reinforce the one-to-one correspondence of counting. She points out that:

...I've seen a few drag and drop programs ((on the computer))... but... I don't think that the child is getting it quite the same as if they have to pick an item up and move it compared to, when they're dragging a picture across a screen... when they're dragging, they're thinking more of the mouse movement... than they are realizing it as a one-to-one correspondence thing.

Donna gives an example where her class practices counting as a group during the calendar activity (see Figure 25). She thinks that this activity is powerful because:

...the whole group is chanting things together... it's very, very powerful whether you're learning to count or whether you're learning to read... that's interactive because everyday somebody gets to be the one with the pointer and so they get to track the words, which is demonstrating their one-to-one correspondence, whether it is words, or whether it is numbers.



Figure 25. Calendar activity, where a student leads the whole class to count or read

Donna thinks that it is important for students to keep practicing these skills until they get the feeling of how things work. She says that:

...I'm more of a believer that... that concept will kick in for them at some point... if they feel successful with the algorithm and they can do it, and they can get it right... they get a feel for it... it doesn't matter whichever way they get the answer, just do it... I think you can... do that just as well... with having the computers as any other way.

Donna supports the theory that people have different ways of learning. She describes that some children learn better by listening, while others learn better visually or kinaesthetically. She believes that children with no learning disabilities can learn through all modes of learning, but children who have learning problems tend to develop preferences toward a specific mode of learning. Donna points out that, even though is it ideal that teachers incorporate all learning styles, it is not possible to continuously *"present everything in every maximum way to each kid."*

"Children vary in their learning styles, prior knowledge and experience, and abilities and rates of development... learners have greater abilities in some types of activity and learn more easily through one method than another... The responsibility to respond to learning differences remains largely with the classroom teacher... One useful model for education is Gardner's (1983; 1993) Theory of Multiple Intelligences. (British Columbia Ministry of Education, 2000, p. 39).

Box 35. B.C. Ministry of Education's position about differences in children's learning

Beliefs about the roles of primary teachers. Donna believes that the main role of primary teachers is to teach children routines. Donna finds that teaching routines is important in helping children to be independent learners. For example, in the first few weeks of school, Donna expected her students to prepare themselves for the school day without parental aid. They were expected to hang up their coats, get their planners out, and take their books out of their backpacks on their own. By January, Donna expected that they would be able to perform these tasks independently and without having to be told. She believes that learning routines and performing them independently will help students to develop good work habits and good study habits.

"Children benefit from predictable structure and orderly routine in the learning environment and from the teacher's flexibility and spontaneity in responding to their emerging ideas, needs, and interests" (NAEYC, 1996 in BC Ministry of Education, 2000, p. 18).

Box 36. The importance of routine as well as flexibility

Besides setting up routines, Donna believes that teachers should set the curriculum to include goal setting for the children, thereby giving them direction to develop their skills, and "*keeping them on track.*" Donna finds that communicating her expectations to the parents helps parents participate in further developing their child's skills at home. In particular, Donna believes that home experiences and parental support are very important

in the development of primary students. She explains that the experiences of children at home is

...the most significant... in kindergarten and grade one, what you really do in a classroom is enhance what they do at home. You give them some directions on where they should be practicing. But if they do not practice at home, they often will only minimally advance.

"The relationship established between home and school is an important link in a child's education. Educators direct the more formal aspects of the child's learning; parents are recognized as the child's first and most important teachers" (British Columbia Ministry of Education, 2000, p. 177).

Box 37. The relationship between home and school

As a way of communicating her expectations to parents, Donna usually sends a class book, containing documentation of students' work on a particular projects so that parents can compare how well their child is doing with the other children in the class. Donna explains that this serves as a subtle way of communicating her expectation to parents, so that they will be *"able to see the path of where they might want to go when working with their child."* She describes that parents always ask how their child is doing compared to the rest of the class. Even though Donna notes that primary teachers usually avoid comparing students' work, she emphasizes that it is important to show different qualities of work produced by the class, as she explains that:

...if you don't see what poor work is, and what excellent work is, how can you aspire to be excellent?... like myself when I was learning... if I only got like, a B, and I'd think, "how come that person got an A?" If I would look at their project and examine it, then I would think, "Oh, that's what an A project looks like..." then I'd have a clearer picture of what the expectations were.

According to Donna, teachers need to incorporate diverse instructional methods to help children learn, including whole group, small group, and one-on-one activities. Donna stresses that each of these instructional methods is powerful in its own way. She further explains that, *"one-on-one is best... you have to look at each child as a little individual because your expectation for one child will be different from your expectation for another child, just because of where they're at."* Donna thinks that teachers need to adjust their goals to suit each child's skill levels. She also believes that, *"as a teacher you should be challenging every child in your class."*

Beliefs about Developmentally Appropriate Computer Uses for Primary Students

Donna thinks that computers play a significant role in today's society and that *"almost everything in our society now is involving computers."* For example, she notes that, nowadays, people pay their bills and acquire their pay cheques online. She thinks that it is important to be able to use computers, otherwise people will be *"totally lost in our world."*

Donna believes that students can still achieve high levels of learning in the absence of computers; however, she is confident that computers can make things more efficient. For example, for the pen pals activity that she does with her students, she finds it much quicker to use e-mail rather than airmail and the class can *"accomplish more immediately."*

Donna believes that it is important for children to learn how to use computers, particularly for their future employments. She believes that the primary years are a good time to start introducing computers to children, because of their enthusiasm. She compares the process of learning about computers with learning to drive, and notes that:

...the younger you learn, the more comfortable you will be with the skill. It's easier because you're not panicking all the time. And I feel that's kind of similar to

getting them on the computer. If you get them using the computer when they're little and it's fun for them, they won't be worried if they make a mistake, and they'll be confident that either they can fix it themselves or somebody will help them fix it. The overall idea here is that it is okay to make a mistake.

Donna believes that children who learn to use computers while they are young have a huge head start, whereas others who do not have the same opportunity will find it difficult to catch up. Moreover, she thinks that once someone has mastered the skills of using one computer, it will be easy to transfer those skills onto other computers, because they operate in similar ways.

Donna also believes that there is no significant difference between children's activities at the computer compared to those done with pencil and paper. She explains however, that once children have become more familiar with the keyboard, it will not make a significant difference whether children write using pencil and paper or write using the computer.

"Technology has the potential to assist young children in their learning in many ways. For example, it may allow students to focus on words and ideas rather than the mechanical aspects of writing (Jones and Pellegrini 1996). For some children, however, word processing seems to interfere with their writing processes (Dahl and Farnon 1996)." (British Columbia Ministry of Education, 2000, p. 24).

Box 38. The potential of technology to assist children's learning

Donna further describes that she wishes that students would be able to write at the computers as if they are writing with pencil and paper, because at the later grades (i.e., intermediate levels and above), there is an increasingly higher expectation to hand in assignments that have been typed as opposed to hand in assignments that are hand written.

Donna finds that the computer in her classroom is like *"having an extra teacher in the room in some ways."* In addition to the computer lab activities, computers in the classroom can give students the opportunity to practice the material at the computers after the lesson has been taught. Donna points out, however, that she would not do this until she felt that the students were able to work independently at the computers. She explains that the strength of using computers is that each student *"can work at their own speed individually,"* and teachers can vary the level of the material for each student at once. She compares using the computers for adjusting to different learning levels with the way she tries to adjust her lessons without computers, where:

...you're constantly going between making it simple enough for some students and challenging enough for the more advanced students. So, some students will be frustrated and some students may get bored, which can lead to a noisy classroom. You constantly have to go back and forth, back and forth, back and forth.

Donna thinks that another advantage of having students work individually at the computer is that *"everyone can be a star."* She observes that each child can participate equally during the computer lab times. When teaching more traditionally without computers, some children might dominate the classroom interaction, where:

...there are some students who will yell out the answers and some kids who won't get a chance to think... there are always these bright ones yelling out the answers... the other students will be just about to say their answer and somebody beats them to it and yells it out... Whereas, when at the computers, everybody is engaged at the same time... that individuality allows them all to give their answer in the time they need, rather than hearing it before they can get it out.

Donna finds that children are attracted to the computers. She emphasizes that computers create excitement for the students and:

...that's what you want learning to be, to be fun and exciting... there isn't really anybody that I have come across that didn't want to go to the computer. For instance, there have been lots of students that don't want to go to finger painting because they don't want to get their hands dirty... there are students who don't want to play with blocks... children have preferences for things like that. But I have yet to come across a child that didn't like to go to the computer.

Donna also notes that students stay on task longer and work more intently at the computer. She believes that they do so because only a limited amount of time is available for computer work and because they enjoy using the computer.

Donna believes that with computers, people can generate better products; for example, report cards will look nicer and more uniform. She explains that students' work looks better when done on the computer, so students are proud of being able to "take command of that equipment and used it." She further notes the pride students feel when they work at the computer is higher than when they work with other things, such as writing a journal, because their work at the computer looks better. She observes that when working at the computers, children are more willing to do good work. She illustrates how

...I keep telling them every time they pick their pencil up they should do their very best work. Every time they pick that crayon up they should do their very best work. And often they do not. Sometimes they just make a big mess... and scribble all over it. And they can't really do that scribbly thing on the computer... It's a little bit different because the final product can look just as good for each student regardless of their skill level. I've never had a student that didn't take lots of pride on what came off the computer printer

Donna points out that using computers in the classroom helps to integrate students with special needs into the class and helps them to produce better work. For example, she explains how

...the learning disabled kid is going to be more invisible, meaning the students with lower skill levels will not show up as obviously on the computer... their final product is just going to look pretty much as good as anybody else's... because that font is going to be the same. You will not see the student who cannot use that pencil very well, the one with the poor fine motor skills. The only thing that you're going notice is that they produced perhaps a shorter sentence than some of the other students.

Donna also feels that working at the computer enables students to work consistently throughout the year despite their temporal mood. For example, Donna compares a student's work in September and November, where the student:

...has nice printing here ((September)) but not here ((November)). But if you see on the computer, even though she was having a bad day these last few days... her work would have looked more consistent... However, in their portfolio, you may think they have digressed in their skills versus thinking that they have just had a bad day... So, by using the computer, a student could still feel proud of themselves and the effort they put in because their work would look more consistent on the computer. So there are times like that, when technology can make a difference ((see Figure 26)).

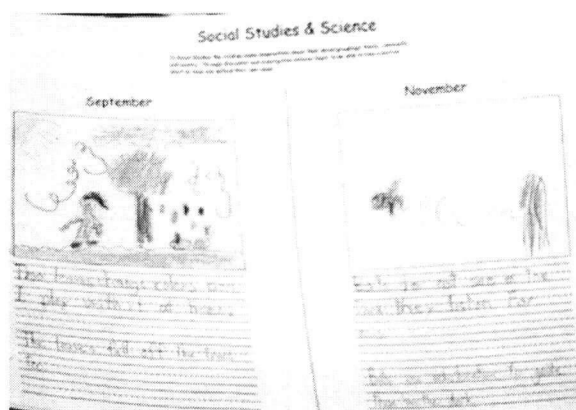


Figure 26. A student's work in September compared with the one in November

Donna believes that using the Internet will help students access current information. She explains that, *"it rather opens up... or brings the world into the classroom."* According to her, the use of the Internet is valuable compared to the use of textbooks, because *"books get ripped and torn and things like that. Well I guess computers can break down too but it is more... up-to-date than your books."*

Donna finds that working at the computers increases efficiency. She illustrates how people can duplicate their work easily through printing or copying and pasting. She explains how using computers for writing report cards saves time for teachers in that the time she spends writing a report card at the computer is only half an hour per student, while, without using the computer she would spend about two and a half hours per student. She also explains that writing letters to pen-pals with computers is more efficient because her class can write one letter and e-mail it to three different groups of students. Furthermore, she points out that computers offer an alternative way of storing and sharing students' work, such as saving electronic copies of the work and then sharing them with other people through e-mail.

Donna also illustrates the efficiency of using computers from an economic perspective. She finds that using computers reduces paperwork and reduces the school expenses. She explains that when children are practicing their skills at the computers, it is

not necessary for teachers to photocopy the materials and worksheets. Also, Donna believes that using computers can save space in the classroom. She notes that she does not use some of the manipulatives as frequently because of having manipulative activities on the computer:

...it is good for them to have hands on manipulatives... but... there are a lot of things on the shelves that I really don't use that much any more because we have access to computers... a lot of things like various buckets or boxes ((see Figure 27))... For instance, you end up having several different manipulatives so that you can have more students working on the same concept but with the different manipulatives because there aren't enough of each manipulative for each student to have the number of them that is needed for the activity. At the computer, in a very small space you can have lots of concepts with, a very little space.



Figure 27. Buckets of manipulative objects in Donna's classroom

Donna believes that computers do not negatively impact teachers. For students, she believes that the computer can be detrimental to their social skills if they use it for long periods of time. She feels that at this age, children need more face-to-face interaction, whereas when they are using the computers, they tend to work by themselves. She explains that face-to-face interaction cannot be replaced by online interaction. However, Donna believes that the case is different for older children, because for older children she feels that computers can facilitate their social interactions. For example, she

describes how her daughter seems more confident and talkative when she is socializing online.

Donna believes that some computer games and Game Boys can have adverse effects on children's social skills, in that they can demonstrate antisocial behaviours. She explains how she had noticed that her daughter tended to behave rudely toward others when she had spent a lot of time playing with her Game Boy. She feels that it is important to have *"a proper balance of how much is enough."* She explains that balancing is needed, not only for computers, but also for other things.

...you have to have an equitable amount of time using other tools like crayons or scissors, or even basketballs. You need to develop skills in many different things... It is possible for someone to develop a preference for one way to do things, to become one track minded where all they want to do is use the computer or always go to the blocks at centre time and that's when its time for the adult to take charge and say, "no, you need to practice something else for a while now. It's time for you want to try or work on something else..." I think that's just the way life is... we teach them to do things in balance...

Donna thinks that it is difficult to specify how much time a child should be allowed to use the computer; however, she explains that the time a child should be allowed to use the computer depends on the age and the nature of the computer activities.

Donna believes that, generally, using the computer with children is appropriate; however, the appropriateness of certain computer uses depends on the ability level of each child. For example, she explains that an Internet site that requires a lot of reading should only be used if it is suitable to the child's reading level. Donna does feel, though, that advanced children can be challenged by participating in more advanced levels of

computer activities. She emphasizes that this is important because, *"as a teacher you are supposed to be challenging every child in your class."*

"Children benefit from situations that challenge them to work at the edge of their developing capacities and from ample opportunities to practice newly acquired skills and to acquire the disposition to persist" (NAEYC, 1996 in BC Ministry of Education, 2000, p. 18).

Box 39. The importance of challenge

Donna believes that computer use should be supervised. She feels that teachers are responsible for ensuring that students are not at risk for encountering any pornographic materials when they use the computer. In her computer lab, Donna only allows children to go to sites that she has already previewed. During times when students are free to decide what programs they would like to use, they must still receive Donna's permission before going to an Internet site.

When the students are using the computers, Donna believes that it is important to give them some time for free exploration. She finds that when students are allowed to explore, they are able to discover new ways of doing things. During exploration time, Donna observes that, *"kids do phenomenal things if they've been allowed to have access and some time to play with it."* For example, one of Donna's students actually taught Donna how to gradually enlarge pictures using KidPix. Donna outlines some advantages of having free exploration time. First, she finds that students can explore the programs, discover new ways of doing things, and diminish any fears they might have of computers. Second, she feels that having exploration time allows her to make note of her students' interest, and provides her with opportunities to expand what students have learned in the lessons. For example, she says that one of the exploration times created a situation whereby the class ended up learning about an animal that they had read about in the previous class:

...one time I had somebody who wanted to go to a site about... an animal that was just randomly mentioned in the story we read. Well, that was kind of exciting because we went to the computer in the classroom and did a search on the Internet to find more information about that particular animal. And you knew the kids were interested in it because they asked for more information about the animal. It really doesn't matter what animal it is, you still want them to know about the habitat, the eating habits, etcetera and things of this kind. You can tie it into other subject areas when they've got an interest about something.

Third, while the class is exploring freely, Donna can use this time to call up individual students for assessment for the report cards.

Donna feels that primary students learn best at the computer when they do the operations themselves. She thinks that it is necessary for each child to work individually at a computer, rather than in pairs because she feels that grade-one and grade-two students are still at the developmental stage of solo or parallel stages of play, and that many of them do not work cooperatively when they are at the computer:

I just don't think you'll learn unless you're doing it... when they get older they probably can work as a team. But when they're little, they don't... it's like parallel play with solo play... that child that gets that mouse... that's whose in control... it's one child engaging their brain and the other child sitting there wishing they had the mouse.

"The sweep of Parten's theory suggests that from age 2 on, children make the transition from being non-social... to socially aware... to close proximity... and finally to interactive... We see the child making the transformation from pre- or asocial, toward a stage when an experience is socially shared. This transformation typically occurs in the preschool years, so that children can be cooperative with peers by age 5 or 6" (Frost, Wortham, & Reifel, 2001, p. 53).

Box 40. The development of social play, based on Mildred Parten's theory

"It is expected that students will... demonstrate a willingness to work co-operatively when using information technology tools [Information Technology]" (British Columbia Ministry of Education, 2000, p. 208).

Box 41. A learning outcome to "interact and co-operate with others" for grade K-3

Criteria for choosing software. Donna's criteria for choosing software are based on her previous experience with her daughter, who is now in high school. When she used to buy her daughter software for children, she would typically observe how her daughter used the software, and used this as a reference for judging the quality of specific software. Donna believes that it is necessary to choose software that engages children. She has noticed that software that was too simplistic lost its novelty quickly, and her daughter grew bored. Conversely, Donna has found that her daughter found more interactive software to be more interesting:

...for instance those early books that would read a story to them like... "Nicolai's Trains" ((an interactive story)) is one of the early ones that was a book on a CD that you could buy. Well before the day was out, she was bored with that because it read her the story a couple of times and that was it. But you see the difference between Starfall ((www.starfall.com, a reading site)) and the Nicolai story was that you can click on individual words and have them read to you, or each sentence, or each page. Also the pictures were graphically better and there are way more stories to choose from; it wasn't just one story. At Starfall they keep adding more stories plus there are... games with phonics and comprehension questions.

Donna also believes that software that incorporates multiple subjects, such as the "Jump Start Series" is valuable because it provides children with

...a variety of things... math... reading and phonics... spelling... practice drills in each of the subject areas, and there is so much content on one CD that... months

would go by and she still hadn't explored all that there was to explore. So, multiple areas were touched upon.

Donna believes that good software requires students to think. She does not favour game-like software such as "Math Blaster" (math game software), because she feels that these types of games do not encourage student thinking because

...the kids keep clicking... they are not really thinking about what was that equation... They're just wildly putting guesses and clicking and clicking and not even looking half of the time at what the answer was and if it was correct. They'd just click any number and... finally it would proceed to the next equation... so they'd just try all the numbers... but they are not really learning the math skills... whereas other programs are designed a little bit different where you know they can't just click... it won't let them go until they've really read over and looked at what it was they were supposed to learn.

Donna also feels that it is better to use software that incorporates multiple senses so as to address the different ways children learn. She prefers software that incorporates not only text or pictures, but also auditory components.

Donna likes to visit the website "Starfall" (<http://starfall.com>), a site to help students learn to read, with her students. She values "Starfall" because it provides various activities depending on students' reading level: beginner readers can choose the early levels, and advanced readers can choose higher levels. She notes that

...it gives them practice in a fun way that they are in control of. Instead of having a book in their hand, they've got a mouse in their hand... they can be interacting with those stories all on their own and, not being held back by, not knowing a word. The student is able to control if they want to read a story independently, a

story at their level, or can have a story at a more advanced level read to them, and enjoy the story...

Donna describes how students can choose to listen to how the sentences are supposed to sound while they read a story at this site by clicking on it:

it reads the story and as it's read, the sentence or the word is highlighted as they say it so that they can connect the word that is written to the word that is spoken, "Oh that's the word 'they,' that's the word 'can', that's the word 'run'..." then afterwards they can just click on the word "have" and it will say the word "have" for them, so they get the auditory and the visual simultaneously, which is what happens in your brain whether you read out loud orally, or silently... (see Figure 28))

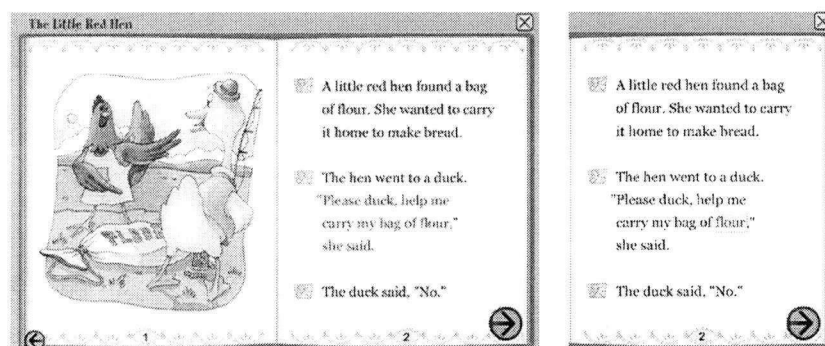


Figure 28. "The Little Red Hen" story from <http://www.starfall.com>

Donna believes that the auditory component of this online reading program facilitates children's reading. She believes that ESL students in particular, can benefit from this online learning tool, as it can help them learn how the sentences should flow and how the words should be pronounced. Donna explains that

...with a lot of ESL children, what happens is they don't know the flow of the language... how it's supposed to sound. And they'll be choppy with their reading. Whereas, at the website, they're hearing it... how it is supposed to flow and sound.

The more they just hear the language... the more they can emulate the language, they need to hear it often in order to replicate the language.

Even though Donna feels that "Starfall" is a very good site, she explains that the district Primary Department does not support the use of this site because they have categorized it as a 'drill-and-kill' site. She objects to the districts designations of 'drill-and-kill' software in general, and the "Starfall" site in particular, as illustrated when she says that

...they didn't think that it was a useful site because they said it was "drill-and-kill." And, a few of us were discussing it and thought, well in any language arts, if you're teaching children to read or write, you'll have to "drill-and-kill" them They need to practice. We send home reading every night in order for the child to practice, practice, practice.

In her opinion, drill-and-practice is important in helping children develop skills, and one way they can do so is by using this site; however, she acknowledges the danger of using computers for long periods of time, and believes that it is important to have a balance between various kinds of activities.

Classroom Practices

Class taught. Donna reports that her class is fairly dynamic, and the composition of the students changes during the academic year. This year, she notes that she began with 21 students in September, consisting of 11 grade-two students and 10 grade-one students. When the interview took place in June, Donna had 18 students, seven of which were grade two, and 11 who were grade one. She describes that about 60% of the students speak English as their second language.

According to Donna, the variability in class size is typical of schools in the north end of the district, particularly because some parents bring their children back to their

home country for a couple months during the academic year. She thinks that this phenomenon "*slows everything down... You just cannot cover the amount of the curriculum that you had intended to.*" She explains that when new students come in the middle of the year, they do not know the rules that have been established in the class, and may do things differently than they are supposed to. For example, she explains how the new student who joined the class in May, completely changed her class dynamics and triggered disruptive and challenging behaviours among other students; thus, making it difficult for her to assess her students for final report cards.

Donna describes that this year in particular is a tough one for everyone at the school because the school year started later than usual. Second, she describes that traumatic events, such as the death of a staff member and of a student, have interfered with the atmosphere at the school this year and people found it hard to concentrate. Her students, in particular, have exhibited challenging behaviours such as slapping each other, or calling each other names.

In addition to unexpected events at the school, Donna admits that teaching ESL students is a challenge. She relates her observations of a unique English dialect that has developed among some of her ESL students, a dialect she finds difficult to understand. Donna feels that it is harder to teach ESL students to read and write, particularly because they do not understand rhymes, which is essential for their vocabulary. She suspects that these students do not understand rhymes because their parents do not expose them to nursery rhymes, and that these students learned English incorrectly at home. For example, she has observed that these students cannot pronounce some-sounds correctly:

Computer facilities. According to Donna, when she first came to the school, she brought two PC computers and a printer to use in her classroom. She notes that these computers are not connected to the Internet; thus, limiting their usability. Additionally,

she has recently acquired a new Macintosh computer from the school, to be used in the classroom. This computer is connected to the Internet, but Donna explains that she has not had a chance to use it with her students because she is not yet familiar with the computer.

In addition to the classroom computers, Donna explains that the school has a computer lab, a set of mobile wireless laptops that can be signed out for classroom uses, and some old computers in the school hallway. Donna notes that her major problem with the computers in the lab lies in the inconsistency of computer versions. She explains that there are three different generations of Macintosh computers in the lab, each of which has its own version of software. She feels that having different versions of software makes it difficult for her to teach, since the appearance of the software in some computers is different from that of other computers.

Since there are both Microsoft Windows and Macintosh platforms in Donna's classroom computers, the software available in the classroom consists of PC software and Macintosh software (see Table 5). She notes that a number of programs are compatible with her PC computers because she had originally purchased this software for her daughter. Donna explains that in the computer lab, the available software depends on the version of the computer. For example, newer computers have iMovie and GarageBand; however, AppleWorks and KidPix are available on all the computers. Donna notes that she decided to use AppleWorks most frequently, because she thinks that with this software students can do a lot of things, including writing and drawing.

Table 5. Types of software available for Donna's students

Type of software	Examples of software (PC)	Examples of software (MAC)
Word processing	Amazing Writing Machine*	AppleWorks
Reading	ReaderRabbit*, Chicka Chicka Boom Boom*, and Kid Phonics*	All The Right Type (typing)
Math	Math Rabbit*, Millie's Math House*	n/a
Drawing or graphic	Colour Magic*, Paint*, KidPix*, and Inspiration*	KidPix
Internet browser	n/a	Safari and Internet Explorer
Topical readings	Magic School Bus* and Jump Start Series*	World Book (encyclopaedia)

* Software that belongs to Donna

Classroom computer uses. According to Donna, during the first term of the academic year, the computer labs throughout the district experienced login problems, and the computers could not be used. Donna describes that her class did not have computer lab times until January, when a new system was installed and the computer labs began to function properly.

Donna explains that since the computers have worked properly in January, the class has visited the computer lab once a week for 40 minutes. In addition to that, Donna describes that she would allow students who finished their work early to use the

classroom PC computers. The Macintosh computer had just arrived and Donna notes that she was not ready to use it with the students. She plans to start using the Macintosh in the next academic year and allow her students to take turns using the computers for writing journals or checking for information on the Internet. According to Donna, in previous years, she would occasionally use the computer as a centre activity during centre time; however, due to behavioural problems in her classroom, she does not use computers as centre activity this year.

Pedagogical practices. Donna notes that her computer-related goal for her students focuses primarily on student mastery of basic computer skills. She notes that when students use a program for the first time, she will *"walk them completely through it,"* later, when students have familiarized themselves with the computer, they can work independently. For example, she describes that when the students used the Internet for the first time, she first taught them each step they needed to perform; as time passed, she just gives them a list of the sites that they can go to. Donna illustrates how she sometimes does *"guided computing"* to help students follow her instruction when she teaches new skills, where:

...I get in between... with two people on either sides of me... there will be about five children in a row, and I will just say, "everybody watch, we are doing this at the same time. And so I'll say okay, we're clicking on... this. And then we click up there, and now we're going to type... "www." and I can get all five going at the same time. So it is almost like a guided reading type of activity... we're kind of guided computing.

To facilitate this process, Donna notes that she usually arranges the seating plan, so that

...I will have my slowest person surrounded by people who are capable so that when I do those kinds of things that the students... can follow along and type in what we need to and click until they get to where it is that you want them to be.

She explains that, by doing it this way, she can model the skills that students need to learn, and make it easier for students to watch her and then perform the steps themselves.

Donna reports that she engages her students in two types of computer activities during computer lab times: project-oriented activities and free exploration time. When the class is working on a project or a theme, Donna will ask students to follow her instructions. For example, she asked them to draw an Easter egg on the computer and write about it, or she will occasionally have her students access the Internet to find information related to the class theme. For instance, Donna illustrates that when the class was learning about butterflies, she took them to visit an Internet site about butterflies.

Donna notes that when students have done a satisfactory job on their work, she will print two copies of the work and place one copy in the class book for the associated theme, and place the other in the student's portfolio. In order for their work to be printed, Donna expects her students to produce good quality work. She states that, *"of course... you don't let them print just anything... it is a privilege to be able to print a piece of paper off... if the assignment is not done in an acceptable manner, they won't get to print it. So they do try hard."* Figure 29 shows a class book on Easter egg, while Figure 30 shows a class book on butterflies.

computer software should be engaging, encourage thinking, and incorporate multiple areas. In her classroom practice, she focuses on teaching students basic computer skills as well as providing times for free exploration.

Cross-case Analysis

The teachers in this study shared similarities and differences in their academic background, work experience, beliefs about primary students and computers, and classroom practices. This cross-case analysis presents both these similarities and differences, and compares the beliefs the teachers hold with pragmatic claims provided in public knowledge resources exerted by early childhood organizations and related research reports.

Background Information

The teachers who participated in this study have taught primary grades for many years. Ann, Beth, and Claire have taught primary grades more than 25 years, while Donna has taught for 10 years. All of the teachers received a post baccalaureate diploma in teaching technology from the same university. Claire and Donna completed the program approximately three years ago, while Ann and Beth completed the program over six years ago.

Ann and Beth are known in their districts as computer experts, in that they have facilitated workshops to help other teachers incorporate ICTs in their classrooms. Ann and Beth reported higher computer uses, in terms of the frequency and the variety of their computer uses with their students, as compared with Claire and Donna. Moreover, in addition to taking their own students to the computer lab, they both took an additional primary-grade class to the computer lab to expose more primary students to computers. Thus, Ann and Beth facilitated the computer lab activities four times a week in total: two of which were spent with their own students, and two of which they spent with the

students from another class. On the other hand, Claire and Donna reported less experience with using computers with their students and reported using the computer less, whether it be in the lab or in the classroom.

Beliefs about Learning

Beliefs about primary children's learning. All of the teachers believe that primary-grade students have a high level of enthusiasm. Donna, in particular, believes that due to the enthusiasm of primary students it is necessary to introduce them to a variety of activities, including using computers. All of the teachers believe that specific activities or situations can help primary students learn better, that practice is important for mastering skills, and that activities should be fun and engaging. In addition to this, they feel that students have different styles of learning, and that it is important to address each of these learning styles when teaching. The belief of catering to students' different "learning styles" is continuous with the B.C. Ministry of Education's position (2000) about the existence and importance of "learning styles."

Aside from these common beliefs about how primary students learn, there are variations among teachers' beliefs about how children learn. Each teacher discusses the importance of using manipulatives. Compared to the recommendation of the early childhood education organizations about the importance of using manipulatives and structuring lesson plans to move from concrete to abstract materials (British Columbia Ministry of Education, 2000; NAEYC & NAECS/SDE, 2003), the emphasis that the teachers place on manipulatives or concrete objects varies. Claire and Ann both place greater importance on manipulatives than do Beth and Donna. Claire explains that it is essential to use manipulatives when introducing mathematical concepts. She also prefers to use books and educational toys rather than using the computer with her students. Ann also feels that manipulatives are necessary, particularly for teaching new concepts and for

teaching math. However, Ann believes that it is more important to consider the order in which materials and activities are used. She feels that teachers need to use manipulatives in the beginning; however, once the students grasp the concept, they are able to move on to learning the concept more abstractly using computers. Beth and Donna, on the other hand, state that manipulative activities at the computer can be as good as manipulating real objects. Beth feels that using manipulatives is particularly important for helping kinaesthetic learners; in line with Ann's statement, she believes that once students have experienced the real object, manipulative activities at the computer can be as good. Donna thinks that with the exception of learning the one-to-one correspondence of counting, the use of manipulatives is not superior to the use of computers. She also highlights that with the use of computers, she does not use manipulative objects with her students as much as she used to.

The emphasis on the importance of using concrete objects with primary students corresponds with Piaget's theory of cognitive developmental stages (Piaget & Inhelder, 1969), which states that before the adolescence period (11 or 12 years old), children are not likely to be able to understand abstract concepts; rather, their understanding of concepts needs to be directly related to concrete objects. Yelland (1999), Clements and McMillen (1996) argue that the issue of using computers versus using manipulatives calls for a redefinition of the term "manipulatives." They argue that when using certain software (e.g., LOGO, KidPix), children are able to do manipulative activities with the available tools. For example, with LOGO, students can manipulate a "turtle" to move to certain directions, whereas with KidPix, students can apply various colours and patterns to their drawings, or move objects on the screen from one spot to another. In the same manner, Beth points out that she uses the software "Math Circus" to allow her students to

match colours and shapes, and she feels that using this software is as good as manipulating real objects.

Beth and Claire believe that the attention span of primary students is limited; as such, they argue that it is important that teachers continually vary class activities to refocus student attention. This argument is continuous with the recommendations made by the B.C. Ministry of Education (2000) about the importance of considering "children's attention span and capacity for sustained focus" to develop effective instructions (p. 153). Both teachers also feel that in order to learn effectively, primary students require support, both academically and emotionally. Beth and Claire illustrate how they usually provide the support for their students; for example, at the beginning of the year, Beth usually helps her grade-one students to remember their last names to prepare them to login to the computers, while Claire gives students reassurance that it is normal to make a mistake. However, both teachers note the importance of gradually raising their expectation for students to take responsibility for their own learning.

Overall, the teachers in the study hold relatively similar beliefs about the characteristics of how primary students learn. Their beliefs are continuous with the recommendations made by the B.C. Ministry of Education (2000) or NAEYC and NAECS/SDE (2003), including their beliefs about the existence of various learning styles, the importance of practice and support, and the importance of adjusting the lesson to match the students' attention span. In addition, the teachers believe that using manipulatives is important, however, the degree of importance that is placed on manipulatives varies.

Beliefs about the roles of primary teachers. All of the teachers in this study believe that it is important to respond to the individual needs of their students. Ann and Beth, in particular, feel that their roles are very important in the classroom in order to help

students develop their skills, particularly their literacy and numeracy skills. Ann, Beth, and Claire, emphasize the importance of assessing and evaluating their students so as to further develop the skills of each student and understand the areas of the lesson that each student may have had difficulty mastering. Their emphasis on the importance of assessment and evaluation is consistent with the suggestions of the B.C. Ministry of Education (2000) and the NAEYC and NAECS/SDE (2003).

Claire and Donna feel that they face more problems nowadays in their classrooms compared with the problems in the classrooms they had in the past. They point out to the increasing number of physical and social problems of their students. Claire particularly illustrates the increasing pressure that she feels in the classroom due to the problems that students have, and the inclusion of special needs students in the regular classrooms, often without any aid or teaching assistant. She feels that dealing with special needs students decreases her actual teaching time, and that it can be very exhausting. Donna points out that the behaviour problems in the classrooms can present difficult situations for her; for example, she illustrates how a student's misbehaviour can trigger other students' misbehaviours and then make it difficult for her to manage the classroom or assess individual students.

Ann, Beth, and Donna stress the importance of encouraging students to learn from one another; a belief that is continuous with the B.C. Ministry of Education's position (2000) that social interaction is critical for student learning. Ann also feels that encouraging students to interact with their peers is important for students' future employment because she believes that employers usually look for employees who are able to work well with others. She explains how she tries to encourage her students to collaborate with each other by assigning them to work at the computer in pairs. In the same manner, Beth describes how she encourages students to use each other as resources,

and to look at each others' work at the computer. Donna also explains that she prefers to choose activities where the students can interact with one another; however, this preference does not apply when it comes to computer activities.

In summary, all participants agree that the role that teachers play in catering to the individual needs of their students is important; a belief that is continuous with the recommendations of the B.C. Ministry of Education (2000) and NAEYC (2003). Some teachers emphasize the importance of assessment, evaluation, and cooperative learning in primary classrooms. These principles also apply for classroom computer use, with the exception of Donna, who does prefer to have her students work independently at the computer.

Beliefs about Developmentally Appropriate Computer Uses for Primary Students

Regarding the use of the computers in general, all of the teachers, with the exception of Beth, believe they can still achieve all their learning outcomes in the absence of computers. Although all the teachers emphasize the presence of computers in the daily lives of children, the importance they place on introducing computers at the primary level varies. According to Donna, the earlier children are introduced to computers, the better their future will be. Moreover, she believes that children who learn about computers later on in their life will have trouble catching up. In contrast, Claire stresses that the use of computers is not a basic element at the primary level, and that students will still be able to master computer skills in later grades, even if they had not learned these skills in their primary grades. Despite this belief, however, Claire does feel that introducing computers at school will help students to use computers for educational purposes rather than solely for game playing. This belief is also shared by Ann.

All of the teachers believe that the use of computers is associated with positive as well as negative impacts on primary children. Ann and Beth, in particular, emphasize that

it is not computers per se that will have positive or negative consequences on children, but it is the way in which the computers are used that can bring about consequences on children's learning. For example, Ann describes that computer uses will contribute to students' learning when the computers are used as a tool to achieve the learning outcomes. In addition to this, Beth suggests that using the computer for drill-and-practice exercises will not significantly impact student learning, whereas more creative computer activities, that incorporate the use of open-ended software such as drawing or creating slide shows with KidPix, or writing with KidWorks, will encourage higher level of thinking and a higher sense of accomplishment among students. All of the teachers note that the familiarity that the teacher has with the software is critical for effective computer use. Moreover, Claire and Donna specifically explain that the reason they do not use certain software is because they are not familiar enough with them.

The teachers in this study outlined a number of beneficial impacts of using computers in their classrooms; however, the beliefs of computers' beneficial impacts are not necessarily consistent among teachers. Overall, the teachers in this study feel that computer use in the classroom is beneficial because they provide current resources and information, improve student motivation, improve the quality of student work, increase students' sense of accomplishment, improve literacy skills, provide a medium for practicing skills, and balance class participation.

Teachers consistently argue that the computer is valuable for providing them with resources. They also note that the use of the Internet provides their students with up-to-date information. Second, the teachers feel that using computers is very motivating for students. They have all observed that, when working at the computer, students tend to stay on task longer than when they are working off the computer. For example, Ann, Beth, and Claire, describe their students as being more willing to do their phonics

exercises at the computer rather than doing the same exercises with paper and pencil. Consistent with NAEYC's statement that "computers are intrinsically compelling for young children," (1996, p. 2), the teachers believe that the auditory and visual components of computer software are appealing to the children, and motivate them to stay longer at the computer. Third, the teachers feel that the work the students complete at the computer looks better than the work they create using pencil and paper. They argue that the aesthetic appeal of creating something beautiful over the computer increases the students' sense of accomplishment. Claire emphasizes that computers can serve as an "equalizer" for students' work, where students with lower ability are still able to create beautiful products at the computer, despite their disabilities such as their fine motor problems. This belief is also shared by Donna, who further notes that computers can help integrate special needs students into the classroom and help students to consistently produce good quality of work despite their temporal mood. Furthermore, Ann and Beth point out that students can write more at the computers. Ann and Beth emphasize how the computer can help develop the writing skills of students by reinforcing the finger spacing between words; Beth further describes that she can reinforce the students' uses of lower case and upper case letters in their writing, by encouraging them to use the "Shift" key at the computer. They also value the picture-word bank in their word-processing software, Talking First Words (Ann) and KidWorks (Beth), for helping students find the words they want to use in their writing. Beth, specifically, emphasizes the role of the picture-word bank as helping to scaffold her students' writing, and how her students can produce significantly more at the computer. In the same manner, Claire also states that using the picture bank in Kidspiration provides the students with visual cues for planning their writing. According to Claire and Donna, the visual cue of certain computer software is also useful for helping ESL students and visual learners. The potential for using

computers to scaffold young children's writing is also supported by recent research with grade-one and grade-two students (Englert, Manalo, & Zhao, 2004). In this study, students were reported to write significantly more, use significantly more writing conventions (e.g., the use of punctuation, periods, or capitals), and organize their writing better when they use a web-based software compared to when they use paper and pencil (Englert, Manalo, & Zhao, 2004). Furthermore, the teachers' statement that the students' writing can be enhanced by means of computers is continuous with Vygotsky's (1978) notion of "zone of proximal development," which implies that, with the assistance of others, children can achieve a level of accomplishment that is higher than what they can achieve independently without any assistance.

Fourth, the teachers believe that using the computer is beneficial for helping students practice the skills they have acquired through classroom instructions. Ann and Donna, in particular, explain that using the computer can help them vary the difficulty level of exercises, and therefore, match the exercises with the ability level of their students. Ann and Claire note that using computers can be an alternative medium for learning that can reduce students' boredom of performing the same exercises with paper and pencil. Finally, Donna feels that the advantage of using computers can help balance participation in the classroom where each student can work at their own pace, compared to a whole group classroom instruction, where the bright students usually dominate in answering the questions and some students do not get the opportunity to express their thoughts.

Ann and Beth stress that computers can be used to help deliver the curriculum and meet the learning objectives. Both teachers state that having more time with the computers would enhance their lessons. Furthermore, Ann she feels that having more

computers in the classroom can speed up her curriculum. In contrast, Claire and Donna feel that they cannot have more computer time because they must cover their curriculum.

The teachers agree that using computers for long periods of time can have negative impacts on children by supplanting children's other activities, including physical activities (Ann, Beth, and Claire) and social interactions. Ann, Beth, and Claire explain that using computers for a long time can bring on a number of physical problems, such as visual problems, sore thumbs, or diabetes. Claire, specifically, points out that the number of physical problems experienced by children, such as diabetes, is a result of the decrease in time children spend doing physical activities and the increase in time children spend watching television and using computers. Her argument is continuous with the recommendations of the American Diabetes Association for limiting the amount of sedentary activities, including television viewing and computer use, and increasing physical activities for preventing the development of obesity and diabetes (American Diabetes Association, 2000). In addition, Cordes and Miller (2000) summarize the potential problems of prolonged computer use, including physical hazards, such as repetitive stress injury, eye strain, obesity, and electromagnetic radiation; as well as social hazards, such as social isolation and commercial exploitation. However, some studies also show that computer uses can help promote cooperative learning and interactions among students (Freeman & Somerindyke, 2001; Svensson, 2000). In the same manner, Beth notes that during the computer lab times, her students do interact with one another. Furthermore, Claire notes that the extent in which computer use brings negative impacts on children's social interactions depends on the child's personality; she notes that children who have less social skills have higher tendencies for using computers for a long time to avoid social interactions with their peers.

Regarding the issue of high computer usage among children, all of the teachers note that this is more a parental or home issue rather than a school issue. They feel that the way computers are used at their schools will not bring any harm to the development of their students. In addition to all this, all the teachers believe that the computer skills the teachers possess are important for effectively using computers in the classroom. Beth, in particular, believes that as long as computer use in the classroom is facilitated by a skilled teacher, there will not be any negative impacts for students. She notes that teachers with less computer skills are more likely to use closed-ended software such as drill-and-practice software rather than open-ended software. She further describes that, due to the stereotype of female being less comfortable with computers than males, there is a lack of primary teachers who are skilled with computers. She feels that it is necessary to encourage primary teachers to improve their computer skills.

Claire and Donna explain that technical problems in the computer lab can bring frustration for both students and teachers. Claire describes computer lab episodes where some of her students cried when they experienced problems with the computers; for example, when they missed some of Claire's instructions and got behind with the task. She explains how the problems can create frustration for her, especially because she feels that the students require one-on-one assistance, whereas she does not have any assistant in the computer lab. Donna also states that the different versions of the software in the computer lab make it difficult for her to instruct her students.

In summary, all the teachers agree that computers are a part of the students' world; however, the teachers vary in their beliefs on the importance of introducing computers in primary grades. All the teachers believe that computers can have both beneficial and detrimental influences on children's learning, and some of these beliefs are continuous with the positions of the NAEYC (1996), the American Diabetic Association (2000), or

other research reports (Cordes and Miller, 2000; Englert, Manalo, & Zhao, 2004). Ann and Beth emphasize that it is the way computers are used, and not whether the computer is used or not, that makes the difference in how influential the computer will be in facilitating how children learn. All the teachers stress the importance of teachers being familiar with the software in order to effectively teach children with the computer.

All of the teachers believe that computer use should be adjusted to the students' level of ability. For example, they explain that in choosing Internet sites for their students, they will look for sites with large fonts and good pictures. Claire further stresses that the amount of information presented on the website should not be in excess so that students will not feel overwhelmed. In addition to this, Beth describes that she uses the prescribed learning outcomes for the grade she teaches as a standard for judging the appropriateness of computer uses. In line with Beth, Ann also describes that she uses the IRPs to inform her about the learning outcomes that the students need to achieve, and further makes decisions about the best tools she can use to achieve these learning outcomes. These beliefs are continuous with the B.C. Ministry of Education's recommendation (2000) that using a variety of media can support students' learning by catering to various learning styles, and NAEYC's statement that, "Educators must use professional judgment in evaluating and using this learning tool appropriately, applying the same criteria they would to any other learning tool or experience" (NAEYC, 1996, p.1). Ann further adds that it is important to ensure that, when teaching new concepts or math, concrete materials should be used first before using computers. Ann, Beth, and Claire believe that the computer use should be integrated into the curriculum, which is continuous with the recommendations made by NAEYC (1996).

All of the teachers believe that it is important to supervise their students when they use the computer. They also feel that the access their students have to the computer

should be limited. According to Ann, Beth, and Claire, there is a maximum time primary children should be permitted to use the computer. Beth further notes that children's access to computers needs to be limited because they need to engage in activities that are appropriate to their limited attention span. Ann and Beth feel that 30 minutes per day is enough, while Claire believes 30 to 60 minutes per day is ample. Donna also feels that it is important to limit children's access, but she does not indicate a specific time limit. While there are no recommendations given by the B.C. Ministry of Education or NAEYC, the belief that the amount of time children spend on the computer should be limited is continuous with the recommendations of the American Academy of Pediatrics (AAP, 2001), which states that children should be given a limit of 1 or 2 hours of screen time per day, which includes the time they spend in front of the television, videos, computer, and video games.

Ann and Claire believe that computers should not be used to teach new concepts. Rather, they should be used either to practice newly acquired concepts or skills, or to present what students have learned. Regarding the use of computers for practicing skills, Beth and Donna value the use of drill-and-practice software, because they provide the exercises that students need to practice their skills, they are interesting for students, and are cost efficient for the school. Beth, however, does believe that teachers should limit the amount of time they use drill-and-practice software (up to 15 minutes per day). She notes that the use of these types of software, especially those with sound and visual stimuli may lead students to use the computer longer than what is appropriate for them; thus, reducing the amount of time they have to use open-ended software. These beliefs are consistent with the findings of an experimental study conducted by Haugland (1992), where children who use drill-and-practice software were shown to stay at the computers three times longer than children who used software that was rated as developmentally appropriate

using the Developmental Software Scale created by Haugland and Shade (1988). Moreover, Haugland reported that, while the children who used drill-and-practice software regularly for seven months produced higher scores in concentration and short term memory test, they produced lower scores in creativity tests when compared to their initial scores at the beginning of the study. She suspected that these children became passive reactors to the software and became captivated by the drill-and-practice software so that they spent significantly more times at the computers and obtained lower scores on creativity.

With respect to Internet use, all of the teachers agree that it is not safe for primary students to perform Internet searches. Ann and Beth describe the dangers of encountering pornographic materials when students search the Internet, and they explain how easy it is to encounter inappropriate materials on the Internet. Their concern is supported by the results of a national survey of 10- to 17-year olds in the United States who use the Internet regularly (Finkelhor, Mitchell, & Wolak, 2000). The survey reveals that one out of four respondents report that they encountered unwanted exposure to pornographic pictures on the Internet (Finkelhor, Mitchell, & Wolak, 2000). Moreover, Ann feels that computers should not be used as a reward, or to be viewed as a toy. Instead, she feels that teachers must encourage children to view computers as educational tools, such as for finding information related to class lessons.

In summary, all the teachers believe that in order to be appropriate, the computer should only be used under certain circumstances: they should be adjusted to the students' abilities, integrated into the curriculum, supervised, and limited by time frames. Some of these beliefs are continuous with the recommendation provided by the NAEYC (1996), the B.C. Ministry of Education (2000), AAP (2001), or research reports (Finkelhor, Mitchell, & Wolak, 2000; Haugland, 1992).

Criteria for choosing software. All of the teachers feel that software that has multi levels, which can be used by students with various levels of ability, is valuable. This is consistent with Shade's (1996) recommendation to use "low entry, high ceiling" software that can be used by young children with limited level of abilities as well as by more mature children with developed abilities. Ann and Beth emphasize that, in general, open-ended software, which is not restricted to a limited subject area or skill level, is better than software that is only limited to certain subjects or skill levels, or software that requires specific answers. Ann illustrates her use of word processing, and Beth describes her use of KidPix with the students as examples of their use of open-ended software. However, they do value and make use of software that is more specific for helping students practice basic skills (e.g., phonics, math) or learn about specific subjects (e.g., spiders, dinosaurs). The teachers' preference on the use of open-ended software is supported by Shade and Haugland's criteria of developmentally appropriate software (1994).

In addition to open-ended software, Ann and Donna note that it is important to use software that requires students to think before responding to the software. For example, when students are writing with a word processor, they will need to think about what they are going to write; whereas according to Donna, when students are using some software, such as Math Blaster, they tend to randomly clicking on any answer to get points more quickly. Ann and Donna do not favour game-like software that requires students to collect as many points as possible. They believe that these types of games do not encourage student thinking, and that students would be caught up in the spirit of collecting as many points as possible rather than learning the associated skills. In contrast, Beth prefers the reward features of some software. She feels that these extrinsic rewards motivate her

students to practice their basic skills. Beth acknowledges, however, that this kind of software focuses on lower level of thinking, and therefore should not be used too much.

When it comes to the content of software or Internet sites, Ann and Beth emphasize the necessity of avoiding software with violent content. They feel that violence can be detrimental to children. Beth, specifically, explains that it can desensitize children to violence, while Ann emphasizes the importance of predicting the kind of attitudes that the students might learn from interacting with such software. These beliefs are continuous with the recommendation made by the AAP (2000) and the NAEYC (1996) which state that media violence is harmful for children, and that adults are responsible for protecting children from media violence, including violent software. Furthermore, the teachers point out the importance of being cautious of pornographic sites. To help adults choose software for children, AAP recommends using the software ratings assigned by the Entertainment Software Rating Board, ranging from "Early Childhood" software that does not contain any inappropriate materials, to "Adults only" software that may contain violence and sexual content (AAP, n.d.). Aside from violence and pornographic content, Beth also tends to avoid commercial software because she feels that this kind of software will only be popular for a limited time period, and according to her experience, commercial software usually do not meet her criteria for good software.

Ann and Beth illustrate that their subscriptions to computer-related magazines or mailing lists help them to stay current with computer-related news and its application to classroom practice. They also describe that the B.C. Ministry of Education provides teachers with recommendations for software, but the teachers do have some concerns about these recommendations. Ann explains that the recommended software list consists primarily of software that requires a Macintosh platform, and therefore does not fit the needs of her district, which is equipped primarily with computers with Microsoft

Windows platforms. In an attempt to remedy this problem, a committee in her district has been formed to adapt the recommended software in the original IRPs or Primary Program, from the Macintosh version into the Microsoft Windows version. The recent B.C. Ministry of Education documents such as the IRP for Science K-7 (2005), however, contain the software that is available for both Macintosh and Windows platforms. Beth thinks that the B.C. Ministry of Education recommended software is usually out of date, because the document is not issued as frequently as the development of computer software. For example, the software recommended in the current IRP for English Language Arts K-7 (British Columbia Ministry of Education, 1996a) is mostly from the year 1994 and 1995. Most of the software used by the teachers in the study (e.g., KidPix) is not listed in the recommended software in the IRPs, with the exception of KidWorks 2, Wiggle Works (British Columbia Ministry of Education, 1996a) and Millie's Math House (British Columbia Ministry of Education, 1995c). In addition, Chicka Chicka Boom Boom is listed in the grade collection online learning resource for English Language Arts published in 2001 on the B.C. Ministry of Education website (http://www.bced.gov.bc.ca/irp_resources/lr/resource/gradcoll.htm).

In summary, all of the teachers value the use of software that is multilevel and open-ended. Some teachers are concerned with the effect of game-like software on student learning, and advise the use of this kind of software with caution. Some teachers are mindful of the dangers of encountering pornographic material on the Internet, which is supported by NAEYC (1996) and AAP (2000). They also discuss the usability of the B.C. Ministry of Education recommended software list.

Classroom Practices

Classes taught. Overall, the teachers in this study have 18 to 23 students in their class. Ann and Beth have one student with special needs, and therefore, have a teaching

assistant. Donna must deal with the challenge of teaching a class where the student composition does not remain constant (i.e., some students leave in the middle of the year, while new students come in) and where several students have behavioural problems. Donna explains that due to the misbehaviour of her students, she does not use the classroom computers as much as she used to.

Computer facilities. In addition to the computer facilities provided by the schools, Ann and Donna, and Beth bring supplemental software from home. Furthermore, Ann and Donna have also supplied their classrooms with additional computers. Ann and Claire note that the computers in their classroom, which are old, do have problems. However, they differ in their decisions whether to use these computers or not. Claire chooses not to use the old computers as frequently because of the problems they have, such as the problem to save a document, or the problem to connect to the Internet. Ann, on the other hand, continues to use the older computers daily with her students. She notes that with her computer expertise she is able to troubleshoot any computer-related problems that may arise.

Donna and Claire both describe the difficulties they experience in their computer labs. The computer labs in Donna's district had problem with the login system for the first half of the academic year, while the computer server in Claire's district lost the data at the beginning of the academic year and had to use a new system. Beth, who is in the same district as Claire, does not discuss the problems her district experiences; rather, she explains that compatibility or network problems will always exist. She also feels that today's networks are improving, and teachers do not need to worry about it.

The software available for and the software used by the teachers vary. Claire and Donna use two types of software, in particular, AppleWorks and KidPix. Ann and Beth, on the other hand, use a variety of different software throughout the year. Beth limits her

students' access by means of a software manager, whereas Ann, Claire, and Donna do not apply such automatic restriction to student computer access. Regarding software availability in the computer lab, Donna notes that she has difficulties because there are various versions of software (e.g., various versions of AppleWorks that have various appearances) available in the computer lab.

In summary, the availability of computers in the schools and classrooms where the teachers work varies in term of the platform, the number, and the age of the computers. It is interesting to note that the teacher who reported using computers most frequently was the teacher whose classroom computers were older compared to those of the other teachers; which implies that having less updated computers does not necessarily prevent teachers from using the computers with their students. All the teachers have access to various kinds of software. Ann and Beth, who are known as computer expert teachers, reported their uses of various kinds of software with their students, but Claire and Donna, who reported to have less computer experience, decided to focus on only two kinds of software.

Classroom computer uses. The amount of the time the teachers spend using computers with their students varies. Ann and Beth take their students to the computer lab twice a week for a total of 80 minutes per week, while Claire and Donna take their students to the computer once a week for a total of 40 minutes per week. In addition to taking their students to the computer lab, Ann and Beth use their classroom computers each day to search for information on the Internet, to schedule activities, such as reading at the computer (Ann) or centre times (daily for Beth, and twice a week for Ann), and to assign optional activities to students who have completed their daily tasks (Beth). Furthermore, both teachers continuously seek opportunities to spend more time with the computer. For example, Ann tries to sign out a class set of mobile wireless computers

from the school district to use daily with the WebQuest project, while Beth keeps an eye out for classes who might not be using the computer lab during their scheduled time period, and books her class to use the computer lab during this now available time slot. Both teachers value the opportunity to have more computer times; for example, Ann indicates that having more computers in the classrooms can speed up her curriculum, whereas Beth believes that with her computer expertise, she can think of "*almost anything*" to use the computers to improve students' learning.

On the other hand, Claire feels that spending time in the computer lab once a week is enough for her students, and she does not find it necessary to increase the amount of time they use the computer. As with Donna, although she feels that she would like to have more computer times, she points out that she is concerned with the amount of curriculum that she has to cover, the misbehaviours that exist in her classroom, and that she has not been able to find a way to have more computer time. For example, she explains how she is not aware of how to sign out the school's laptops because this is her first year teaching at the school. Claire and Donna also point out that they cannot use the computer more because of the amount of materials that they need to cover throughout the year. They also indicate that they do not use computers for certain activities either because they are not knowledgeable about good software for those activities, or because they are not familiar enough with the software at their schools that can be used for those activities. Familiarity with the computer is another issue. For example, Donna notes that she is more familiar with software that operates under the Microsoft Windows platform. She notes, however, that not all software with Microsoft Windows platform that she considers good is available for Macintosh, which is the platform that her school is using. She also notes that her lack of familiarity with the new Macintosh classroom computer dissuades her from using it with her students this academic year.

In summary, the teachers in this study use the computer at least once a week, however, there is some variance in that some teachers use the computer twice a week and attempt to integrate computer use into daily class activities, while other teachers feel that using the computer once a week is plenty. Ann and Beth express their wishes to have more computer time to support their students' learning; however, Claire and Donna note that their lack of familiarity with some software and computers dissuades them from using the software with their students.

Pedagogical practices. The teachers vary in the way they organize their computer activities. Compared to the other teachers, Ann seems to integrate more computer use into her daily class schedule. Everyday Ann assigns a portion of her students to perform tasks at the computers, such as reading or practicing math. Beth, Claire, and Donna, on the other hand, use the computers for classroom management or for extra projects. For example, Beth uses the Internet to look for information when the students have discussions or questions during the day. Beth and Donna allow students who finish their work early to use the computers, while Claire uses the computer as a reward by allowing students who have done outstanding work to "publish" their work using the computer. In contrast to Beth, Claire and Donna, Ann disagrees with the use of computers as a reward. She notes that this practice may give students the impression that computers are toys that can be played with after they have completed their tasks.

When it comes to using the Internet, the teachers apply different ways of keeping the Internet safe for their students. All the teachers explain that they would search for the sites first, preview them, and then provide the links to the students. This is continuous with the recommendations of the B.C. Ministry of Education in the recent IRP for Science K-7 (2005), that teachers should preview Internet sites to ensure their appropriateness for students. The teachers use various approaches to giving the links to their students. Ann

allows her students to browse the website she has developed herself. On this website, students can click links to go to various children sites that Ann has previewed and considered safe for children. In addition, she also explains the value of using WebQuest to reduce the possibility of students encountering inappropriate materials. A typical WebQuest site provides students with related links containing the information they need for completing their task. Therefore, students are browsing for information rather than searching for information on the Internet. The use of WebQuest has been suggested as a way of preventing students from encountering inappropriate material on the Internet (Vidoni & Maddux, 2002). Research has revealed that teachers value the use of WebQuest because of the structure, the interactivity, the effectiveness, the collaborative activities, and the critical thinking skills that come with this software (Perkins & McKnight, 2005). Perkins and McKnight further note that teachers who have created and used websites with their students have higher tendencies to use and develop WebQuest.

Beth, Claire, and Donna have other ways of keeping the Internet safe for their students. Beth saves the sites onto the computers and makes them available offline so that students can browse through the links while disconnected from the Internet. Claire compiles a "jump page," where she provides a list of links that the students, accompanied by their parents at home, can simply click on to access the information. Donna teaches students to type the Internet address into the Internet browser, and asks them to check with her each time they want to go to a certain site outside of those she has assigned.

In addition to the ways teachers choose to use the Internet with their students, some teachers also spend time teaching their students how to evaluate Internet sites. Ann and Beth educate their students by teaching them to identify advertisements from actual website content, and they both advise their students to avoid clicking on these advertisements. Ann and Claire teach their students to deal with inconsistent information

that they might find on different websites by teaching them to compare the information they find online with reliable information that comes from books or the encyclopaedia. The practice these teachers exercise is continuous with NAEYC's suggestion about teachers' responsibility "to assist children to become critical viewers of all forms of media" (NAEYC, 1994, p. 3), and AAP's comments on the importance of media education (1999). Furthermore, NAEYC reviews the importance of developing a curriculum that encourages critical viewing skills. Ideally, a media literacy curriculum should be aimed at encouraging children to think critically about the media they watch, and to think logically as to whether the information that they receive is realistic (Singer & Singer, 1998). Some examples of activities for developing media literacy in children, such as encouraging students to think critically about the nature and purpose of commercials and understand common techniques used to present positive impressions in commercials, as suggested by Singer and Singer (1991), support Ann and Beth's efforts to educate their students about advertisements.

The teachers report a number of strategies for making computer use effective in the classroom. Donna creates seating arrangements during computer lab times, so that students with lower computer skills are surrounded by students who have higher computer skills. Ann and Claire attempt to ensure that all the students have the background skills needed before they use the computers. For example, Ann stresses the importance of using concrete materials prior to using computers, while Claire emphasizes the need to teach the curriculum and to teach computer skills separately before linking the two together and using the computer as a presentation tool for showing what the students have learned. Beth, Claire and Donna explain how they make the computer activities very directed when the students learn about a particular program for the first time. Beth illustrates how she helps students by breaking down the skills into small chunks of

instruction. She also helps students prepare for computer activities by asking them to do some prior thinking and to plan the work they want to do at the computer lab before they actually go to the lab. In contrast to Beth's preference that students write directly at the computer, provided they have done some prior thinking, Claire prefers to have students do all of their writing with pencil and paper first before typing it at the computer. Beth stresses that it is easier for students to write and edit their work at the computer, while Claire emphasizes how using the computer is challenging enough for the students. In addition to these instructional strategies, Ann and Beth also have methods of tracking their students' progress in assigned computer-related tasks by recording the names of the students and their assigned task.

During computer times, Ann and Beth report encouraging social interaction among their students. Beth explains that she encourages students to look around and see other students' work so they are able to learn from each other. Ann illustrates that she sometimes asks students to work in pairs at the computer, so they can discuss and collaborate when working on certain tasks. Claire also allows her students to help each other in the computer lab; however, to avoid having a dominating or "expert" student, she has a rule that students are able to help and guide other students, but they are not allowed to do the task for their classmates. In contrast with Ann, who encourages students to work in pairs, Donna feels that it is inappropriate to ask primary students to work in pairs at the computer because they are not able to collaborate. She notes that instead of working together, one student will dominate the other. This statement is discontinuous with the recommendations of the B.C. Ministry of Education (2000), and previous research that has found that students interact significantly more when they were working at the computers, irrespective of whether they are controlling the mouse or they sit beside a classmate who was controlling the mouse (Svensson, 2000). In addition to this, Svensson

has also reported that the students' interactions at the computer were mainly focused on the task.

In summary, the variation in the nature of how teachers use computers with their students exists. In their uses of Internet, all teachers apply various strategies for preventing students from encountering inappropriate materials. Ann, Beth, and Claire report strategies for educating their students in evaluating Internet sites, which is continuous with the recommendation of the AAP (1999) and the NAEYC (1994) about the importance of developing critical viewing skills. The teachers vary in the way they encourage and regulate student interaction when using computers.

CHAPTER FOUR: DISCUSSION

While the previous section has presented the findings of the study in a descriptive format, this section will further highlight and discuss some important themes that emerge throughout the cases. In this section, I will situate the key findings of the study in the context of schooling as well as related research concerning the integration of ICTs in schools.

This study investigated the beliefs teachers have about using computers with primary students. More specifically, this study sought to explore four distinct questions: (a) what are the beliefs primary teachers hold about developmentally appropriate uses of computers in primary classrooms? (b) how do these beliefs compare with their descriptions of their pedagogical practices? (c) how do these beliefs resonate with teachers' beliefs about how primary students learn in general? and (d) how do teachers' beliefs and pedagogical practices compare with the recommendations made by early childhood education organizations? What follows is a discussion of related research and implications of these findings for conceptualizing early childhood education.

This study revealed that both continuity and discontinuity exist between teachers' beliefs, their pedagogical practices, and the official discourses of the early childhood education organizations about teaching and learning. These findings are consistent with previous research findings that revealed both continuity (Kang & Wallace, 2004; Pajares, 1992; Peterson, Fennema, & Carpenter, et al., 1989) and discontinuity (Hinostroza & Mellar, 2000; Levitt, 2001; Schraw & Olafson, 2002; Simmons, Emory, Carter, et al., 1999; Wang, 2002) between teachers' beliefs and their pedagogical practices. While teachers' overall beliefs regarding computer use for primary students reflected the discourses of developmentally appropriate practice exerted by early childhood education organizations, their reported pedagogical practices were not necessarily continuous with

their espoused beliefs. Moreover, their overall pedagogical practices did not differ substantially with the addition of computers in their classroom. This was consistent with the argument that computers tended to sustain teachers' existing practices rather than change them (Becker, 1994, 2001; Cuban, 1993, 2001; Cuban, Kirkpatrick, & Peck, 2001), and Ungerleider and Burns' (2002) prediction that the mere existence of computers will not change the learning process unless there is a change in the instructional method.

Based on the framework suggested by Pratt and Nesbit (2000), Britzman (2003), and Clark and Peterson (1986), it is argued that teachers' pedagogical practices are shaped, supported, and constrained by the social context of their school community. As noted by Pratt and Nesbit (2000), teaching is a "complex interplay of social structures and individual agency" (p. 126), where the local teaching cultures, such as "the layout of the buildings and classroom in which they work, class size, the structure of their timetable, the nature of professional relationships, the expectations of their colleagues and students, the curriculum, assessment procedures, or the resources made available" (p. 7) influence teachers' pedagogical practices. The following section discusses the continuity and discontinuity between teachers' beliefs, their pedagogical practices, and the official discourses of the early childhood education organizations about the developmentally appropriate practice, as well as the social context of the school to explain the existing continuity and discontinuity.

Knowledge Construction

In line with the position of early childhood education organizations (British Columbia Ministry of Education, 2000; NAEYC & NAECS/SDE, 2003), all participants emphasized the importance of supportive learning environments—environments that have been claimed as essential for early learning, including the importance of active learning, critical thinking, scaffolding, challenging tasks for each individual student, and social

interaction. In their beliefs about pedagogical practices of computer use, teachers reemphasized the importance of this learning environment, and illustrated the role of computers in customizing the learning activities for individual students. All teachers in the study believed that in order to be appropriate, computers should only be used under certain circumstances: they should be adjusted to the students' abilities, integrated into the curriculum, supervised, and limited by time frames. Some of these beliefs are continuous with the recommendations of the NAEYC (1996), the B.C. Ministry of Education (2000), and the AAP (2001). However, when it comes to their descriptions of pedagogical practices, both continuity and discontinuity exist.

Active Learning

All participants agreed that children needed to actively engage in the learning process. This is continuous with the B.C. Ministry position expressed in the Primary Program document, that, "The program addresses the development of the whole child. It reflects an understanding that children learn through active engagement and play, and that children represent their knowledge in a variety of ways" (British Columbia Ministry of Education, 2000, p. 16). Beth, for example, argued that the students had to do the learning, while the teacher facilitated students' learning. However, she also noted how children were "blank pieces of papers" that need to be filled by teachers. Her two arguments contradicted one another: the first argument stated that students should be the centre of the learning process, which represented a constructivist view of learning supported by the NAEYC (2003) and the B.C. Ministry of Education's position (2000); the second argument implied that teachers were experts who transmitted all the knowledge into students' minds, which resembled what was called by Everhart a "'factory model' of learning; that is, the teachers pouring in the facts and the students pouring them back in the form of papers and test..." (Everhart, 1983, as cited in Britzman, 2003, p. 28).

Beth's pedagogical practice appeared to be discontinuous with her first argument, but continuous with her second argument. For example, she explained how she made her instructions very explicit during a slide creation, such as asking all students to use the penguin stamp, make the stamp big, and add an iceberg. Rather than facilitating students in figuring out what they wanted to do with their slides, such as, what pictures to put, and how big the pictures should be, Beth seemed to instruct students to make the slides the way she thought they should be, which was continuous with her metaphor of students as blank pieces of papers to be filled by teachers, but discontinuous with her argument that it was the students who had to do the learning. In explaining their pedagogical practices, Beth, Claire, and Donna pointed out that it was easier to make the lessons in the computer lab very directive, where everyone was doing the same activities, especially when they were learning about new software. This implied that their choice of instructional technique in the computer lab was based more on the ease of the process rather than whether the activities encourage active learning.

Critical Thinking

All participants emphasized that it was important that the students were thinking in the classroom activities. For example, Ann, Donna, and Beth explained that they did not like software that did not encourage thinking. In her pedagogical practice, Ann illustrated her use of a WebQuest project to encourage students' critical thinking. The task of this project is to build a community; thus, students need to learn about what a community consists of, and plan to build their own community. She noted how students were engaged in solving a big question by breaking the task down into small chunks: they surveyed their own neighbourhood, created a mind map about various jobs needed by a community, chose which elements of community they would incorporate (e.g., mayor, tour agent) in this project, put their ideas into more concrete plans (e.g., drawing the town

map), and enacted various roles of community members. This was continuous with her belief about the importance of critical thinking. However, she also explained that this year her class did not do the whole process of the community building project due to their lack of daily access to the Internet. She noted that she decided to omit some tasks in the process of community building. While her main goal was to help students practice breaking down the task into small chunks until the whole task was completed, eliminating some tasks during the process could create a gap in the problem solving process. This demonstrated that despite her belief about the value of the WebQuest project, the lack of classroom Internet access became a constraint that limited Ann from practicing what she believed to be good for developing students' critical thinking.

As a comparison between low level and high level thinking, Beth compared the use of electronic worksheets, which she associated with low level thinking, with the use of word-processing software to write and KidPix for drawing dinosaurs, which she categorized as high level thinking. Her description of writing a story was continuous to her argument about high level thinking, such as planning the character and setting of the story. However, her explanation about her use of KidPix for drawing dinosaurs seemed to be discontinuous with her argument about high level thinking. Her explanation that she instructed students to follow her directions, in which she broke down the skills into the smallest chunks, demonstrated her strategic plan of breaking down the task into small chunks that were achievable for students. This implies that students were only following her directions as opposed to actively engage in high level thinking to plan their own strategies to draw the dinosaurs.

Scaffolding Writing

Ann and Beth argued that due to the structure and scaffolding provided by some computer programs, students' writing at the computers was significantly different than

writing off the computers. This argument is continuous with the position of the B.C. Ministry of Education (2000) and confirmed by previous research findings that computers can assist students' writing and promote their literacy skills (Englert, Manalo, & Zhao, 2004; Gore et al., 1989). However, while the B.C. Ministry of Education pointed out that with computers, students can focus on ideas rather than the mechanical aspects of writing, Ann and Beth seemed to focus more on the mechanical aspects of writing when they explained the differences between writing at the computers and off the computers. For example, Beth pointed out that with computers, students can produce significantly more texts. Both Ann and Beth illustrated how students learned to use the spacebar to make spaces between words. Thus, the idea of the use of computers to help students produce better quality of writing (e.g., more creative ideas in students' writing) has been reduced into quantitative measures, such as producing specific numbers of sentences.

Furthermore, a closer examination to their explanations about the advantages of using computers for writing showed that the positive impacts they described were actually more about pragmatic values for their teaching practices rather than about the children's learning processes. For example, Ann and Beth's further explanation about their argument that computers can help students write revealed that the computers made it easier for them to read students' writing, or to evaluate whether students have learned a specific skill. For instance, Ann noted that when students were writing at the computers, it was easier for teachers to see whether students had learned to leave spaces between words compared to when they were writing with pencil and paper. This example did not seem to actually deal with the students' actual learning process (i.e., whether they actually learned to leave spaces between words at all, irrespective whether they write at the computers or off the computers), but it was more about whether it was obvious or not for teachers to observe students' learning outcomes. Furthermore, Claire and Donna's comment that computers

was valuable as an "equalizer" to help low achieving students work better also seemed to focus on the appearance of the students' work rather than the quality of their learning process. The term "equalizer" here seemed to refer to equalizing the appearance of the final products rather than equalizing the learning process among students with different levels of abilities. All participants seemed to value the work of students at computers because the final products were easier to read and evaluate. This is continuous with earlier research finding that teachers tended to value "the look of the product rather than the intellectual significance of the writing process" at the computers (Bryson & de Castell, 1998, p. 555).

In addition to Ann and Beth, Claire also pointed out that computers could provide visual cues to help students generate ideas for writing. She described the value of using the picture bank in Kidspiration to provide visual cues for students in creating webs to assist them with planning to write a paragraph. This would imply that Kidspiration could be used during the process of creating webs to generate and enrich students' ideas for writing. However, in her pedagogical practice, Claire described that in any computer activities she conducted with her students, she would have her students create their writings or webs of ideas with pencil and paper first before they type them at the computer. Despite her beliefs about the value of using visual cues while creating webs, she reported her use of the program to type students' work after they have created their writing or webs off the computers, because she thought that it was challenging enough for students to use the technology. Additionally, she also believed that she was not familiar enough with the software to be confident in making use of it, which was consistent with Braak's (2001) research report that teachers' experience with computers influenced their classroom computer uses. This illustrated that despite the belief Claire held about the

value of Kidspiration, the challenging task of mastering technology played a role in creating discontinuity between her pedagogical practice and her belief.

Matching the Computer Activities with Students' Level of Ability

All participants emphasized that the use of computers could help customize learning activities according to the students' level of ability. Some of their reported pedagogical practices were continuous with this argument. For example, Ann varied the reading level of the software she used for different group of students based on their reading abilities and pulled out her special needs student from the whole group activity that was too high for his ability, while Claire used the computer to give remedial exercises for students with low reading abilities. However, there were some occasions where teachers' decisions to use the computers seemed to be based on practical considerations rather than pedagogical considerations. For example, while describing the use of computers for her special needs student, Ann made a comment that, *"if he gets too wild, we set him at the computer and he is happy for a while..."* This also happened in Donna's classroom, where she noted how demanding it was when some students exerted challenging behaviours. She illustrated that when she could send a student with challenging behaviour to work independently at the computer, the student's attention would be focused toward the computer, so that she would be able to focus her attention to the rest of the class. This implied that Ann and Donna used computers as a classroom management tool to control students' behaviour rather than to match computer activities with the students' ability. Moreover, this practice could serve as reinforcement for students: having the teacher set students with challenging behaviours at the computers could be rewarding for the students, which in turn could reinforce their challenging behaviours to get the chance to work at the computer.

Social Interaction

All participants emphasized the importance of social interaction in primary students' learning. They also expressed their concern that computers could supplant the time children spent to socialize with others. While the B.C. Ministry of Education and the NAEYC carried a more optimistic view of the use of computers for children in their official documents (British Columbia Ministry of Education, 2000; NAEYC, 1996), the concern that these teachers had was parallel with the concerns asserted by Healy (2004) and Cordes and Miller (2000). Some teachers illustrated how they encouraged social interactions, both during classroom activities in general and during computer activities in particular, which was continuous with their beliefs about the importance of social interaction. For example, Ann illustrated how she asked students to work in pair at the computers, while Donna illustrated how she asked students to practice reciting poem in pair and correct each other. As with Beth, she also described how she encouraged social interaction during the computer lab times, by asking students to be resources to one another, and asking them to look at each other's work. While these activities illustrated some social interactions among students, the interactions seemed to be limited to the exchange of information rather than collaborative activities among students. Thus, each student still worked individually at the computer as opposed to work collaboratively in pairs or small groups.

In contrast to the beliefs that teachers held about the importance of social interaction in general and their concern that computers made students work in isolation, some teachers stated that the computer was more suitable for individual work rather than collaborative work. Furthermore, they seemed to encourage children to work individually at the computer rather than encourage them to work collaboratively. For example, Claire described that she would only send a student to use the classroom computer if the student

could work independently at the computer without interrupting her lesson, while Donna was against having two students working at one computer. As opposed to encouraging social interactions, this practice could reinforce the students to use computers in isolation by providing a model of computer use for students. This shows discontinuity between their beliefs about the importance of social interaction for learning and their pedagogical practice in using computers with the students.

Motivation

All participants emphasized the value of using computers as motivating for students. They illustrated how the use of computers could motivate students to stay on "boring" tasks such as phonics. They explained how the visual and auditory stimuli were interesting for students, and that these stimuli could help students stay on task longer, and practice more. Teachers also noted how they used computers to help students practice their skills, such as reading skills. However, teachers showed ambivalence about the motivational effect of computers. In contrast to their previous statement about the advantage of the motivational aspect of computers, the teachers also expressed their concern about the audiovisual stimulation of the computers that could make students use the computer for a lengthy period of time. This corresponded with earlier research report that teachers appeared to show ambivalence in the implementation of computers, where they were both enthusiastic and questioning the pedagogical value of using computers (Bryson & de Castell, 1998).

In their pedagogical practices, all participants with the exception of Ann incorporated computers in their reward system in the classroom, where they allowed students to use the computers after they have finished their work or when they have done exceptional work. This was consistent with earlier research reports about the way teachers used computers in their reward-punishment system (Garrison & Bromley, 2004, Olson,

1986, Wilson, Notar, & Yunker, 2003). In contrast to the notion of the importance of intrinsic motivation (e.g., Donna's statement that she would like the students to think of classroom activities, including computer uses, as something that they want to do), the use of computers has been incorporated as an extrinsic reward to control students' behaviour. According to Pintrich and Schunk (2002), this type of reward that focuses on the controlling students' behaviour could lead students to attribute their actions to external factors rather than internal factors, which in turn could decrease their self-determination. As with Ann, even though she was concerned with the use of computers as a reward and decided not to use computers as a reward, the way she used computers with her special needs student (i.e., to calm him down when his behaviour was not controllable) reflected that she used computers to control the student's behaviour.

Furthermore, some teachers' policy to print the students' work only if they meet the standard illustrated their emphasis on the end product rather than the process of students' work. This could encourage students to perform their work only to avoid failure to meet the teacher's standard, and in turn avoid taking risk to experiment with their creative ideas in doing their tasks. According to Pintrich and Schunk (2002), students who have high motive to avoid failure tend to be reluctant in working for their academic achievement. Moreover, this practice might prevent students whose work was not printed from revisiting and reflecting upon their work, because they would not be able to access their work without logging into the school computers.

Pedagogical Practices

Pedagogical versus Practical Considerations in Teachers' Decision Making

While explaining their pedagogical practice, teachers justified their choice of activities or software by pointing out the underlying pedagogical considerations behind their decisions. For example, Beth explained that manipulative activities at the computers

could be as good as manipulative activities off the computers, especially when students had had an exposure to real objects prior to the computer activities. She also explained how children could achieve more while working at the computers. Her further explanation, however, showed that her preference over the use of computers seemed to be based more on practical considerations, which was the neatness of the finished product or the tidiness of her classroom. For example, when comparing the use of manipulative objects versus the use of computers, she illustrated that when using the computers, *"things are not falling all over the floor."* In the same manner, Donna also explained that when students were working at the computer, they could not make a mess by scribbling over their work; something that they could do with pencil and paper. Furthermore, Beth explained that cutting and pasting manually with scissors and glue were messier than doing electronic cut and paste at the computer. This argument seemed to reflect a practical point of view, since from a pedagogical point of view, manual cutting, pasting, and gluing would involve more effort than merely clicking on objects at the computer, and could help students practice coordinating and developing their fine motor skills. This showed that while teachers held some pedagogical considerations about their choices of activities, their decisions seemed to focus on the practical reasons.

Appropriate Computer Uses

Overall, the teachers' beliefs about the appropriateness of computer uses were continuous with their beliefs about how primary students learn in general, and their pedagogical practices. For example, Ann, who believed that it was necessary to expose students to manipulative activities prior to the use of abstract materials, decided to use manipulatives each time she introduced new concepts, and made sure that students understand the concept first before sending them to work at the computer. Claire, who believed that primary students learned best by doing hands-on activities and

experimentations, preferred to use books and manipulatives over the use of computers.

Beth and Donna, who believed that primary students learned best by repetition and practice, valued the use of computers to help students practice their skills.

Each teacher had her own beliefs regarding the way computers should or should not be used. In their pedagogical practices, there were both continuity and discontinuity between their practice and beliefs. An example of the continuity is the way Ann and Beth taught their students to differentiate advertisement from the actual contents of Internet sites. This was continuous with their beliefs about the need to teach students to evaluate Internet sites, as well as the recommendation from the NAEYC (1994) and the AAP (1995) regarding media advertisement. An example of discontinuity was found in Beth's argument that the computer should not be used for activities that can be done off the computer. In contrast to this argument, her computer activities seemed to sustain her existing classroom practice rather than change it. For instance, the students were drawing and writing at the computers the way they would draw and write with pencil and paper. They would go to the Internet to find information that they used to look for in books and encyclopaedia. When there was a difference between the activities at the computers and off the computers, the difference tended to be quantitative (e.g., the time it took to write a paragraph or to find specific information) rather than qualitative. The finding that teachers tended to use computers to sustain the existing pedagogical practices was continuous with earlier research reports (Becker, 1994; Cuban, 1993; 2001; Ungerleider & Burns, 2002).

In addition to both continuity and discontinuity between teachers' beliefs, pedagogical practice, and the recommendation from the early childhood education organizations, there were instances where the early childhood education organizations

offer no guidelines for specific computer uses (e.g., is it appropriate to use computers as reward? Is it appropriate to use drill-and-practice software?).

Performance Goal Orientation versus Mastery Goal Orientation

All participants argued that students' final product on the computer looked more beautiful and professional, and that students preferred to do their work on the computer for the same reason. This comparison appeared to refer to somewhat superficial differences rather than qualitative difference between working at the computer and off the computer. Moreover, this comparison seemed to resemble performance goal orientation, where the focus was to demonstrate competence, rather than mastery goal orientation, which focuses on the learning process to develop new skills and competence (Pintrich & Schunk, 2002). Here, teachers tended to focus on students' performance on the tasks rather than the learning that occurred during the process. The focus on performance, according to Pintrich and Schunk (2002), is associated with extrinsic motivation, where students are motivated to show their competence and tend to avoid challenging tasks and mistakes; on the other hand, the focus on mastery can lead students to see mistakes as part of the learning process of mastering new skills.

Comparing the process of students' writing or drawing at the computer could reveal some more differences between the process of working at the computer and off the computer. When students were drawing at the computers with KidPix, for example, they could pick the stamps they would like to use (e.g., penguin stamp), specify the size, and then click on the place they wanted to put the stamp to be part of their "drawing." They could browse the available border and background and choose the one they like for their "drawing." They could also add their own drawing by clicking and dragging the mouse. Then, they could choose the colour they wanted to use to "paint" their drawing. They could select the pattern they wanted to apply on their drawing (e.g., for the dinosaurs'

skin) just by clicking on the desired pattern to be applied on their drawing. Compared to drawing at the computer, drawing off the computer seemed to involve more complicated fine motor skills. For example, the manipulations of all drawing tools at the computer are mediated by mouse clicking, while manipulations of drawing tools off the computer (e.g., pencil, eraser, and crayon) would require students to master various ways of handling these tools. "Colouring" at the computer involves selecting a colour and clicking on the field to be "coloured," whereas colouring off the computer involves coordinating various kinds of strokes and movements for colouring rather than just mouse clicking. This shows that when a comparison is made from the mastery goal orientation point of view, working at the computer is not necessarily better than working off the computer, in term of the fine motor skills involved and exercised during the process of drawing or writing. However, teachers' emphasis on the production of beautiful finished work in a shorter period of time illustrated their tendency to view this matter from a performance goal orientation perspective rather than a mastery goal orientation perspective.

When teachers were comparing the final product of working at the computer with the one off the computer, they might disregard their actual purpose of the task itself. For example, all participants illustrated that some students had fine motor problem that hindered their writing abilities. Ann further explained that in primary grades, teachers are needed to help students develop in various areas, including their physical and fine motor skills, which was continuous with the B.C. Ministry of Education's position (2000). While the teachers' observation that some students' fine motor problem might indicate that these students needed to practice their small muscle coordination, the teachers reported that they used computers to eliminate the issue of the students' fine motor problem, rather than to help students practice and develop their fine motor skills. From the performance goal orientation point of view, eliminating the fine motor problem issue seemed to be

effective, because students were able to produce beautiful writing and drawing. However, from the mastery goal orientation point of view, teachers' decisions to send students to write or draw at the computer might even reduce children's opportunities to practice their printing or drawing skills.

Child-Initiated Activities versus Teacher-Initiated Activities

Early childhood education organizations suggest the importance of encouraging child-initiated activities in addition to having teacher-initiated activities. The NAEYC emphasized that, "Curriculum provides opportunities for children to initiate activities, as well as for teacher initiation and scaffolding... Curriculum promotes children's developing attitudes as "learners"— using their curiosity, creativity, and initiative" (NAEYC & NAECS/SDE, 2003, p. 19). More specifically, the NAEYC exerts that, "Learning is facilitated when children can choose from a variety of activities, decide what type of products they want to create..." (NAEYC & NAECS/SDE, 2003, p. 6). Some of the teachers' pedagogical practices were continuous with this position, where the teachers granted students choices to some degree. For example, Claire let her students choose the theme of their fairy tale story or the host of their Flat Stanley, while Ann let her students choose the roles they would like to play in the community building project. However, when it comes to computer uses, the teachers' pedagogical practices seemed to focus more on teacher-initiated activities rather than child-initiated ones. For example, most of the computer uses described by the teachers involved activities (e.g., drawing dinosaurs, practicing math, and reading at the computer) and software (e.g., spider CD-Rom and KidPix) chosen by the teachers. Even though some teachers gave some opportunities for students to choose the activities or software to some extent, the opportunities mostly applied for students who had finished their main tasks, or during centre times. Moreover, the opportunities for choice did not seem to be offered when the students were working

on their main tasks. This discontinuity between the teachers' pedagogical practice with their beliefs and the recommendation made by early childhood education organizations was consistent with Cuban, Kirkpatrick, and Peck's (2001) argument that teacher-centred instruction, rather than student-centred instruction, continued to be the norm in the classroom, even with the existence of computers. Despite holding a belief that supported child-initiated activities, the constraint of the computer lab, such as the limited time available to use the computers and the absence of support assistants, might lead teachers to choose activities that they considered good for the students, rather than giving students opportunity to initiate the activities. This was exemplified by Beth and Donna in their statements that it was easier when all students did the same things in the computer lab.

Software Selection: Preference on the Use of Open-Ended Software

All participants had their own criteria in choosing appropriate software for their students. Most teachers argued the importance of open-ended, multimedia, and multilevel software. While their earlier comments focused on the pedagogical values of the software that could match the cognitive abilities of individual students and allow students to do a wide range of possible activities, their further comments revealed that this kind of software was cost efficient for the school. They noted that educational software licensing was expensive, so that it was important to purchase software that could be used for a wide range of grade levels. Moreover, some teachers explained that they decided to use a program because it was the only program available in the school computers (e.g., AppleWorks as the only word-processing software). This was further exemplified by Beth's statement that teachers were mostly left with the programs that came with the school computers (e.g., AppleWorks and KidPix), or free programs that can be downloaded from the Internet. This illustrated how teachers' decision to use specific

software seemed to be based more on the availability of the software rather than pedagogical considerations about the educational values of the software.

Most teachers emphasized the value of open-ended software as giving children an opportunity to do a wide variety of activities with the software, depending on their cognitive ability. However, the pedagogical practices reported by the teachers actually showed that despite the open-endedness of the software, teachers did not seem to use the software in an open-ended manner. While specific software can be used for diverse kinds of activities, the computer activities described by the teachers showed that the computers were used in the same manner by all students at a given time. For example, in a typical computer lab session reported by the teachers, all students would be using the same software to do the same kind of activities chosen by the teachers. When the activity was about drawing a butterfly, all students would draw butterflies by following the teachers' direction; when the activity was about creating a slide show about Mexico, all students would create similar types of slide shows. These practices were discontinuous with teachers' beliefs about the value of open-ended software.

The Use of the Internet

All participants consistently argued that the Internet had an important role to provide up-to-date information for students, and Beth further claimed that the existence of the Internet could support students to be life-long learners. However, in their practice, teachers reported that they limited students' access to the Internet. They also described their uses of Internet, which was limited to provide information that they used to look for in books, to use some pictures from the Internet as illustrations to support the lesson, or to provide model of what the students had to emulate. In contrast to Beth's claim about developing life-long learners, these uses of Internet did not seem to be continuous with her claim. For example, she illustrated how she asked students to choose among the

pictures that she downloaded from the Internet for their slide shows rather than having students look for the pictures themselves in the Internet or use their own drawing. She explained that, "*The time versus the learning for me is not worth it,*" which showed her preference to save time rather than letting students learn to look for or create the picture themselves. In the reported Internet uses, students seemed to be receivers of the information selected by the teacher rather than actively seeking and selecting the information that they needed themselves. These uses reflected that the teachers were using the Internet just the way they were using encyclopaedia, books, or pictures to support their lessons. Thus, teachers' uses of the Internet were discontinuous with their earlier claim about the role of the Internet in students' learning.

Educational versus Non-Educational Activities

All participants expressed their beliefs about the kinds of activities regarded as educational or non-educational for primary students. All teachers emphasized the importance of play, which showed continuity with the early childhood education organizations recommendation about the importance of play as an authentic environment for children to learn (British Columbia Ministry of Education, 2000; NAEYC & NAECS/SDE, 2003). However, when it comes to computer uses, the argument about the importance of play did not seem to hold true for some teachers. They expressed their concern about the use of game-based software, because they suspected that these activities could engage students in lengthy periods of computer activities. Thus, there seemed to be a contradiction between the notions of play as a naturally engaging activity: the play off the computers seemed to be regarded as meaningful experience for children more than the play at the computers.

In addition to the importance of play, Donna emphasized the importance of free exploration. She illustrated how she provided students with free exploration times to give

students an opportunity to play and explore software. She gave examples where exploration time led her students to discover new strategies and actively follow their curiosity to learn. However, she further explained that she provided students with free exploration time only when she needed to do her assessments for the report cards. According to Donna, because students did not have to hand anything during free exploration time, she did not have to give intensive assistance and instructions to the class, so that she could use some of the time to call individual students to assess them. This showed how Donna's decision about when to provide exploration time was more influenced by a practical consideration rather than by a pedagogical consideration. For example, she did not base her decision on any pedagogical consideration about the appropriate time for exploratory activities (e.g., when students were learning new software), but she chose to base her decision on the time when she needed to do her assessments for the report card. Also, in contrast to her belief that students need to be given a time to actively explore software applications, Donna illustrated an occasion where she limited the students' use of the available tools, which was, not allowing students to use the eraser at drawing software. This shows discontinuity between her beliefs with her pedagogical practice, where directing and limiting students' use of the eraser did not correspond with her belief that it was important that students were able to do their own exploration and without being afraid of making mistakes. A possible explanation for this discontinuity is the limited time she has in the computer lab, where she needed to guide students in a directive way to finish their task.

The Equity Issue in the Use of Classroom Computers

While all participants agreed that computer activities are appropriate for any students, their reported pedagogical practices showed that there seemed to be inequity in students' access to the classroom computers. With the exception of Ann, the teachers'

practice of allowing students who have finished their work to use the computers may lead to inequity in students' computer access, where bright students could have more choices of activities, including accessing the computers, while low-achieving students would more likely have lower access to the classroom computers. Claire's decision to send students to use the classroom computers if they were capable of working independently, and her explanation that due to the absence of teaching assistant she used the computers more for gifted students than for special needs students, reflected unequal students' access to the classroom computers. Moreover, her practice of asking students to look up some Internet sites with their parents to find out answers to some questions (e.g., why Ivory soaps float in the water) could only be done by students who had Internet access and had parents who were willing to set aside time to help them. On the other hand, students who did not have Internet access would not be able to participate in finding out the answers to the questions. Even though Claire noted that these questions were not treated as a big issue, only students who had Internet access could report back to the class with the answers, while the students who did not have Internet access might feel incompetent because of not being able to participate in answering the questions. This practice could lead to the "rich gets richer" phenomenon, where students with higher abilities have more opportunities to extend their potentials by means of higher computer access and more free choices of activities. This practice is discontinuous with the NAEYC's (1996) advice for teachers to be cautious about the equity issues, which cites Thouvenelle, Borunda, and McDowell's research findings that teachers tend to have attitudes that hinder some students' (i.e., low achieving students) access to the computers. The NAEYC further suggests that, "Early childhood educators must find ways to incorporate technology into their classrooms that preserve equity of access and minimize or even reverse the current trends" (Borunda & McDowell, 1994, as cited in NAEYC, 1996, p. 3).

Constraints Faced by Teachers

While teachers held some idealistic beliefs of teaching and learning, sometimes their pedagogical practices were not continuous with their beliefs. According to Pratt and Nesbit (2000), Britzman (2003), and Clark and Peterson (1986), teachers' pedagogical practice is influenced by the social context and external demands, which can be constraining them from putting their beliefs into practice. This section discusses the constraints as described by teachers in their pedagogical practice.

Pressure from the Curriculum

All teachers described that there is a large amount of materials that they have to cover in the primary curriculum, especially to teach reading and writing. Beth especially pointed out that the pressure was high for grade-one teachers to have their students master basic literacy skills by the end of the academic year, while Claire described the pressure teachers faced to take care of special needs students in the regular classrooms. Claire and Donna illustrated how they felt a pressure to cover a large amount of curriculum in limited time that they had in the classroom, and further explained how this situation dissuaded them from using computers in the classroom. For example, Donna explained how she had many ideas to use computers with her students, such as teaching them keyboarding skills and editing, but she could not do it due to the lack of time and the amount of curriculum she had to cover. This was continuous with earlier research reports about the lack of time and resources that teachers had in facilitating classroom computer uses (Bryson & de Cañtell, 1998; Garrison & Bromley, 2004; MacArthur & Malouf, 1991).

Britzman (2003) noted how "teacher's skills are reduced to custodial moments: the ability to enforce school rules, impart textbook knowledge, grade student papers, and manage classroom discipline appear to be the sum total of the teacher's work. Hidden is

the pedagogy teachers enact..." (p. 28). With the large amount of pressure and the limited time available to do their work, Claire and Donna reported that they did not have enough time to learn new software and to incorporate computer uses in the way they believed to be more beneficial for students' learning. Consistent with Britzman's argument (2003), it seems that these teachers' pedagogical beliefs did not manifest in their actual classroom practice due to the pressure that they faced. In order to plan for their computer uses, the teachers reported how they had to use their leisure time (e.g., weekends, summer vacation) to explore the computer software that they would like to use with their students. This is continuous with previous research report about the way elementary teachers work after school hours to prepare their classroom practice (Bryson & de Castell, 1998), and the stereotypes of favourable teacher image as "self-sacrificing, kind, overworked, underpaid, and holding an unlimited reservoir of patience" (Britzman, 2003, p. 28).

Class Taught and the Available Support

Besides the pressure from the curriculum, the classroom conditions and the characteristics of the students could present a challenge for teachers. For example, Donna illustrated how her classroom dynamics, where the student enrolment varied throughout the year, presented a challenge for her, and made the learning process slower than it could have been. She noted that she did not use the classroom computers much this year because she had concerns regarding her students' challenging behaviour. Claire illustrated that the inclusion of special needs students in the regular classroom could be challenging and stressful. She particularly pointed out that not all special needs students were eligible for funding, so that her school decided to place all special needs students in one classroom that had a teaching assistant. She illustrated that even with the help of a teaching assistant, which was only available for limited time during the day, last year she was frustrated with the existence of several special needs students. This year, however,

she did not have any special needs student, so that there was no teaching assistant for her class. According to Claire, not having a teaching assistant made it harder for her to facilitate the computer lab times, as well as to use the classroom computers for individual students. She noted that for the computer lab time, it was difficult to provide support for all students without any teaching assistant. Furthermore, it was difficult for her to send students to use the classroom computers. She noted that unless the students were independent enough to use the classroom computers, they would keep interrupting her from teaching the class.

In both Claire and Donna's illustrations, it appeared that the classroom situation could create challenging situations for teachers, which in turn influenced their decision and planning for their pedagogical practices. The available support could help teachers put their beliefs into their pedagogical practice. For example, in Claire's case, having a teaching assistant in the previous year helped her use of computers, both in the lab and in the classroom; while the absence of teaching assistant in this year reduced her classroom computer uses. Claire also noted that in the previous years, having a school librarian allowed her to send a group of students to the school library to do research with the assistance of the school librarian, both at the computers and off the computers. However, she noted that with the significant (50%) cut of the school librarian's time this year, she could not send her students to do research at the library anymore, because there was no available block of time where the librarian could assist her students. This shows how budget cut that reduced school librarian time played a role in Claire's use of ICT. Similarly, Ann's statement that she stopped working in the ICT Learning Support Team in her district due to the budget cut provides an example of how budget cut could result in a reduction of ICT support throughout the district. This finding is supported by previous

research (Bryson & de Castell, 1998), which reports how the province-wide budget cut seemed to limit computer coordinators' time to support teachers in their use of ICT.

Equipment Availability and Accessibility

The schools where the participants worked centralized the newest computers in the computer lab. While each participant had computers in her classroom, these computers were not as updated as the lab computers, which limited their usability. Moreover, some of the computers were reported not working properly, or not having the feature that the teachers would like to use. For example, even though Ann had five working computers, she noted that only two computers had Internet access, which limited her use of the WebQuest community building project with the students. Claire noted that one of her classroom computers was not working, while the other one could not save her work properly. Donna noted that in addition to having the computer lab not working for the first half of the academic year, one of the reasons why she did not use the computer as much this year was that her classroom computers were not linked to the computer lab network. She noted that if the computers were hooked up to the computer lab, she could have let her students who had not finished their work in the computer lab continue their work at the classroom computers. She also noted that in her previous years when she had a classroom computer with an Internet access, she could rotate the students to work at the computer on a daily basis. This shows that even though these teachers had the intention to use the classroom computers with their students, the fact that the available equipment did not have some features that they needed limited their uses of computers with their students.

Having a classroom computer that does not work at all or does not work properly can be a factor that prevents teachers from using computers with their students. In Claire's case, even though her school had a computer technician, the problems with her classroom

computers were not dealt with, as she commented that, *"With getting the laptops up and running and with keeping the other lab running, there is no technician time to work on these old computers."* Having this situation, Claire reported that this year she could not use her classroom computers as much as she used to. This finding is supported by previous research, which reports that one of the factors that dissuade teachers from using computers with their students is the lack of support when computer problems arise (Bryson & de Castell, 1998; Cuban, 2001). Studies report that even though there are computer coordinators in the schools, often times the problems that teachers have cannot be solved immediately, and that the need for computer assistance overwhelmed the computer coordinators (Bryson & de Castell, 1998; Cuban, 2001). Cuban notes that one of the questions that teachers ask when making decision about computer use is, "If the system breaks down, is there someone else who will fix it?" (2001, p. 168), and that teachers report that they had to have a back-up lesson plan for each activity that involves computers.

To cope with the lack of available equipment, all participants with the exception of Claire reported that they brought their personal belonging (e.g., computers, CD-Rom) into classrooms. Furthermore, they also reported how they purchased software from their own pocket to add to the classroom software collection to be used with the students. In contrast, Claire, whose school provided a large collection of educational software in the library to be signed out by teachers for classroom uses, reported that she had never signed out any software from the library. This decision was continuous with her comments that she was not familiar with various kinds of software, the problems with the classroom computers being not working, her belief that her students did not need to have additional computer time, and her concern about the amount of curriculum she had to cover.

Even though all participants expressed their wishes that they had better or more computer access, it was interesting to note that not all computer facilities available at the schools were used by the teachers. For example, even though all teachers whose schools had a class set of wireless laptops expressed that it would be great to sign out the laptops for classroom uses, they reported that they did not use the opportunity to sign out the laptops for various reasons. Beth and Claire explained that there were other teachers who would like to use the laptops, whereas Donna, who earlier described that she preferred to have distributed computers over the use of computer lab, pointed out that she was not sure how to sign out the laptops and that she was concerned with her students' challenging behaviour. Furthermore, even though Donna just recently had a new computer with an Internet access, she did not use the computer because of not being familiar yet with it. This showed that equipment availability did not necessarily ensure access for teachers. Even though teachers wanted to make use of the equipment, there were other factors in the school structure that served as constraints, such as the expectation from their colleagues (e.g., to use the laptops with their own students), the limited time available, and the behaviour of their students.

With the exception of Ann, all participants' computer uses mainly happened in the computer lab. All participants noted how a 40-minutes block of time was not enough to accomplish what they would want students to do at the computers, especially because students could not actually work for the whole 40-minutes. Donna illustrated how it took a while to prepare students to go to the computer lab and login to the computers. Claire noted that when her students reached the computer lab, the lab was usually still used by the previous class, which delayed Claire's students' uses of computers. Claire and Donna also noted that before the students worked at the computer long enough, they would have had to start clean up and logout from the computer lab. The limited time available in the

computer lab served as another constraint for teachers to use the computers, where they could not plan a lesson the way they wanted. For example, Ann noted that if her class had more frequent access to the Internet, her students would have been able to complete the whole WebQuest project.

How Decisions are Made Regarding the Use of Computers?

Even though teachers are the ones who make decisions about the use of the computers in their own classrooms, their decisions are not necessarily shaped by their own beliefs, but also influenced by the social context of their school community. Pratt and Nesbit (2000) emphasized that, "Physically, teachers are often alone in their own classrooms, with no other adults for company. Psychologically, they never are" (p. 124). This study revealed that there were external forces that influenced the extent to which computers were used or not, and how they were used. This section discusses three external forces that seemed to influence the teachers' use of computers in the classrooms: the school policy, the school district instructional technology support team, and the school district parent advisory council.

School Policy

In describing their pedagogical practice, participants pointed out the existence of a school policy that governed their uses of computers. For example, Beth and Claire described their schools' policy that students were not supposed to use the Internet by themselves before they reached a certain grade. Despite their beliefs about the value of the Internet, Beth and Claire adhered to this policy by not letting their students explore the Internet. This illustrated how the school policy and decision influenced teachers' pedagogical practices. Ann illustrated that her school preferred to spend the money on buying new computers rather than purchasing software, and that she bought software from her own pocket for her classroom computers uses. Donna described how her

decision not to use her classroom computers was because these computers were not connected to the computer lab network. Thus, the school policy and the infrastructure implemented at the school could impede teachers from actualizing their beliefs into their pedagogical practices. As noted by Bryson and de Castell (1998), "the implementation decisions (e.g., in-class vs. laboratory-based placement of computers) seemed to be governed by administrators' perceptions of efficacy rather than by teachers' instructional practices, pedagogical preferences, or judgments about educational effectiveness" (p. 559).

The School District Instructional Technology Support Team

Despite teachers' own beliefs about the appropriateness of particular computer uses, their computer uses could also be influenced by the school district instructional technology support (ITS) team. This team is meant to provide support and advice for teachers in their uses of computers, including their choice of software and computer activities. This team also provides recommendation as to what software to be supplied by the district for the school computer labs. However, there could be some discrepancies between the beliefs teachers hold and the beliefs that the school district ITS team holds. This situation was illustrated by Donna, who had a disagreement with her district ITS team regarding the use of drill-and-practice software. While she felt that the "Starfall" reading site was good to help students develop their reading skills, it was not supported by the district ITS team. She expressed her resentment regarding this issue, particularly because she thought that the district ITS team was not clear about their criteria of appropriateness of specific software or Internet sites.

In addition to this disagreement regarding the appropriateness of software, Donna also expressed her frustration with the district policy of supplying a limited number of computers to each school's computer lab throughout the district, which caused the

computer labs to have different versions of computers. According to her, it would be more useful to upgrade all computers for a few schools each year, so that each school would have the same version of computers in the computer lab. Furthermore, Donna pointed out the earlier district policy to put firewall setting that banned teachers to most of Internet sites. She explained how this situation prevented her from sending and receiving any e-mail attachment, including the ones containing students' work, and prevented her from accessing the Internet sites she needed. For example, she noted that she could not access a particular site about animal because it contained information about different characteristics of different sexes of the animal. Thus, her pedagogical practice was not necessarily continuous with her beliefs because of the school district's policy of the use of the Internet.

The School District Parent Advisory Council (PAC)

As noted by Claire, the PAC can play a significant role in the existence of computers in the schools. She illustrated how parents love to see their children use computers at schools. This is consistent with Bryson and de Castell's (1998) report about parents' support toward the use of computers at school, and Rideout et al.'s (2003) report about parents' belief that computer use is beneficial for their children's intellectual development. At her school in particular, Claire described that the PAC supplied some of the computer equipment, so that teachers could use them with the students. Claire felt that the choice of purchasing computers was not in the teachers' hands, because otherwise, she would prefer to spend the money on books and other educational materials. Despite her preference to books over the computers, her frustration in dealing with technical problems in the computer lab, and her argument that, "*money wise the technology is a total drain on the system,*" Claire explained that she decided to take her post baccalaureate diploma in teaching technology because her school had lots of equipment which she was not familiar

with. She also illustrated parents' enthusiasm about the use of computers at schools, and how she felt that the use of computers helped her relate with parents. This showed how Claire's use of computers was not continuous with her beliefs about computers; rather, her pedagogical practice was influenced by the school's decision on purchasing equipment, which was supported by the PAC.

Implications of the Study

This study provides insights about the beliefs teachers held about the developmental appropriateness of using computers with primary students and the pedagogical practices reported by teachers in their uses of computers with their students. This study reveals that while teachers' overall beliefs were continuous with the discourses of the early childhood education organizations about teaching, learning, and computers, their pedagogical practices were limited by the existing school culture. This section discusses the implications of this study for both educational practices and future research.

Educational Implications

Teacher Development

As noted by Kerr (1991), "after eighty years of efforts to apply technology in ways that would 'revolutionize' education, most teaching practice today looks remarkably the way it did at the beginning of this century" (p. 114). Cuban (2001) also suggests that fewer than 10% teachers in his study were serious users of ICTs in their classrooms, and that school structures and external demands influence the way computers are used. For example, he points out that most schools' decision to centralize computers in computer labs, the high workload that teachers have, and the view that computers are mere "add-on" to the curriculum constrain the way computers are used in the classrooms.

Consistent with Kerr's (1991) and Cuban's (2001) suggestions, and the socio-cultural framework of teaching suggested by Britzman (2003), Clark and Peterson (1986),

and Pratt and Nesbit (2001), the finding of this study implies that holding beliefs that adhered to the official discourses about teaching and learning does not necessarily assure continuity between teachers' beliefs with their pedagogical practices. The finding of this study suggests that, if teacher professional development and teacher preparation programs are only aimed to change or shape teachers' beliefs, these programs will not be enough to produce sustainable changes in teachers' pedagogical practices. Thus, it is important for teacher professional development and teacher preparation programs to focus on the socio-cultural contexts of teaching in addition to focusing on teachers' belief systems. Kerr (1991) suggests that, "efforts to provide preservice and in-service education about technology in the classroom should *not* proceed from an assumption that teachers' views of technology need to be 'fixed,' or that teachers are recalcitrant without reason in their approach to technology" (p. 132). He notes that changes cannot be made instantly through one-day professional development workshop or a course in teacher education program; instead, he recommends that more attention needs to be paid to the schools as social organizations and cultural institutions to accommodate changes in teachers' uses of ICT. In the same manner, Cuban (2001) also argues that "it is untrue that schools or teachers cannot change" (p. 195). He believes that there can be fundamental changes in teachers' uses of ICT, provided that there are "comprehensive changes in the existing system of schooling... For such fundamental changes in teaching and learning to occur there would have to have been widespread and deep reform in schools' organizational, political, social, and technological contexts" (p. 195).

In order to produce meaningful changes in teachers' uses of ICT, there needs to be collaboration among various elements of the school community and related institutions (Bryson & de Castell, 1998; Cuban, 2001; Fullan, 2001), including local schools, school districts, teacher education programs, parent associations, and related organizations.

Fullan (2001) emphasizes the importance of "reculturing," in which the school culture is transformed to produce "the capacity to seek, critically assess, and selectively incorporate new ideas and practices - all the time, inside the organization as well as outside it" (p. 44). Fullan further argues that the process of reculturing involves transforming the social context of schooling, including developing relationships, building knowledge, and striving toward coherence.

The reculturing framework suggested by Fullan (2001) can be applied to promote changes in primary teachers' developmentally appropriate use of computers. First, Fullan indicates that the establishment of a knowledge-sharing climate among teachers is important to promote changes, since the mere access to the abundance of information is not meaningful enough to allow teachers to use the information for their teaching practices. Some examples of knowledge sharing as part of teacher professional development activities suggested by Fullan (2001) are intervisitation, peer advising, and instructional consulting services. Through intervisitation, teachers can learn from each other, and exchange ideas by observing exemplary pedagogical practices of computer uses in other classrooms, both inside and outside the school and school district. Classroom observation can also be a medium for teachers to get peer feedback on their classroom computer uses. Furthermore, the existence of an instructional technology consultant can be another alternative to help teachers cope with problems they face in their classroom computer uses.

Second, Fullan (2001) stresses the importance of coherence-making efforts, since he notes that the main problem in schools lies in "the presence of too many disconnected, episodic, piecemeal, superficially adorned projects... schools are suffering the additional burden of having a torrent of unwanted, uncoordinated policies and innovations raining down on them from hierarchical bureaucracies" (p. 109). Thus, it is important that all

elements of the school community share the same vision and commitment toward their goals (DuFour & Eaker, 1998; Fullan, 2001; Hargreaves, 1994). In the use of computers in primary classrooms, for example, teachers' commitment to strive toward developmentally appropriate computer use needs to be supported by the school administrators' commitment toward the same goal by providing adequate equipment in the classrooms. DuFour and Eaker (1998) further suggest that a shared vision is an effective instrument for change, and that it is important that the vision is co-created rather than being imposed, in order to develop a sense of ownership toward the shared vision. They suggest that instead of centralizing the vision creation at the school district level, each individual school representative should be involved in creating and evaluating the school district vision. Furthermore, a vision statement needs to be supported by value and goal statements that provide guidance toward the actualizations of the shared vision.

The finding of this study is confirmed by a recent study conducted in a Faculty of Education (Bartosh, et al., 2005), which reported that even though 70% pre-service teachers believed that the use of computers could maximize students' learning and about 60% pre-service teachers indicated that they would like to incorporate computer uses in their future classrooms, only 15% or less pre-service teachers reported that they actually used specific subject matter software during their practicum. This report illustrates that despite having positive attitudes toward the use of computers, pre-service teachers did not make significant uses of computers during their practicum. Moreover, the pre-service teachers in Bartosh et al.'s (2005) study pointed out that their teacher education programs did not provide them with enough preparation in term of preparing them to use computers effectively, especially for specific subject areas, which was confirmed by the fact that only 19% of the instructors reported high preparedness in teaching pre-service teachers to use computers effectively.

Lave and Wenger (1991) argue that learning is situated in a social context, where new comers in a community of practice have a chance to exercise their role, starting from peripheral participation toward higher or full participation in the community of practice. Learning to teach involves practicing teaching in addition to merely internalizing educational theories, and therefore it is important that teacher education students are not only being exposed to theoretical frameworks in their coursework, but also to strategies to put their beliefs into practices in classroom settings. As noted by Mackinnon and Grunau (1994), "not all teaching can be characterized and communicated with words alone," and "at least a portion of professional knowledge resides in the actions of practitioners ('knowing how' as opposed to 'knowing that')" (p. 170). To bridge the gap between the pre-service teachers' coursework, practicum, and their future pedagogical practices, teacher preparation education programs need to be situated in the context of the school community. This can be achieved by promoting collaboration between pre-service teachers and in-service teachers. For example, Fullan (2001) suggests the importance of modeling and mentorship to promote learning processes that are embedded in the social contexts, whereas Bryson (2002) suggests integrating teacher education coursework with school-based experiences, such as the application of problem-based learning in the form of analyzing digital video case studies to help teacher education students apply theories into practice. Furthermore, teacher preparation programs need to involve more hands-on training on the use of computers in specific classroom settings or subject areas, which according to Beyerbach, Walsh, and Vannatta (2001) could help teachers change the nature of their computer uses from teaching technology to using the technology to support students' learning. To prepare teacher education students for their future pedagogical practices, teacher preparation programs should provide their students with experience in designing classroom computer activities, evaluating the appropriateness of certain

software or computer activities, engaging in discussion forums dedicated to evaluate computer uses in classroom settings, and sharing ideas and strategies for classroom computer uses. Also, it would be helpful for pre-service teachers who wish to develop their use of ICTs to work with teacher mentors who use computers in their daily classroom activities.

Toward a Coherent Plan of ICT Implementation Strategies

As Cuban (2001) suggests, merely focusing on approaches to "help" teachers better integrate ICTs in their classrooms may reflect a "blame and train" strategy, while setting aside the fact that teachers' use of ICTs is limited by poor infrastructure in schools. This study reveals constraints faced by teachers that limited their use of ICTs, such as a high amount of pressure from the curriculum, limited available support, and problems with their classroom computers. Thus, this finding implies that it is important that strategies toward building teachers' capacity to integrate ICTs in their classrooms are complemented with the improvement of the infrastructure that will support ICT implementation at schools. Particularly, the finding of this study implies that the mere availability of computers in the classrooms does not necessarily assure ICT integration into the daily activities, especially when the computers do not have the features that can facilitate teachers' plan for ICT integration into the curriculum. Furthermore, it is imperative to have ICT facilities that are reliable for classroom uses, and immediate technical support that helps ensure that the effort and time that teachers invest in order to integrate ICTs into their daily classroom activities will not be wasted.

Reflecting on Teaching Practices

Pratt and Nesbit (2000) suggest that as a set of interaction rituals, teaching is heavily loaded with normative expectation, and that teachers as members of the community of practice tend to think, value, and act in ways that sustain the existing

teaching cultures. Moreover, they argue that the existence of external pressures and the limited time available might discourage teachers from critically question the "accepted ways of doing things which can lead to the adoption of more conservative and traditional teaching approaches" (p. 125). In order to promote continuity between teachers' own beliefs and their pedagogical practices, it is important to bring the existing discontinuity into teachers' and administrators' awareness. According to Pratt and Nesbit (2000) and Ableser (2005), it is important to encourage teachers to critically reflect on their teaching practices, and the beliefs and values that they hold. Through a reflective practice, teachers will be able to identify and acknowledge the existing discontinuity, and take the necessary steps to make adjustments to their pedagogical practices. Furthermore, Hargreaves (1994) suggests that collaboration among teachers can increase teachers' capacities for reflection, where teachers can be the source of feedback for their peers, and help each other to reflect on their own pedagogical practices. Reflective dialogues among teachers, such as observing and reflecting upon each other's teaching practices, can help sustain the effort to change the school improvement processes (DuFour & Eaker, 1998). On the other hand, Kerr (1991) advises that reflective practices cannot happen easily, particularly because the high amount of responsibility and the limited time that teachers have. Thus, Kerr recommends restructuring classroom time in order to alleviate the pressures that teachers have. In the same manner, DuFour and Eaker (1998) also acknowledge that the tradition of collaboration among teachers is still rare. Therefore, they suggest that collaborative culture needs to be promoted, not only by invitation for collaboration, but also by building collaborative teams that have explicit purpose, adequate training and support, as well as adequate time during the school days.

For administrators, conducting reflective practice will also be helpful, to allow them to review the decisions made and the existing infrastructure that might impede

teachers from actualizing their personal beliefs into pedagogical practices. The decision to provide teachers with old computers in their classrooms, for example, limited teachers in incorporating Internet uses in their students' projects optimally. In primary grades in particular, where teachers tend to have a lower specification of classroom computers than the other grades, which has less features than what they need to conduct more meaningful activities, it is important that administrators realize how primary teachers have been limited in their classroom computer uses by having inadequate equipment, and that merely providing computers is not enough to ensure meaningful changes in teachers' pedagogical practices. Furthermore, the fact that the existing centralized equipment (e.g., wireless computers and software in the library to be signed out for classroom uses) were not heavily used by primary teachers called for further actions, such as keeping teachers informed with the availability of the equipment (e.g., providing an annotated software list, or circulating an annotation of recently purchased software) and procedure to use the equipment, and ensuring equity in the accessibility of the equipment (e.g., giving equal access for teachers of all grade levels to sign out wireless computers).

Research Implications

Several implications for research can be drawn from this study. First, further empirical evidence is needed to validate the arguments that teachers have about the developmental appropriateness of computer uses for primary students. More evidence is needed to find out more about the impacts of various computer uses on children's development and learning, including the use of various kinds of software (both software that is claimed as developmentally appropriate and software that is suspected to be developmentally inappropriate), various ways of using the software (i.e., the nature of the activities at the computers), and the amount of time that should be spent at the computers. In addition, it would be interesting to examine whether integrating computer use into

daily lesson plans and curriculum is more beneficial for student learning than using computers as a reward. It would also be valuable to investigate whether the ways computers are being used at the school, which are aimed to inform children to make use of computers in an educational fashion, actually correlate with the ways children use the computers at home. This would enable the development of research-based criteria of developmentally appropriate computer uses for primary students, and provide more guidance for primary teachers. Furthermore, it would be valuable to investigate primary students' perspective on the use of various software and activities, including the ones that teachers believe to be developmentally appropriate or inappropriate for primary students, to better understand the children's perspective about their experiences when using computers.

At the institutional level, it would be valuable to conduct an intervention study to produce sustainable changes in teachers' developmentally appropriate uses of computers for primary students. Since this study revealed that teachers' pedagogical practices were shaped by the social context of the school community, intervention studies that incorporate meaningful collaboration among researchers, teacher education students, teachers, administrators, school district ITS team members, researchers, teacher educators, and parent associations are necessary to improve teachers' uses of computers at schools. Further research is needed to initiate, develop, and test a model of collaboration among various elements of the school community (Bryson, 2002).

Limitations of the Study

This study has several limitations. First, it is likely that since the interviews were cross-cultural linguistic events, where I, the interviewer, was speaking English as my second language, this influenced the interview process. For example, it was challenging for me to think on my feet and to choose and compose follow-up questions in my second

language, while listening to the teachers and trying to guide the conversation in a natural way. Furthermore, as a person who has never experienced teaching in Canadian primary classrooms, I felt that my understanding of the full nature of teaching culture was limited. On the other hand, being an outsider of the school community allowed me to listen to teachers' voices and critically reflect on their stories from a different perspective. To confirm my interpretation of the interview process, a member check was done with each participant, where I sent each individual case description draft to the teacher I interviewed. This member check process gave me the opportunity to validate my understanding of the interview process, as well as giving the participants opportunities to review their belief statements and provide clarification they considered necessary.

Second, the reported classroom computer uses in this study were based solely on teachers' report, and not confirmed by systematic classroom observations. This could give a one-sided portrait of the classroom practices, where the teachers reported classroom computer uses from their own perspectives. The students' work presented in the case descriptions supported practices that the teachers reported; however, these pieces were chosen by the teachers, and might not represent the overall work produced by the students.

Third, since the study examined the beliefs and practices of a small number of primary teachers, it may not represent the larger population of primary teachers. Moreover, the fact that the teachers who participated in this study had many years of teaching experience, went through post baccalaureate training on teaching technology, and reported to work in schools that were well-equipped with computer facilities limited the generalizability of the findings.

Conclusion

As a member of the community of practice, teachers' beliefs, values, and actions are shaped by the cultures of their teaching community (Pratt & Nesbit, 2000). This study revealed that having teachers who shared similar values about developmentally appropriate practice with their colleagues and the early childhood education organizations was not necessarily consonant with a coherent picture where their pedagogical practices were consistent with their espoused beliefs. This study revealed that several constraints limited teachers from "translating" beliefs into pedagogical practices. Moreover, at the institutional level, the existing infrastructure clearly limited teachers' efforts to apply "developmentally appropriate" practices in their classroom computer uses. Thus, expecting sustainable changes in teachers' pedagogical practices toward more developmentally appropriate ICT uses requires changes in a bigger context, that is, infrastructure changes to existing school cultures. To support teachers in the implementation of developmentally appropriate practice in their classroom ICT uses, it is imperative to ensure the availability of a material, as well as a conceptual infrastructure that will support teachers in making meaningful uses of computers, the availability of technical and instructional support for teachers, and the accessibility of the available equipment. In teacher development and teacher preparation programs, there is a need for adequate hands-on training to support teachers and prepare pre-service teachers in their uses of computers in their current and future pedagogical practices. Further research is needed to provide deeper understanding about developmentally appropriate and inappropriate uses of computers for primary students, and to develop and implement intervention programs that involve various elements of the school community to collaboratively produce sustainable change toward developmentally appropriate uses of computers.

REFERENCES

- Ableser, J. (2005). Mismatched curriculum: One size does not fit all. *Curriculum and Teaching, 20* (2), 23-40.
- American Academy of Pediatrics (n.d.) *The ratings game: Choosing your child's entertainment* [On-line]. Retrieved on October 15, 2005, from <http://www.aap.org/family/ratingsgame.htm>
- American Academy of Pediatrics, American Academy of Child & Adolescent Psychiatry, American Psychological Association, American Medical Association, American Academy of Family Physicians, & American Psychiatric Association (2000). *Joint statement on the impact of entertainment violence on children*. Congressional Public Health Summit July 2000. Retrieved on September 4, 2005 from <http://www.aap.org/advocacy/releases/jstmtevc.htm>
- American Academy of Pediatrics Committee on Communications (1995). Children, adolescents, and advertising. *Pediatrics, 95* (2), 295-297.
- American Academy of Pediatrics Committee on Public Education (1999). Media education. *Pediatrics, 104* (2), 341-343.
- American Academy of Pediatrics Committee on Public Education (2001). Media violence. *Pediatrics, 108* (5), 1222-1226.
- American Diabetes Association (2000). Type 2 diabetes in children and adolescents. *Diabetes Care, 23* (3), 381-389.
- Bartosh, O., Bruce, R., Dobson, T., Erickson, G., Gaskell, J., Guo, R., Mayer-Smith, J., Nicol, C., & Petrina, S. (2005). A faculty study of technology practices: Understanding pre-service teachers' and instructors' competencies and attitudes to learning technologies. Retrieved on November 30, 2005, from http://educ.ubc.ca/technology/tech_report05.pdf

- Becker, H.J. (1994). How exemplary computer-using teachers differs from other teachers: Implications for realizing the potential of computers in schools. *Journal of Research on Computing in Education*, 26, 291-321.
- Becker, H.J. (2001). *How are teachers using computers in instruction?* Paper presented at the 2001 Meetings of the American Educational Research Association. [Electronic version]. Retrieved March 20, 2004, from <http://www.crito.uci.edu/tlc/FINDINGS/special3/>
- Berg, B.L. (1995). *Qualitative research methods for the social sciences (2nd edition)*. Boston, MA: Allyn and Bacon.
- Bernard, H.R. (1994). *Research methods in Anthropology*. Thousand Oaks, CA: Sage Publications.
- Beyerbach, B., Walsh, C., & Vannatta, R. (2001). From teaching technology to using technology to enhance student learning: Preservice teachers' changing perceptions of technology infusion. *Journal of Technology and Teacher Education*, 9(1), 105-127.
- Borja, R.R. (2003). Children's home computer use linked to learning and weight. *Education Week*, 23 (10), 14.
- Braak, J.V. (2001). Individual characteristics influencing teachers' class use of computers. *Journal of Educational Computing Research*, 25, 141-157.
- Bredekamp, S. (1987). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. Washington, DC : National Association for the Education of Young Children.
- British Columbia Ministry of Education. (1995a). *Applied Skills K to 7: Technology Education Component. Integrated resource package 1995*. Victoria, B.C.: Ministry of Education.

- British Columbia Ministry of Education. (1995b). *Physical education K to 7: Integrated resource package 1995*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1995c). *Science K to 7: Integrated resource package 1995*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1996a). *English language arts K to 7: Integrated resource package 1996*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1996b). *Information technology K to 7: Integrated resource package 1996*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1998a). *Fine Arts K to 7: Integrated resource package 1998*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1998b). *Social studies K to 7: Integrated resource package 1995*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education. (1999). *Personal planning K to 7: Integrated resource package 1999*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education (2000). *The primary program: A framework for teaching*. Victoria, B.C.: Ministry of Education, Student Assessment and Program Evaluation Branch, Province of British Columbia.
- British Columbia Ministry of Education (2002). *Evaluating, selecting, and managing learning resources: A guide*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education (2005a). *Science K to 7: Integrated resource package 2005*. Victoria, B.C.: Ministry of Education.
- British Columbia Ministry of Education (2005b). *B.C. Ministry of Education curriculum revision and implementation schedule K-7*. Retrieved on January 17, 2006 from http://www.bced.gov.bc.ca/irp/implement_sched.pdf

- Britzman, D.P. (2003). *Practice makes practice: A critical study of learning to teach*. NY: State University of New York Press.
- Bryson, M., & de Castell, S. (1998). New technologies and the cultural ecology of primary schooling: Imagining teachers as luddites in/deed. *Educational Policy*, 12, 542-567.
- Bryson, M. (2002). *Development by design: e-Capacity building to transform teaching and learning in the digital age*. Retrieved on November 28, 2005, from <http://www.educ.ubc.ca/faculty/bryson/sshrc.htm>
- Campbell, F. A., Pungello, E. P., Miller-Johnson, S., Burchinal, M., & Ramey, C. T. (2001). The development of cognitive and academic abilities: Growth curves from an early childhood educational experiment. *Developmental Psychology*, 37, 231-242.
- Campbell, F. A., Ramey, C. T., Pungello, E. P., Sparling, J., & Miller-Johnson, S. (2002). Early childhood education: Young adult outcomes from the Abecedarian Project. *Applied Developmental Science*, 6, 42-57
- Carta, J.J. (1995). Developmentally appropriate practice: A critical analysis as applied to young children with disabilities. *Focus on Exceptional Children*, 27 (8), 1-14.
- Clark, C.M., & Peterson, P.L. (1986). Teachers' thought process. In M. Wittrock (Ed.). *Handbook of research on teaching* (pp. 255-296). New York: Macmillan.
- Clements, D.H., & McMillen, S. (1996). Rethinking concrete manipulatives. *Teaching Children Mathematics*, Jan., 270-279.
- Clements, D.H., Nastasi, B.K., & Swaminathan, S. (1993). Young children and computers: Crossroads and directions from research. *Young Children*, 48 (2), 56-64.

- Collis, B.A., Knezek, G.A., Lai, K.W., Miyashita, K.T., Pelgrum, W.J., Plomp, T., et al. (1996). *Children and computers in school*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
- Cordes, C., & Miller, E. (2000). *Fool's gold: A critical look at computers in childhood* [On-line]. Retrieved on October 25, 2005, from http://www.allianceforchildhood.net/projects/computers/computers_reports.htm
- Creswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications.
- Cuban, L. (1993). Computers meet classroom: Classroom wins. *Teachers College Records*, 95, 185-211.
- Cuban, L. (2000). Is spending money on technology worth it? *Education Week*, 19 (24), 42.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge: Harvard University Press.
- Cuban, L., Kirkpatrick, H., & Peck, C. (2001). High access and low use of technologies in high school classrooms: Explaining an apparent paradox. *American Educational Research Journal*, 38, 813-834.
- de Castell, S., Bryson, M., & Jenson, J. (2002). Object lessons: Toward an educational theory of technology. *First Monday*, 7 (1). Retrieved August 24, 2004 from http://firstmonday.org/issues/issue7_1/castell/index.html.
- DuFour, R., & Eaker, R. (1998). *Professional learning communities at work: Best practices for enhancing student achievement*. Bloomington, Indiana: National Educational Service.

- Englert, C.S., Manalo, M., & Zhao, Y. (2004). I can do it better on the computer: The effects of technology-enabled scaffolding on young writers' composition. *Journal of Special Education Technology, 19* (1), 5-21.
- Ferguson, S. (2005, June 6). How computers make our kids stupid. *Maclean's*, 24-30.
- Finkelhor, D., Mitchell, K.J., & Wolak, J. (2000). *Online victimization: A report on the nation's youth* [On-line]. National Center for Missing and Exploited Children. Retrieved on October 10, 2005 from <http://www.netsmartz.org/pdf/OnlineVictimization.pdf>
- Freeman, N.K., & Somerindyke, J. (2001). Social play at the computer: Preschoolers scaffold and support peers' computer competence. In D.D. Shade (Ed.). *Information technology in childhood education annual* (pp. 45-56).
- Frost, J.L., Wortham, S., & Reifel, S. (2001). *Play and child development*. Upper Saddle River, NJ: Merrill Prentice Hall.
- Fullan, M. (2001). *Leading in a culture of change*. San Francisco, CA: Jossey-Bass.
- Garrison, M.J., & Bromley, H. (2004). Social contexts, defensive pedagogies, and the (mis)uses of educational technology. *Educational Policy, 18*, 589-613.
- Gestwicki, C. (1995). *Developmentally appropriate practice: Curriculum and development in early education*. Albany, NY: Delmar Publishers.
- Giacquinta, J.B., Bauer, J.A., & Levin, J.E. (1993). *Beyond technology's promise: An examination of children's educational computing at home*. Cambridge University Press.
- Gilstad, B.C. (1995). A descriptive study of a teacher and six preschoolers interacting with computers: Teacher-mediated activities, teacher-child interaction, and the teacher's perspective. *Dissertation Abstract International, A55/10*, 3078.

- Gore, D.A., Morrison, G.N., Maas, M.L., & Anderson, E.A. (1989). A study of teaching reading skills to the young child using microcomputer assisted instruction. *Journal of Educational Computing Research*, 5, 179-185.
- Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education*, 101, 261-315.
- Hargreaves, A. (1994). *Changing teachers, changing times: Teachers' work and culture in the postmodern age*. Toronto, Ontario: OISE Press.
- Haugland, S.W. (1992). The effect of computer software on preschool children's developmental gains. *Journal of Computing in Childhood Education*, 3, 15-30.
- Haugland, S.W. & D.D. Shade. (1988). Developmentally appropriate software for young children. *Young Children*, 43 (4), 37-43.
- Healy, J.M. (1998). *Failure to connect: How computers affect our children's minds-for better and worse*. NY: Simon & Schuster.
- Healy, J. M. (2004). Young children don't need computers. *Education Digest*, 69 (5), 57.
- Hildebrand, V. (1986). *Introduction to early childhood education*. New York: MacMillan.
- Hinostroza, E., & Mellar, H. (2000). Teachers' beliefs about computers: Report of a case study. *Journal of Educational Computing Research*, 22, 397-409.
- Hyun, E. (1998). *Making sense of developmentally and culturally appropriate practice (DCAP) in early childhood education*. *Rethinking Childhood vol. 6*. NY: Peter Lang Publishing, Inc.
- Kagan, D.M. (1990). Ways of evaluating teacher cognition: Inferences concerning the goldilocks principle. *Review of Educational Research*, 60, 416-469.
- Kang, N.H., & Wallace, C.S. (2004). Secondary science teachers' use of laboratory activities: Linking epistemological beliefs, goals, and practices. *Science Teacher Education*, 89, 140-165.

- Kerr, S.T. (1991). Lever and fulcrum: Educational technology in teachers' thought and practice. *Teachers College Record*, 92 (1), 114-136.
- Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage Publications.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.
- Levitt, K.E. (2001). An analysis of elementary teachers' beliefs regarding the teaching and learning of science. *Science Education*, 86, 1-22.
- Lonka, K., Joram, E., & Bryson, M. (1996). Conceptions of learning and knowledge: Does training make a difference? *Contemporary Educational Psychology*, 21, 240-260.
- Lynch, S.A., & Waner, L. (2004). Computer use in Preschools: Directors' reports of the state of the practice. *Early Childhood Research & Practice*, 6 (2), 1-13.
- MacArthur, C.A., & Malouf, D.B. (1991). Teachers' beliefs, plans, and decisions about computer-based instruction. *Journal of Special Education*, 25, 44-72.
- Mackinnon, A.M., & Grunau, H. (1994). Teacher development through reflection, community, and discourse. In P.P. Grimmet & J. Neufeld (Eds.). *Teacher development and the struggle for authenticity: Professional growth and restructuring in the context of change* (pp. 165-192). New York: Teachers College Press.
- Margerum-Leys, J., & Marx, R.W. (1999). Teacher education students' beliefs about technology. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal.
- Michaels, S. (1990). The computer as a dependent variable. *Theory Into Practice*, 29, 246-255.

- National Association for the Education of Young Children (1994). *Media violence in children's lives: A position statement of the National Association for the Education of Young Children*. Retrieved August 14, 2005, from <http://www.naeyc.org/about/positions/pdf/PSMEVI98.PDF>
- National Association for the Education of Young Children (1996). *Technology and young children: Ages 3 through 8*. Retrieved March 14, 2004, from http://www.naeyc.org/resources/position_statements/pstech98.htm
- National Association for the Education of Young Children (1997). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8: A position statement of the National Association for the Education of Young Children*. Retrieved April 15, 2005, from <http://www.naeyc.org/about/positions/pdf/PSDAP98.PDF>
- National Association for the Education of Young Children (NAEYC), & National Association of Early Childhood Specialists in State Departments of Education (NAECS/SDE) (2003). *Early childhood curriculum, assessment, and program evaluation: Building an effective, accountable system in programs for children birth through age 8: Position statement with expanded resources*. Retrieved August 14, 2005, from <http://www.naeyc.org/about/positions/pdf/CAPEexpand.pdf>
- NICHD Early Child Care Research Network (2004). Does class size in first grade relate to children's academic and social performance or observed classroom processes? *Developmental Psychology*, 40, 651-664.
- NICHD Early Child Care Research Network (2005). Predicting individual differences in attention, memory, and planning in first graders from experiences at home, child care, and school. *Developmental Psychology*, 41, 99-114.

- Niederhauser, D.S., & Stoddart, T. (2000). Teachers' instructional perspectives and use of educational software. *Teaching and Teacher Education*, 17, 15-31.
- Olson, J.K. (1986). Information technology and teacher routines: Learning from the microcomputer. In M. Ben-Peretz, R. Bromme, & R. Halkes (Eds.), *Advances of research on teacher thinking* (pp. 133-141). Berwyn: The International Study Association on Teacher Thinking.
- Pajares, M.F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62, 307-322.
- Pantiel, M., & Petersen, B. (1984). *Kids, teachers, and computers: A guide to computers in the elementary school*. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*. New York: HarperCollins Publishers, Inc.
- Perkins, R., & McKnight, M.L. (2005). Teachers' attitudes toward WebQuests as a method of teaching. *Computers in the Schools*, 22 (1/2), 123-133.
- Peterson, P.L., Fennema, E., Carpenter, T.P., & Loef, M. (1989). Teachers' pedagogical content beliefs in mathematics. *Cognition and Instruction*, 6 (1), 1-40.
- Piaget, J., & Inhelder, B. (1969). *The psychology of the child*. (H. Weaver, Trans.). New York: Basic Books, Inc (Original work published 1966).
- Pintrich, P.R., & Schunk, D.H. (2002). *Motivation in education: Theory, research, and application* (2nd edition). Upper Saddle River, NJ: Merrill Prentice Hall.
- Pratt, D. (1992). Conceptions of teaching. *Adult Education Quarterly*, 42 (4), 203-220.
- Pratt, D. (1998). *Five perspectives on teaching in adult and higher education*. Malabar, Fla.: Krieger Publishing Company.
- Pratt, D.D., & Nesbit, T. (2000). Discourses and cultures of teaching. In E. Hayes & A. Wilson (Eds.). *Handbook of adult and continuing education* (pp. 117-131). San

- Francisco: Jossey-Bass, Publishers. Available at
<http://www.edst.educ.ubc.ca/faculty/pratt/DPdisc.html>
- Rideout, V.J., Vandewater, E.A., & Wartella, E.A. (2003). *Zero to six: Electronic media in the lives of infants, toddlers and preschoolers. A Kaiser Family Foundation Report*. Retrieved February 14, 2004, from
<http://www.kff.org/entmedia/loader.cfm?url=/commonspot/security/getfile.cfm&pageID=22754>
- Riel, M., & Becker, H. (2000). *The beliefs, practices, and computer use of teacher leaders*. Paper presented at the American Educational Research Association. Retrieved on October 1, 2004 from <http://www.crito.uci.edu/tlc/findings/aera/>
- Sandholtz, J.H., Ringstaff, C., & Dwyer, D.C. (1997). *Teaching with technology: Creating student-centered classroom*. New York: Teachers College Press.
- Schaffer, S.P., & Richardson, J.C. (2004). Supporting technology integration within a teacher education system. *Journal of Educational Computing Research*, 31, 423-435.
- Schnackenberg, H.L., Luik, K., Nisan, Y.C., & Servant, C. (2001). A case study of needs assessment in teacher in-service development. *Educational Research and Evaluation*, 7, 137-160.
- Schraw, G., & Olafson, L. (2002). Teachers' epistemological world views and educational practices. *Issues in Education*, 8, 99-149.
- Schweinhart, L.J., & Weikart, D. (1997). *Lasting differences: The High/Scope preschool curriculum comparison study through age 23*. Michigan: High/Scope Educational Research Foundation.
- Seale, C. (1999). *The quality of qualitative research*. London: Sage Publications.
- Shade, Daniel D. (1996). Software Evaluation. *Young Children*, 51 (5), 17-21.

- Shade, D.D., & Haugland, S.W. (1994). Software evaluation for young children. In J.L. Wright & D.D. Shade (Eds). *Young children: Active learners in a technological age*. Washington, D.C.: The National Association for the Education of Young Children.
- Shapka, J.D., & Ferrari, M. (2003). Computer-related attitudes and actions of teacher candidates. *Computers in Human Behavior*, 19, 319-334.
- Shields, M. K., & Behrman, R. E. (2000). Children and computer technology: Analysis and recommendations. *The Future of Children*, 10(2), 4-30. Available at <http://www.futureofchildren.org>.
- Silverman, D. (1998). Analysing conversation. In C. Seale (Ed.), *Researching society and culture* (pp. 261-274). London: Sage Publications.
- Simmons, P.E., Emory, A., Carter, T., Coker, T. Finnegan, B., Crockett, D., et al. (1999). Beginning teachers: beliefs and classroom actions. *Journal of Research in Science Teaching*, 36, 930-954.
- Singer, D.G., & Singer, J.L. (1998). Developing critical viewing skills and media literacy in children. *Annals of the American Academy of Political and Social Science*, 557, 164-179.
- Singer, D.G., & Singer, J.L. (1991). *Creating critical viewers: A partnership between schools and television professionals*. Denver, Colorado: Pacific Mountain Network.
- Stake, R.E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publications.
- Statistics Canada, & Council of Ministers of Education, Canada. (2003). *Education indicators in Canada: Report of the Pan-Canadian education indicators program 2003*. Toronto, Ontario: Canadian Education Statistics Council.

- Statistics Canada, & Council of Ministers of Education, Canada. (2004). Connectivity and learning in Canada's schools. Ottawa, Ontario: Science, Innovation and Electronic Information Division.
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research*. California: Sage Publications.
- Svensson, A. (2000). Computers in schools: Socially isolating or a tool to promote collaboration? *Journal of Educational Computing Research*, 22 (4), 437-453.
- Teo, H.H., & Wei, K.K. (2001). Effective use of computer aided instruction in secondary schools: A causal model of institutional factors and teachers' roles. *Journal of Educational Computing Research*, 25, 385-415.
- Ungerleider, C.S., & Burns, T.C. (2002). *Information and communication technologies in elementary and secondary education: A state of the art review*. Retrieved March 18, 2004, from http://www.cmec.ca/stats/pcera/RSEvents02/CUngerleider_OEN.pdf
- Vidoni, K. L., & Maddux, C. D. (2002). WebQuests: Can they be used to improve critical thinking skills in students? *Computers in the Schools*, 19(1/2), 101-117.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. (M. Cole, V. John-Steiner, S. Scribner, & E. Soubberman, Eds.). Cambridge, MA: Harvard University Press).
- Wang, Y.M. (2002). When technology meets beliefs: Preservice teachers' perception of the teacher's role in the classroom with computers. *Journal of Research on Technology in Education*, 35, 150-161.
- Warschauer, M. (2000). Technology and school reform: A view from both sides of the tracks. *Educational Policy Analysis Archives*, 8 (4). Retrieved from <http://epaa.asu.edu/epaa/v8n4.html>.

- Washington, S.T. (2003). Teachers' perceptions of the implementation of the Waterford Early Reading Program, a computer-based instruction program: A case study of the evidence from teachers' interviews and students' achievement data in selective Pennsylvania urban elementary schools. *Dissertation Abstracts International*, A64/07, 2341.
- Wiener, R.S. (2000, November 22). More technology training for teachers. *New York Times* [Electronic version]. Retrieved March, 14, 2004, from <http://www.nytimes.com/2000/11/22/technology/22EDUCATION.html?ex=1079499600&en=7a416a2e542febe4&ei=5070>
- Wilson, J.D., Notar, C.C., & Yunker, B. (2003). Elementary in-service teacher's use of computers in the elementary classroom. *Journal of Instructional Psychology*, 30 (4), 256-263.
- Yelland, N. (1999). Reconceptualising schooling with technology for the 21st century: Images and reflections. In D. D. Shade (Ed.), *Information technology in childhood education annual*, 39-59.
- Yin, R.K. (1994). *Case study research: Design and methods* (2nd edition). London: Sage Publication.
- Zigler, E.F., Finn-Stevenson, & Hall, N.W. (2002). *The first three years and beyond: Brain development and social policy*. New Haven, CT: Yale University Press.

APPENDICES

Appendix A: Case Study Protocol

Research question: What are the beliefs that primary teachers hold about computer usage for primary students?

Procedures

1. Descriptions of which schools or teachers in the Lower Mainland are actively using computers in their primary class curriculum will be obtained through meetings with computer coordinators. A research blurb will be sent by e-mail to these coordinators in order to describe the research purpose. Based on their recommendations and contact assistance, information concerning the study will be disseminated to teachers. Interested teachers will then contact the researcher by e-mail or phone.
2. An initial visit will be made to each school to meet with each teacher who shows an interest in participating in this study. The purpose and procedure of the research will be presented to the teachers, including how long the interviews will take place (2 hours). During this visit, questions related to the criteria of inclusion will be solicited and teachers who meet the criteria will be included in the study. After getting each teacher's agreement to participate, the principals will be contacted to ask for their permission.
3. Permission will then be requested from the school district. Since school districts require the University of British Columbia Behavioural Research Ethics Board (UBC BREB) approval before granting such permission, this step will wait for the research ethics approval.
4. An interview lasting approximately one and a half hour will be conducted with each teacher. It will be audio tape-recorded.

5. A consent form will be provided at the initial interview with each participant. A copy of the consent form will be provided to each participant.
6. A second interview lasting approximately one and a half hour will be conducted with each teacher. It will be audio tape-recorded.
7. Encode the interview tapes into digital audio files.
8. Transcribe interviews.
9. Perform data analysis.
10. Write case descriptions.
11. Send each case description to the teacher and ask for her confirmation.
12. Write a research report.

Interview Protocol

First Interview Protocol

Throughout the interview, I will use the term "Information and Communication Technology, or ICT" to refer to computers, laptops, the Internet, and other tools that might be used in complement with the computers.

Background information

1. Tell me about yourself: what's your background as a primary teacher?
2. How did you come to be a primary teacher?
3. Have you held jobs other than as a primary teacher?
4. As a student, how did you use Information and Communication Technology (or ICT) in your K-12 classes?
5. As a teacher education student, how did you use ICT in the classes you took?
6. How do you use ICT in your everyday life outside of school?

Pedagogical practices

7. Can you tell me about the class you're teaching this year? (e.g., what grade are you teaching, how many students do you have?)
8. How many computers do you have in your classroom?
9. What are ICT facilities that your students have access to in the classroom? What are ICT facilities that they have access to outside the classroom?
10. How often do your students use ICT each week?
11. What software is available for your students? Which software is most frequently used? How is it used most frequently?
12. How do you schedule your students' access to the ICT?
13. In order to have ICT-related activities, did you have to give up or reduce other activities? If yes, what did you give up and why? If not, how did you organize it without giving up or reducing other activities?
14. How is ICT being used by students in your classroom this month?
15. How do your students use ICT outside of your classroom this month?
16. What are typical uses of ICT by primary students at your school?
17. How do students at your school use ICT in the classrooms compared to other non-classroom locations, such as in the labs or the library?
18. How have you used ICT for your curriculum development this year? How have you used ICT for your instructional planning this year?
19. In your work at this school, what kinds of things have you seen other teachers do with ICT?
20. What kinds of opportunities do you have to learn about ICT?
21. What would you like to be able to do with ICT and primary students that you cannot do at present time? Why?

Beliefs about computers

22. In general, what are some of the best uses of ICT in primary classrooms?
23. What do you see as the role of ICT as part of your classroom environment? What do you see as the role of ICT as part of your curriculum?
24. Do you think that in primary classrooms ICT is more appropriate in certain kinds of activity or learning than others?
25. How do you evaluate appropriate uses of ICT?
26. What might it mean to be an advanced ICT-using teacher? What would such a person know how to do? What might she do?

Second Interview Protocol

Beliefs about learning and computer

1. What does the Primary curriculum consist of in your classroom?
2. What is the most important aspect of language arts the Primary curriculum? What is the role of ICT in supporting primary students' learning in this aspect? (mathematics, social studies, science, personal planning, fine arts, and applied skills).
3. Are there some specific learning goals that will be best achieved through manipulative activities compare with the equivalent software?
4. Are there some specific learning goals that pertain to social development that will be best achieved through social interaction compare with the equivalent software?
5. How do primary students learn? What is unique about how primary students learn?
6. What problems do they have learning? Why do you think they have those problems?
7. What is your primary role as a teacher in a primary classroom? What does the role entail?
8. How has your teaching changed, as a primary teacher, over the years? What has influenced the changes?

9. Can you think of a metaphor that guides you in teaching in primary classroom? How would you place ICT in this metaphor? What is the role of ICT in your teaching?

Beliefs about computers

10. Are there specific uses of ICT in primary classrooms which have positive impacts for teachers in general and for you specifically? Are there specific uses of ICT in primary classrooms which have negative impacts for teachers in general and for you specifically?
11. Are there specific uses of ICT in primary classrooms which have positive impacts for students? Are there specific uses of ICT in primary classrooms which have negative impacts for students?
12. There have been contrasting opinions about using ICT with primary students. For example, some people argue that, "if schools failed to integrate computers into the curriculum, we'd be missing a huge part of children's life - it would be like not including physical education in the school day." On the other hand, some other people argue that, "computers and the Internet can distract kids from homework, encourage superficial and uncritical thinking, replace face-to-face interaction between students and teacher, and lead to compulsive behaviour." What do you think about these arguments?
13. Regarding literacy development in particular, some people believe that, "computers help students master the alphabet, reading, and writing more quickly than they would in a tech-free environment," whereas other people argue that, "time spent at the screen may crowd out personal interaction with teachers and creativity," and further suggest that, "for reading literacy of young children, very frequent computer use at school

could have a severe effect, since the learning of reading requires a lot of interaction between teachers and students." What is your opinion regarding these arguments?

14. In the British Columbia Ministry of Education document about Primary Program: A Framework for Teaching (2000) and the IRPs for some subject areas, there are some prescribed learning outcomes related to ICT. For example, that "students will employ a variety of effective processes and strategies, including the use of electronic technology, to generate, gather, and organize information and ideas" (K-1 Language Arts IRP, 1996), that "students will demonstrate a willingness to work co-operatively when using information technology tools" (K-3, Primary Program, 2000), and that "students will present ideas using electronic documents" (K-1, Primary Program, 2000). How do these compare with the ICT-related learning outcomes that you expect your students to achieve by the end of the school year? Do you usually incorporate ICT-related learning outcomes in the report cards?
15. In its position statement about Developmentally Appropriate Practice in Early Childhood Program, The National Association of the Education of Young Children (NAEYC) stated that "learning activities and materials should be concrete, real....," and that "children need years of play with real objects and events before they are able to understand the meaning of symbols...." What do you think about this perspective on the development of young children and the appropriateness of real objects versus use of ICT?
16. In its position statement about Developmentally Appropriate Practice in Early Childhood Program, the NAEYC stated that "hands-on activity and experimentation is more appropriate for this age group [6-8 years olds] than fatiguing mechanical seatwork." What is your opinion about this perspective?

17. Some educators and researchers argue that spending time in front of computers may affect young children's social development negatively. For example, they argue that most of the computer time is spent alone, which can limit a child's interaction with others. They also argue that the use of violent games might increase aggression and decrease pro-social behaviour. What do you think about these arguments? Do you think that young children's ICT usage can impair their social and interpersonal development?
18. What would be developmentally appropriate ICT uses for primary children? How would teachers provide learning environment that is developmentally appropriate for primary children?
19. Can you give me an example of software that is appropriate for primary children?
Why is it appropriate?
20. What is developmentally appropriate use of the Internet for primary students? What impacts will Internet have on primary children' learning and development?
21. Is ICT more appropriate for some primary children than for others?
22. What would be developmentally inappropriate ICT uses for primary children? How do you evaluate inappropriate uses of ICT?
23. Can you give me an example of software that is inappropriate for primary children?
Why is it inappropriate?
24. Do you think that there should be a limit to the maximum time a primary child works with ICT? If, yes, for how long? Why do you think so?
25. What do you think about the impact of child-initiated play in primary classrooms on children's development and learning? What is your opinion about Jane Healy's argument that ICT reduces a young child's spontaneous play, which is important for the child's intellectual, creativity, and social skills development?

26. What can we achieve by means of ICT in primary classrooms that we cannot achieve as well by means of other methods? (What is the unique contribution of ICT in primary students' learning that cannot be provided by other methods?)

Appendix B: Simplified Transcription Symbols

Table 20.1 *Simplified transcription symbols*

Symbol	Example	Explanation
[C: quite a [while M: [yea	Left brackets indicate the point at which a current speaker's talk is overlapped by another's talk
=	W: that I'm aware of = C: = Yes. Would you confirm that?	Equal signs, one at the end of a line and one at the beginning, indicate no pause between the two lines
(0.4)	Yes (0.2) yeah	Numbers in parentheses indicate elapsed time of silence in tenths of a second
(.)	to get (.) treatment	A dot in parentheses indicates a tiny gap, probably no more than one-tenth of a second
_____	What's <u>up</u> ?	Underlining indicates some form of stress, via pitch and/or amplitude
::	O:kay?	Colons indicate prolongation of the immediately prior sound. The length of the row of colons indicates the length of the prolongation
WORD	I've got ENOUGH TO WORRY ABOUT	Capitals, except at the beginnings of lines, indicate especially loud sounds relative to the surrounding talk
.hhhh	I feel that (0.2) .hhh	A row of h's prefixed by a dot indicates an inbreath; without a dot, an outbreath. The length of the row of h's indicates the length of the in- or outbreath
()	future risks and ()	Empty parentheses indicate the transcriber's inability to hear what was said
(word)	Would you see (there) anything positive	Parenthesized words are possible hearings
(())	confirm that ((continues))	Double parentheses contain author's descriptions rather than transcriptions
?	What do you think? That's it.	Rising intonation Falling intonation

(Silverman, 1998, p. 264)