

REVOLUTION OR RHETORIC:
FACTORS AFFECTING TEACHERS' DECISIONS
ABOUT COMPUTERS IN CLASSROOMS

by

Kevin Akins

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APPROVAL

Name: Kevin Robert Lorne Akins
Degree: Master of Arts
Title of Thesis: Revolution or Rhetoric: Factors Affecting
Teachers' Decisions About Computers
in Classrooms
Examining Committee:
Chair: A. C. (Tasos) Kazepides

Roland Case
Senior Supervisor

A. J. (Sandy) Dawson
Associate Professor

John C. Walsh
Assistant Professor
University of Victoria

Gerri Sinclair
Adjunct Professor
Faculty of Education
Simon Fraser University
External Examiner

Date Approved July 23, 1992

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Revolution or Rhetoric: Factors Affecting Teachers' Decisions about

Computers in Classrooms

Author: _____

(signature)

Kevin Robert Lorne AKINS

(name)

7/23/92

(date)

Abstract

Since computers first entered British Columbia schools in the early 1980's the call for their increased use has risen to a clamour. Despite increased numbers of computers, it is not clear to what extent and on what basis teachers use them in their teaching. This study investigates factors affecting classroom teachers' decisions about computer use. The study involves a review of publications influencing teachers' decisions, a survey of teachers in a single district and interviews with a sample of these teachers.

A four-page questionnaire was distributed to all of the K-7 teachers in a medium sized British Columbian school district. Responses of 126 classroom teachers were analysed. A sample of 11 teachers were interviewed in order to assist in clarifying the data from the questionnaire and to probe for deeper insights into teachers' use of computers for instruction.

The literature review found that professional, government and lay publications describe computer use in schools in enthusiastic and uncritical terms and often promised revolutionary benefits for schools as a result of computer use. The questionnaire and interviews found that, while most teachers believed they should use computers, their actual practice involving computers was minimal in comparison to the level and quality of use implied in the literature.

The results of the study suggest that the disparity arises predominantly from two sets of factors. First, teachers' use of computers is restricted by three practical impediments: lack of access to hardware and software, lack of knowledge of computers and the instructional use of computers, and lack of time to learn about, plan for and implement the

instructional use of computers. Second, teachers' faith in the need for computers is backed by neither the understanding of why they should employ computers, nor the commitment to change their current low level computer use.

The results of the study suggest two needs if computers are to have a chance to "revolutionize education". First, research is needed to determine if there is validity to the promise of dramatic effect touted in the literature. Second, the Ministry of Education and school districts need to show the teachers that they are committed to comprehensive integration of computers by carrying through with the development of curriculum, provision of sufficient hardware and software and provision of time for teachers to learn about and plan for the implementation of computers. Until such a commitment is acted upon, many teachers will continue to make minimal use of computers.

Dedication

For my father, a classroom teacher who taught me to wonder.

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I would like to thank Roland Case, John Walsh and Sandy Dawson for their unflagging support and friendship. While I don't suppose there is a perfect thesis committee, you came close.

I must also thank the teachers and administrators of "Centrevale" who volunteered to participate in this study. It takes great courage to open oneself up to scrutiny. Their willingness to reveal their thoughts and practice to me demonstrates their commitment to their students. I hope that together we have contributed something to education that is worthy of their trust.

All of my family and friends stood by me through endless complaints and excuses. Each and every one of you contributed to this work and I thank you all from the bottom of my heart for your love and support.

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CHAPTER 1

INTRODUCTION

Statement of objective

The first official introduction of microcomputers into British Columbia schools occurred in 1980 with little obvious public attention. In the 11 years following, the number of computers in B.C. schools has risen above 40,000 and the public has taken a very vocal interest. Educational computing has become an industry, as parents, government and educators have come to believe that computers are as indispensable to classrooms as chalkboards and books. Articles calling indiscriminately for more computers and more use of computers appear regularly in the popular and educational press. The presence of the computers in schools, the interest of parents in seeing their children use computers, the interest of the media in "high technology", and the interest of government in being seen as preparing for the future, all combine to pressure teachers to adopt computers into their practice. However, teachers, the people who are ultimately charged with deciding what will occur in classrooms, are not much better prepared to decide what to do with computers than they were in 1980. Very little is known about what to do with computers in schools and there has been little research to demonstrate that computers offer a great deal in terms of improved instruction. Further, teachers get little direction in how and why computers should be used. They are left largely to fend for themselves. This thesis explores how elementary teachers in one

British Columbia school district make decisions about their use of computers for instruction.

This first chapter describes how hegemonic the belief that computers belong in schools has become and describes four assertions used by proponents to support this belief. Despite the breadth of this support for introducing computers to schools, using those computers in instruction is far from simple. Four factors complicating teachers use of computers will be explored. The chapter will then introduce a study to determine what teachers' attitudes are towards computers and what factors they consider in making their decisions about their instructional use. Finally, the remaining four chapters of the thesis will be outlined.

Breadth of pro-computer sentiment

Educational literature has been heralding a microcomputer revolution since the early 1980's. The assertion has been that computers have transformed what students learn, how they learn and how well they learn. This pro-computer bias continues despite the fact that there has been an almost complete lack of research data to demonstrate the educational benefits of computers (Roblyer, Castine & King, 1988, p. 12). Rather than investigating whether or not computers have educational merit, much of the research that has been published focuses on identifying and eliminating the factors which constrain teachers' acceptance of computers (Bosco, 1986b, p. 115). For the most part researchers assume that, given the chance, computers will have a significant educational benefit. Even those researchers who accept the possibility that computers might not lead to increased student learning tend to focus on how the instructional

environment should be changed in order to facilitate computers' inherent potential (see, for example, Steier, 1987). Although some do question the expansion of computer technology in classrooms, (for example, Bowers, 1988; Roszak, 1986; Weizenbaum, 1976) even those advocating caution rarely question whether the existence of computers in schools is justified on educational grounds. Apple summarizes the resignation of most critics of computer technology in schools: "The new Technology is here. It will not go away. Our task as educators is to make sure that when it enters the classroom it is there for politically, economically and educationally wise reasons" (1986, p. 174).

Computer advocacy

With informed critics accepting the widespread introduction of computers into classrooms as inevitable, if not laudable, it is not surprising there is little resistance to computers from those inexperienced in the field. Virtually all groups who might conceivably comment on the issue are in favour of increasing the presence of computers in schools. Sources in which evidence of such support can be found include: the popular press (e.g., newspapers, magazines); television and radio; specialized educational publications (e.g., teachers' journals, both commercial and juried; teachers' professional publications; parent groups' publications); and publications from all levels of government. Examples from most of these are included below, and in chapter three.

The reasons for advocacy vary, and some are more clearly articulated than others. In many cases no justification is offered. For example, the *Report on Teacher Education in British Columbia* urges

that "familiarization with the use of computers be an integral part of all teacher education programs" (Bowman, 1991, p. 113). Unlike most other recommendations in the report, which are accompanied by lengthy explanation, this statement is presented as if its rationale is self evident. Again it is assumed that computers and classrooms belong together.

Where advocacy of computers in classrooms is accompanied by some justification, these reasons generally fall into four identifiable themes: one, computer knowledge is essential for the future; two, the computer revolution has occurred and schools must catch up; three, computers give students access to previously undreamed of resources; and four, children have a natural affinity for computers.

Need for the future

The most commonly articulated theme is that in the future everyone will need to use computers to be successful. It is suggested that since few areas of human activity will be free from computer use, the necessary skills must be acquired in schools. An example of this line of reasoning can be found in the newsmagazine of the B.C. Teachers' Federation: "Computer familiarity is essential on the part of students today. Even if our students are going to be mechanics or warehousemen, they're still going to have to know the basic elements of running a computer" (Cocking, 1988, p. 1).

Implicit within this line of reasoning is the assumption that computers are somehow icons representative of the future and that by having computers in classrooms we demonstrate a commitment to the future. An example of this is from *Phi Delta Kappan*: "electronic learning is the new technology of education...The action required of us

is clear, we must embrace the new, if society is to meet unprecedented educational demands" (Mecklenburger, 1988, p. 18).

The computer revolution has occurred

The second common assertion is that the computer revolution is a *fait accompli*, and that the onus is on teachers, schools, and school boards to catch up with some presumed standard of computer use. This is reflected in the following quotations from two-page advertisements running repeatedly in *Learning 91*, *Teaching K-8*, and *Instructor*, magazines:

Kids are the key to America's Future. And computers are the tools of their times. By the year 2010, virtually every job in America will require some use of technology. That means that we must prepare all of our youth today to take on technology tomorrow.

In a competitive global economy, students who have attained scientific literacy will be in demand. But traditional teaching methods cannot keep up with the rapid growth of scientific knowledge and technology.

It is apparent from the prevalence and size of their advertisements that computer suppliers have become the major advertisers in these popular, high quality magazines and the consistent message both in the articles and in the advertisements is that teachers must computerize to catch up.

Incomparable resource

Another increasingly common assertion is that computers give students access to previously undreamed of resources:

Never before has so much information been available to so many students. At the other end of the keyboard is a cornucopia of knowledge, stored on CD ROM, on laser disk, and in huge databases, and accessible with just a few simple commands. (Bruder, 1990, p. 39)

Kids love computers

The fourth popular assertion is that children have a natural affinity for computers: "They're everywhere! And, they're for everyone. Walk into any classroom where a computer is being used and you can feel the excitement. Kids love computers!" (Stone, 1988, p. 28).

Factors contending with computer use

These four assertions are important to this thesis because they are either explicitly or implicitly addressed to teachers, the gatekeepers of classroom practice. Each is a recurring theme in a pattern of advocacy pressuring teachers to employ computers. Yet, countering this pressure are at least three reasons why it is not a simple matter for teachers to introduce computers into their instruction: one, teachers lack the knowledge to use computers, let alone use them for instruction; two, many teachers have had bad experiences with computers in the past; and three, there is an almost complete lack of direction in how to use computers in instruction. Each of these is examined below.

Teachers' lack of experience

The first factor complicating teachers' decisions is their lack of experience in personal or instructional use of computers. According to 1984 estimates, 46.3% of elementary teachers in B.C. had familiarity with computers (Flodin, 1984, p. 28). A 1986 survey found

that 43% of teachers were "computer literate" (Simair, 1986, p. 9). In these studies the criteria for what constituted familiarity was not made clear. "Computer literate" might well mean that a teacher knows how to select a disk and turn on the computer. Even given the most optimistic scenario there is a substantial percentage of teachers who do not feel capable of using computers. And the number of teachers capable of *instructional* use of computers is much smaller. The American College of Teacher Education found that less than 20% of graduating teachers felt ready to teach with computers (AACTE, 1987).

Past failures

Even when teachers have had experience with computers, in many cases their experiences have been unpleasant. Virtually everyone who has used a computer for any period of time has had problems with the technology. The tendency of technology to go awry, compounded by inadequate training and insufficient numbers of computers and software, have resulted in many teachers having frustrating early experiences with instructional computing (OTA, 1988). Cases in which teachers have experienced these past frustrations have served only to compound the difficulties teachers face in making decisions about future uses of computers.

Lack of direction

The third factor complicating decisions is the daunting lack of official direction in how to use computers with students. In a 1986 Ministry of Education survey, school districts in B.C. were asked: "What factors have delayed or hampered your district's progress into computer education?". By a two to one margin over any other factor

the response was "Lack of clear statement or direction from the Ministry" (Simair, 1986, p. 3). Lacking clear direction from the Ministry of Education many districts develop their own implementation plans (see, for example, Clayton, 1986; Minshull, 1989). In 1986 46% of B.C. school districts had policies covering "Integration of computer-related learning objectives into the existing curriculum" (Simair, 1986, p. 25). By 1991 50% of the schools responding to the survey had "a policy and long-term plan for the implementation of computer technology" (ETC, 1991, p. 20). This, however, still leaves many districts with no concrete policy for computers and in the absence of provincial curriculum or district implementation plans, many teachers must decide for themselves how to use computers.

Thus, on one hand, teachers are subject to the assertions that: computers represent the future, the computer revolution has occurred, computers offer their students undreamed of resources, and that students and computers belong together. On the other hand, teachers are faced with unfamiliar, and often seemingly hostile, technology for which they receive no direction. I believe that it is important that we discover how teachers are functioning under these circumstances. It is clear that teachers are making decisions about computers – some use them, others do not. What we don't know is how they arrive at these decisions and, more importantly, if their deliberations are based on sound consideration of relevant educational factors.

Centrevale study

In light of the above, a study was conducted into the computer-related attitudes and considerations of elementary teachers in a single school district in British Columbia. Complete details of the district and its selection will be described in chapter three but it is noteworthy that it will be called "Centrevale" as the district administration prefer that it remain anonymous. The study asked three questions regarding teachers' instructional use of computers: What are teachers' attitudes towards computers as an instructional option? What factors most influence their choices in instructional use of computers? and How are teachers' beliefs and attitudes reflected in their practice? The intention is to construct a clear picture of how teachers are responding to the pressure to use computers, and the factors mitigating against their use. Once we understand how this group of teachers feel about computers, what factors they consider in their decisions whether or not to use computers and what they end up using computers for, we will be better prepared to judge whether computers serve an educational purpose in schools or whether they are there for other reasons.

Thesis outline

The second chapter introduces the methods of the study. Due to the limited resources of the single investigator, only the K-7 (kindergarten to grade 7) teachers in the single district were studied. Data were collected in three forms: on a questionnaire completed by 126 classroom teachers; in interviews with a stratified random sample of 11 teachers; and on a questionnaire completed by the principals of

the 20 schools involved. The third chapter covers the literature reviewed for the study. Four bodies of literature are discussed. In the first section previous research into teachers' attitudes and decisions are reviewed and it is determined that no studies could be found which would discharge the need to do my own study. In the second section of chapter 3, two bodies of published material are analyzed to demonstrate that while the provincial government and the Centrevale school district apparently support the use of computers in school, they offer little in the form of direction, and a survey of teachers' publications is conducted to demonstrate that these too offer promises of transformation, with little concrete direction. The fourth chapter describes the results of the study. The data are organized around the three study questions. More specifically, I describe the eleven most common themes in teachers' attitude towards computers; the six most common factors encouraging teachers' to use computers and the six most common factors discouraging them; and finally, the four most common patterns of use of computers among teachers. The fifth chapter discusses the findings of the study. Central to the interpretation of the results is the marked disparity between the revolutionary use of computers which the literature suggests should be occurring in schools, and the evidence that most teachers' use of computers is minimal. Two possible explanations for the disparity are explored: first, a series of practical impediments limit teachers, and second, while teachers have an apparent faith in computers, it is founded on a limited vision for their use, and a limited commitment to change.

CHAPTER 2

LITERATURE REVIEW

Introduction

This chapter serves two functions. The first is to demonstrate that the existing research in instructional use of computers is not adequate to answer the questions posed by this study. In a search of the literature, six studies were found which considered the factors influencing teachers' use of computers. Each had shortcomings which made it inadequate to answer how a British Columbian school district's elementary teachers come to use or not use computers in their practice. The second function of this chapter is to examine the three primary forms of published sources likely to influence Centrevale's teachers' decisions about computing. Examined are: the policies and directions of the B.C. Ministry of Education, the direction to elementary teachers from the Centrevale school district, and the assertions about instructional computing commonly made in teachers' periodicals. I found that, while most of these sources portend a revolution in education as a result of computer technology, there is very little in the way of direction to teachers in how to bring about this revolution.

Research on teachers' decisions regarding computers in schools

A search of the literature on the educational use of computers (*ERIC, Canadian Education Index, Education Index*) reveals very few titles indicating research on teachers' attitudes, or the factors

influencing their decisions about their instructional use of computers. While there is a considerable body of literature on computers in classrooms and the resulting changes, (alternately called "progress", "innovation" or described as "the coming of the new technologies") it appears that teachers are rarely considered active agents in the changes. That is, if the research addresses teachers at all, it is generally only concerned with the non-users and the focus is on turning them into computer users (for example, Cohen, 1979; Ragsdale, 1983; Becker, 1986; Stallard, 1987).

In the course of the literature search, six studies were found to have gone beyond simplistic assumptions about teachers' passive role in the introduction of computers into schools, to consider their attitudes and beliefs about computers and how these factors might influence their practice involving computers. The six studies were: Anderson et al. (1979); Sheingold et al. (1983); Madsen & Sebastiani (1987); Cicchelli & Baecher (1989); Farragher, Francis, & Riecken (1990), and Novak & Knowles,(1991). While these were the only readily apparent studies, there may be more that were not obvious in the indexes surveyed. The six studies are all very different in quality, methodology and the questions that they seek to answer. The common factor which makes them of interest to this thesis is that in the course of the research they address teachers' attitudes towards computers and the factors that influence their decisions. It would serve no purpose to describe the details of these studies here. However, it is my contention that none of these studies goes far enough. For one or more reasons each of them is inadequate to answering the questions posed in this thesis.

The summary which follows indicates the inadequacies among the six studies in their size and selection of the sample, grades studied, geographic location, and singular focus on factors limiting teachers' practice.

Either out of design or because the population was only a single school, five of the six studies had samples ranging between 6 and 78 teachers. The sample of 6 represented a population in excess of 1100 teachers (Novak & Knowles, 1991, p. 4).

In three of the studies the samples were selected by the researchers or by administration on the basis that the teachers were already computer users.

Only one of the studies addresses exclusively elementary teachers, the rest included both elementary and high school or studied high school teachers exclusively. Computer use in secondary schools is very different from elementary: high schools have had computers longer and teachers generally need only be concerned with teaching a single subject. On the other hand, teachers in K-7 have not had the option of computers as long and need to plan for instruction in many areas of the curriculum.

While all are North American studies, only one of the studies was conducted in B.C. It considered only a single school and the study was experimental, testing the result of inservice computer instruction.

Five of the studies were concerned only with the factors inhibiting the use of computers. These studies appeared to assume that computer use was correct and inevitable and thus, while they sought to identify teacher concerns, the emphasis was on identifying

concerns which limited teachers from becoming comfortable and competent with computers.

The intention is not to criticize the research in these six studies. However, they are of little assistance in understanding what is happening with respect to teachers making decisions about computers in a school district in British Columbia. The areas which the studies fail to address adequately are: a focus on a British Columbia school district; a sample which represents the full range of computer use/non use; a sample large enough to represent all of the K-7 teachers in the district; and equal consideration of factors both encouraging and discouraging teachers' use of computers for instruction. Thus, while these studies add to the body of literature on computer use, they do not mitigate the need for the study which is the focus of this thesis.

Potential influences on teachers' use of computers in instruction

This section will describe what appear to be the most likely published influences on teachers' curriculum choices involving computers. There are many opinions about how teachers determine what they teach and how to teach it (e.g., Calderhead, 1984; Clandinin, 1986; Connelly et al., 1988; Ornstein et al., 1988). According to Eisner "There is a profound lack of consensus about what schools should teach among those whose line of work is curriculum" (1990, p. 525). A superficial survey of the literature on curriculum design yields only the understanding that any meaningful summary of all the possible influences on teachers' practice cannot be made.

There are three likely published sources of influence on teachers' practice in this province. The most obvious source of curriculum policy and directives in British Columbia is the Ministry of Education. The provincial contribution to computers in K-7 education will be described for what direction teachers may take from it; however, provincial directives have not been extensive and the school boards are left largely to their own initiative. The district's policies and directions on computers in the classroom amount to little more than some guidelines for word processing and typing, but these will be summarized. Teachers can also seek curriculum guidance from hundreds of professional publications ranging from small specialized broadsheets through glossy large circulation magazines to juried research journals. The number and range of publications and articles makes any sort of comprehensive analysis impractical. Presented below will be a summary of the common themes and assertions found in a survey of a sample of professional publications.

There are, of course, many potential influences other than text-based publications or sources. One might expect that teachers' beliefs and decisions about computers could be influenced by their professional training, by direct contact with administrators and colleagues, by parents, by students and by social acquaintances. However, unlike text-based sources, other sources of influence are difficult if not impossible to assess except through teacher's own accounts. Thus this section is only concerned with published material; other influences will be assessed in chapters four and five.

Provincial government direction

According to Damarin, "Teachers use educational technology partly as a result of administrative mandates and partly through the selection of instructional media and materials for particular goals and topics of the curriculum" (1990, p. 185). Legislative responsibility for deciding what happens in K-12 classrooms in British Columbia lies with the provincial government. While the government has initiated several projects apparently aimed at increasing the presence of computers in classrooms, as we shall see, they have had little to say about how computers should be used.

The first serious government initiative to introduce computers to schools in British Columbia came with the Ministry of Education's Instructional Uses of Microcomputers Pilot Project (Jones et al., 1983 p. 1). One hundred computers were placed in project schools and a series of discussion papers were published reporting on the results. According to Jones the focus on a small number of pilot schools may or may not have been representative of B.C. schools. With the demise of the project, interest at the provincial level seemed to cease and districts were left to their own devices.

In 1984, British Columbia's Minister of Education appointed a Provincial School Review Committee (PSRC) to "undertake a study of public and professional perceptions about schooling in British Columbia" Among other things, participants in the survey process were told that computers and associated technology "has made possible opportunities for learning unimaginable a decade ago" (B.C. Ministry of Education, 1985a, p. 13). The participants in the study were also told that at that time:

- No Provincial directions exist which pertain to the use of computers in schools
- Use of computer-based instruction varies from situation to situation and from school to school
- New instructional "packages" are produced by schools and schools sometimes purchase instructional programs from commercial institutions. (p. 13)

Survey participants were then asked a series of questions about the potential impact and benefits of technological change. The response from public and professionals was apparently loud and clear:

Finally, if there was one area of discussion where complete agreement existed among respondents it has to do with the theme of technology. ...Respondants unanimously held that pupils should be given greater access to computers. Moreover nearly half the respondents held that youngsters should have opportunities to use computers in the elementary grades. (1985b, pp. 12-13)

Respondants went on to detail the many ways in which computers could be beneficial. Of interest in the responses was the strong disparity between the large number of responses insisting that classrooms must be outfitted with computers and the small number of responses that had anything to say about how and why computers should be used. For instance, in contrast with the 100% who said that the number of computers should be increased, only 14.25% felt they should be "implement[ed] with planning" (1985b, p. 13). It appears that, while the professional and lay people are convinced that computers are of great value, they are not clear why.

Strictly speaking, members of the PSRC were correct when they said that there were no provincial directions for computer use. What there was was a K-7 resource guide published by the Ministry of Education. The document *Computers into the Classroom* had been developed in 1983 by the Vancouver School Board for their own use, but was circulated by the Ministry's Curriculum development branch, "as a resource to districts, schools, and teachers who are attempting to meet the computer literacy needs of Elementary School students" (B.C. Ministry of Education, 1984). Rather than specific direction on how and for what purpose computers should be implemented, the volume is a series of suggested opportunities for curriculum integration of computers in Language Arts, Social Studies, Mathematics and Science. By 1990 when this study occurred, it was out of print and very much out of date.

In 1987, the B.C. government initiated a Royal Commission under Barry M. Sullivan to "inquire into and report on education in the Province from Kindergarten through Grade 12" (Sullivan, p. 1, 1988). The most significant government initiative in education in twenty-seven years, the Commission had the mandate to examine every aspect of British Columbia's public and private schools systems and to make recommendations to guide the province into the 21st century. The report addressed briefly the question of computer technology, saying,

Methods of instruction are already changing to take advantage of what the computer can do; youngsters in provincial schools now have access to more than 20,000 computers; and it is apparent that the school curriculum

and indeed, the nature of the learning process itself is being transformed by such technology. (p. 14)

The "transformation" must have been proceeding appropriately because, while the Commission made 83 recommendations dealing with curriculum, teacher training, and education administration, none of the recommendations mentions computers or technology.

In January 1989 the Minister of Education released a response to the Sullivan Royal Commission (Brummet, 1989). In it are outlined the province's mission statement and educational policy directions for curriculum, teachers, system governance and finance. Again, there is no mention of computers or technology.

In 1989 the British Columbia Ministry of Education released the *Year 2000: A Framework For Learning* document describing "the framework which will form the foundation for all program development, student assessment and evaluation through the year 2000 (B.C. Ministry of Education, 1989). This core document was followed in 1990 by a *Primary Program Foundation Document* (B.C. Ministry of Education, 1990a), a *Primary Program Resource Document* (B.C. Ministry of Education, 1990b), and an *Intermediate Program Response Document* (B.C. Ministry of Education, 1990c). According to the *Framework* document, the Ministry of Education is responsible for "setting overall policies, directions and standards" which local boards then address with specific curriculum programs (1989, p. 4). From these documents it is not at all clear what the policies, directions, or standards for educational technology are. The only recognition in the *Framework* document that educational technology exists is the first page which has a large photograph of the Minister of

Education sitting at a computer with a small girl. One might suspect that the computer in the picture is intended to symbolize the future, but there is nothing in the text to support this view. The same photograph appears at the beginning of all Year 2000 documents. In fact computers are used in photographs throughout the four documents, but rarely are they mentioned in the accompanying text. In all there are ten references to computers and associated instructional technology in the 1035 pages of the four documents mentioned above. Most of the references are short such as "desktop publishing" in a list of presentation skills in the Intermediate document (p. 103). There are also three short philosophical descriptions of the function of technology, all of which are essentially the same, supportive of technology and specifically of computers as a tool which "should be a means to an end, not the end itself" (B.C. Ministry of Education, 1990a, p. 38; B.C. Ministry of Education, 1990b, p. 277; B.C. Ministry of Education, 1990c, p. 35). The description in the *Primary Foundation* document outlines a number of the opportunities provided by computers, while the other two caution that computer experiences must be integrated with other classroom work. Finally, there are some examples of instruction which include the use of computers (1990b, p. 279; 1990c, p. 204).

In all of the documents described above, going back to 1985, there are suggestions of an interest in seeing computers used in education. However, there is next to nothing in the way of policy, directions or standards for computer use. Any commitment indicated seems largely *pro forma*. There is virtually nothing to guide teachers trying to understand the place of computers in their instruction.

In addition to the above publications, the B.C. government has initiated three major projects involving technology: the creation of the Education Technology Centre, the Research and Development Project, and the Funds for Excellence grants. The most recent of these, in response to the Year 2000 document, was the creation of the Education Technology Centre (ETC) whose mandate is inservice and training, research and development, and telecommunication (Hoebel & Musio, 1990, p. 102). The Centre opened only months before the initial data was collected for this study and thus could not be expected to have a great impact on the beliefs or practice of the teachers in the study. The Research and Development Project initiated by the Ministry of Education in 1988 may have had more chance to create an impression. All teachers in the province were given the opportunity to apply for funds to carry out technology-based research in their classrooms. 764 teachers applied and \$400,000 was eventually distributed for 162 projects around the province (Moran, 1989). Perhaps the project with the greatest potential to create an impression on teachers was the Funds For Excellence grants distributed in 1986–1987. Schools were asked to submit requests for funding of capital expenses for new projects. The person responsible for assessing the applications had to go through a pile of applications over five feet high (D. Simair, personal communication, January 15, 1992). Ultimately most of the funding went out for computers and related technology. Because no details of the projects funded was ever published the exacts amounts distributed are not available, however, the amount for technology was reportedly between twelve and thirteen million dollars.

The British Columbia government has left an impression, both through pronouncement and through the considerable funds distributed in high profile projects, that it is supportive of computers in classrooms. However, it has given little or no direction as to how or for what objectives these computers should be used. The province appears, by omission, to have left specific directions to the school districts. The following section outlines what the district under study has told its elementary teachers about the instructional use of computers.

School district direction

Centrevale was introduced in chapter one as the district in which the study was conducted. The demographics of the district will be described in chapter three. At this point it is important to note that the district was chosen, among other reasons, because it is recognized by knowledgeable informants as having a comparatively strong commitment to technology.

Centrevale's sole written direction on instructional use of computers in K-7 was a five-page document produced by the district's Elementary Educational Computing Committee in 1989. The document contains a series of 14 recommendations, the first of which is key to the remainder:

That the major focus of educational computing at the Elementary level be Writing, including components dealing with Keyboarding, Word Processing, Computers in the Writing Process. The committee recognizes that databases and spreadsheets are valid productivity tools and their use should be encouraged.

Eleven of the remaining 13 recommendations outline details such as what software should be used for keyboarding, and what grades keyboarding and word processing should be emphasized. The final two recommendations are that the district should continue providing inservice related to computer implementation and should ensure that all elementary schools have access to sufficient computers and software to implement the other recommendations.

Beyond these recommendations the district's only contacts with respect to computers was supplying hardware and software, providing inservices, and, in some schools, the provision of a part-time Computer Resource Teacher (CRT). While the district's directions regarding the use of computers is certainly more detailed than the provincial government's, it remains skeletal. The five-page document provides little more than an outline for when word processing and keyboarding instruction should occur. Further there is no indication of how this level of direction will be disseminated to teachers.

Teacher publications

Aside from Ministry of Education and school district direction, teachers seeking help regarding the use of computers in their classrooms can turn to teachers' publications. As noted in the introduction, there are hundreds of professional publications written for teachers. The majority are of small circulation and focus on teaching specialties such as teacher librarians, or on specific jurisdictions such as Victoria elementary teachers. Many are published by individuals or small groups of volunteers with limited resources; others are subsidized by professional organizations, advertising or public funds. There are also provincial, national, and

international publications with specific or general focus and varying degrees of commercial quality. All of these seek to inform teachers, and many seek to influence how and what teachers teach. Of interest to this thesis is how these teacher publications might influence teachers' beliefs and decisions about educational uses of computers.

An exhaustive analysis of such a broad scope of publications is beyond the capacity of this study. A search was conducted for any references to computers in a convenience sample of the 178 issues of the 33 different Provincial Specialist Association (PSA) and district newsletters in the current collection of Simon Fraser University's Faculty of Education's learning resource library. In addition, three Faculty Associates (teachers recognized for their expertise and seconded to the university to instruct student teachers) were asked what publications they believed teachers read. I examined for any references to computers all of the issues for the years 1987-1991 of the five magazines and journals that were recommended. In total, 35 articles dealing with computers were found in the review (see Appendix 1 for the list of references located) These articles were then analyzed for the common themes and assertions about the use of computers in schools.

The central theme in virtual all the articles was support for the use of computers for instructional or administrative activity. In 83% of the references support for computers was unqualified; in the remaining 17%, although the writers questioned if the efficacy of computers had been demonstrated clearly or criticized some current application of computers, they still supported future use.

Associated with the central theme of support for computer use by teachers were three common assertions: one, computers and associated "information technologies" represent the solution to an information age explosion of facts; two, through endless patience and ability to focus on specific student's needs, computers are the solution to many dropout problems; and three, computers are creating a revolution in the nature and potential benefits of education.

The threat of the information age

Many of the articles portray "information" as threatening to overwhelm "us". The image they convey is of a juggernaut which doubles in size every few years and which threatens to invalidate "our" students if we do not immediately give them the skills and tools to master it. The following are examples of these sorts of descriptions:

The information age is upon us and it will soon overtake us if we don't try to keep up. We owe it to our students to introduce them to the technology that will become part of their everyday lives and to show them how to be effective processors of the fast and growing ocean of knowledge.

(Hetherington, 1990, p. 26)

CD-ROM databases are proliferating like wildfire. Library research is done with fingers on a keyboard, not with feet walking down aisles of books. And yet most schools sit virtually unchanged since the fifties. . . . Without funding for meaningful staff and equipment development, our public schools will become informational backwaters.

(Thornburg, 1991, p. 64)

The common assertion in these articles is that schools and teachers are threatened with obsolescence because we are entering an "information age", and that the only solution to the threat is to adopt information age technologies and learn information age skills.

Infinitely patient teachers

Because computers do not labour under the same conditions that teachers do, it is argued that they have the capacity to be "an infinitely patient teacher". Computers do not get angry, nor do they get frustrated, nor experience prejudice nor feel the urgency of impending deadlines. All of these statements are self evident, and all have been made at some point in support of the use of computers. The second assertion common to many of these articles, and implicit in most, is that computers – because they are non-judgemental, do not experience emotion, and can work with a single student for as long as necessary – offer a solution to many of the problems that cause students to be unsuccessful in traditional classrooms. The following is indicative of this assertion:

With skill development virtually guaranteed by a good CAI system, teachers and students are freed to expand on the creative mind-stretching, and interpersonal experiences that make life worth living. And when low-achieving students choose to spend their lunch hours playing outdoors, it's time to take a closer look at Computer-Assisted Instruction as a means of keeping them from becoming dropout statistics. (Gross, 1989, p. 51)

The assertion here is that, at least for some learning, students can be turned over to computers which will work tirelessly with them until

students have all achieved the required level. This has the added benefit of having freed teachers and students of the drudgery of some learning activities, facilitating learning opportunities for which there was previously no time.

Revolution

The third assertion is one of revolutionary change wrought by computer technology. Authors of the articles surveyed, commonly assert that computers either had the potential to revolutionize education, or were already revolutionizing education. The quotations which follow are examples of such assertions:

The evidence of this "Computer Revolution" is all around us. The question is, who will be the beneficiaries of this revolution and who will be the victims?. Our task is to ensure that our students reap the benefits. (Laitland, 1990, p. 7)

It is the opinion of many observers, including the author, that the alarming situation in mathematics and science education requires radical new approaches to instruction throughout the entire curriculum. The exciting thing about the technology soon to be available is that it has a unique ability to help foster the required large-scale changes. (Tinker, 1987, p. 466)

The articles in which the references to revolutionary change occur are only rarely about the revolution itself. Generally the predictions serve as context for a description of the merits of a specific technology such as CD-ROM, "HyperMedia", or interactive videodisc. In fact, none of the articles argued how a technology or an application of technologies

could constitute a revolution. It appears that proponents of computers take for granted that such predictions need no further justification. It is as if, because they are talking about new technology, they have license to make such predictions. Yet, the assertions of revolution do not always portend an exciting future, some also raise the threat of obsolescence.

Technology has crept up on us unawares, leapfrogging education from the past into the future. Educators who ignore this phenomena and refuse to change their teaching techniques to accommodate the new technology will soon find their methods lamed by functional obsolescence. (House, 1987, p. 451)

While not always using the word revolution, commonly proponents of computers and related technologies assert that the technology will make radical changes to the way education occurs. Whether described as a revolution, a transformation or a technological change, the details are rarely made specific. Generally the writers present the reader with a wondrous example of a new technology or activity, then simply state that it will soon be, or is already, representative of a new direction in education. The details of how we go from technology to transformation are left to the reader.

Summary – teacher publications

In surveying these publications, what is of interest to this thesis is how the articles might influence teachers' attitudes or decisions about computers. The articles located in this search had one consistent theme – computers have a prominent place in classrooms. Supporting this theme were three assertions. The first assertion is

that, in some sense, the adoption of this technology is a matter of survival because we are faced with a growth of information that constitutes an unspecified danger to those who lack the equipment and skills to manipulate it. The second assertion is that through their capacity to provide individual instruction, computers present a miracle remedy to many of the problems of the modern classroom, and particularly to the problem of students who are at risk of being left behind or of dropping out entirely. Finally, the third assertion is that computers and the associated technology represent a revolution in education.

This sample of publications was not selected randomly from the hundreds published for teachers; thus it is not possible to estimate what percentage of the remainder might have had articles critical of computers. It is therefore not possible to predict whether teachers reading other publications might not gain a more critical perspective of computers. All I can state is that the overall impression left by the publications surveyed is that computers are portrayed as a positive, flexible, and necessary solution to an unsettling present and an uncertain future in education.

Summary

This chapter serves two functions: it reviews previous research on teachers' attitudes about computers and the factors influencing their decisions; and it surveys the three bodies of publications likely to most influence elementary teachers' beliefs and decisions (i.e., provincial government policy with respect to computers, school district direction for the use of computers, and teachers' publications for the common themes related to instructional use of computers).

The review of previous research found six studies which considered teachers' role in the movement of computers into classrooms. Unlike other studies, which seem to consider teachers as neutral agents in the use of computers in schools, these six looked at teachers' attitudes towards computers and at their decisions about their use for instruction. However, while they considered some of the same issues as this thesis, in considering the specific questions posed by this thesis, each of the six studies has more than one flaw. Only one of the studies is set in B.C. and it looks at an experiment in a single school. The other studies were all conducted in the United States, and while some looked at very large populations, the samples of all but one study were small. Several of the samples were selected specifically for their level of computer use and thus do not represent the full spectrum of teachers. Most problematic was an underlying assumption in all but one of the studies that the goal of the research was to determine why teachers were not using computers. It is taken as given that computers will be used, thus only those attitudes and factors inhibiting use are seriously studied. Thus, there is still a need for a study of B.C. teachers representing varying degrees of computing use, to investigate what makes teachers decide to use, or decide not to use, computers.

Through short statements of philosophy and high-profile projects the provincial government showed some interest in the use of computers in schools. However, they provide virtually no direction for the use of computers in K-7. Teachers looking to the Ministry of Education for help in understanding how and why they should adopt computers into their instruction will find an eight-year-old, out-of-print resource guide (B.C. Ministry of Education, 1984), and a few

examples of teaching ideas in the *Primary Program Resource Document* (B.C. Ministry of Education, 1990b). Thus, the responsibility for establishing direction for the use of computers falls to the school district. Centrevale's sole published instruction to teachers on the use of computers at the elementary level is a five-page document which provides 14 recommendations on the timing of keyboarding and word processing instruction and on appropriate software.

When juxtaposed, the two levels of administration's messages are almost startlingly divergent. The province tells teachers that, "the school curriculum and indeed, the nature of the learning process itself is being transformed by such technology" (Sullivan, 1988, p. 14), yet, the direction from the school district for teachers who wish to be involved in this "transformation" is to do some word processing and keyboard practice. From their published documents, it appears that neither level of administration has a marked commitment to the use of computers in elementary classrooms. The province feigns commitment, but takes little action likely to impact on the practice of the thousands of teachers in the province. The school district's only commitment is to a minimal level of word processing and keyboard proficiency.

Finally, a survey of teachers' publications found virtually unanimous support for computer use. The three assertions commonly made about computers in the 33 articles found were: that computers and associated "information technologies" represent the solution to an information age explosion of facts; that through endless patience and ability to focus on specific student's needs, computers are the solution

to many dropout problems; and that computers are creating a revolution in the nature and potential benefits of education.

In reviewing samples of the publications from these three sources likely to influence teachers' beliefs about computers and their decisions about their instructional use of computers, I found mixed messages. It is clear that ultimately "the teacher is the final arbiter of what happens in the classroom" (Hofmeister & Lubke, 1990, p. 2). But it is unclear how teachers should make decisions with regard to computers. The only consistent message is that computers should be used, however, while both the provincial government and the assorted professional publications speak of revolutionary transformation they give little or no direction and the district advises only on word processing and keyboarding. Teachers are making decisions with respect to their computer use. The following chapter describes the study which was conducted to determine on what basis teachers are making those decisions, because from the existing literature it is far from clear.

CHAPTER 3

METHOD

Introduction

This chapter describes the methods of the study. The study is descriptive, based on data from two sources: a questionnaire circulated to all K-7 teachers in a single school district, and interviews with a subset of teachers responding to the questionnaire. Data from a second questionnaire circulated to the principals of the subject schools was gathered and used to guide the analyses of the teacher questionnaire and interview results.

The chapter begins with a description of the district in which the research was done and of how the district was selected. This is followed by a brief description of the questionnaire circulated to the principals. The principal questionnaire should not be confused with the questionnaire completed by the teachers. The development, circulation and initial analysis of the teacher questionnaire will be described next. This is followed by descriptions of the selection of the sample for interview, development of the interview protocol, the conduct of the interviews, and the procedures for analysis of the results.

Description of school district

The study examined a group of K-7 classroom teachers in a British Columbia school district. The study was limited to a single district for practical reasons, including the necessity of extended personal interviews and the personal contact required to obtain a high

questionnaire return rate. Adequately assessing a larger population would not have been practical given the resources of a single investigator. The district chose to remain anonymous and will be referred to in the study as "Centrevale".

The district was selected on the recommendations of three consultants recognized for their knowledge of the implementation of computer technology in British Columbia schools. The requirements given to them were that the district be a medium-sized lower mainland district with a history of commitment to computers. All named "Centrevale" as a first or second choice. Historically, Centrevale's record of supplying computers to schools has been slightly better than average. In a survey of British Columbia school districts conducted in 1983, the district's average ratio of 133 students per computer was 30th of 75 districts responding (Jones, 1983). In 1987 it continued to be 30th in ratios of students to computers (Roger, 1988).

Centrevale has a mix of rural, suburban and urban schools spread through two communities. It is approximately the fifteenth largest school district by population in the province with an estimated population of 57,000 in 1990. As of April 1990 there were 23 elementary schools in the district, ranging in size from 100 to 600 students.

Description of principal questionnaire

A questionnaire was circulated to the principals of each of the schools in order to gather information about their school, about the number of teachers, students, and classrooms, computers, and about levels of computer use (see Appendix 2 for principal questionnaire).

These data are used throughout the thesis when they can illuminate data from the primary sources – the teacher questionnaire and interviews. No separate analysis is done with the data obtained from the principal questionnaire.

Description of teacher questionnaire

The teacher questionnaire phase of the study provides for descriptive analysis of the experience and opinion of 126 of Centrevale's estimated 249 classroom teachers with respect to their instructional use of computers. The questions on the questionnaire covered the following topics: (1) demographic information including gender, years teaching and years at present school; (2) computer experience including hours of courses attended, number of relevant books read, and amount of time spent using computers; (3) beliefs about computers in schools including support and reasons for their use, and how many computers are necessary; (4) experiences with using computers in instruction including how often, planning involved, and impact on students' education; and (5) the factors which encourage and discourage their instructional use of computers.

Creation of teacher questionnaire

Drafts of the questionnaire were created following several brainstorming sessions with committee members on the sort of items which might elicit answers to the research questions. Items were revised repeatedly for both quality and clarity. Immediately prior to wide scale distribution the questionnaire was piloted with a convenience sample of five K-7 teachers from other districts. The results and the feedback of the test group were analyzed and the questionnaire altered accordingly.

Distribution of teacher questionnaire

Permission to conduct the study was obtained from the school district office (see Appendix 3 for letter requesting permission). The district's computing principal gave feedback on the questionnaire during the revision period. He cleared the way for the questionnaires by asking all of the principals to cooperate with the study. Each of the district's 23 elementary school principals was contacted individually by the researcher and times were arranged when the questionnaire could be explained and circulated to their teachers.

Between April and June 1990, the questionnaire was distributed to all K-7 teachers in the district. Suitable quantities of questionnaires were left at each school depending on the number of reported teachers in each school. The procedure for explaining the study at each of the schools was essentially the same. The nature of the study and what was being asked of respondents was explained to the assembled teachers, questions were answered, and sufficient questionnaires were circulated for all of the teachers in the school. An envelope was attached to each of the questionnaires to facilitate anonymous return. The researcher was generally well received at these meetings and teachers appeared interested in the topic of the research. Teachers were told that the completed questionnaires would be picked up three school days after distribution. A cover letter with each questionnaire reiterated the purpose of the study and identified the specific date they would be picked up (see Appendix 4 for cover letter). In most cases teachers handed them in to a school secretary. To increase compliance, where possible, the principal was

contacted when the questionnaires were to be picked up and a second date set for picking up late returns.

Procedure for analysis of teacher questionnaire data

As the questionnaires were returned, responses were entered into the computer. Every tenth questionnaire entered was checked for accuracy of keypunching. The range of keypunching errors was between 0 and 4 per questionnaire, the average was .6.

This study is concerned with the attitudes, decisions and practice of elementary classroom teachers. According to the principals of the 20 schools participating in the study ¹ there are 342 "teachers" in these schools; however, this number includes many teachers with roles other than that of classroom teacher ². While the uses to which these other teachers put computers are interesting, they will be different from the instructional use of a full-time classroom teacher, and it is this latter use which is the focus of this study. Thus, the study was restricted to teachers who had regular classes of students at the time of the study. The size of this population is estimated at 249 teachers which represents the total number of regular classes in the 20 schools.

¹Three schools were not included in the study. One principal chose not to have his school included. A second school was not surveyed due to scheduling problems. A third school was dropped from the study because on analysis of its returns, done before any other schools were given questionnaires, it was found that there were still problems of clarity with some of the questionnaire items. As a result the questionnaire was altered and this first set of responses was not included in the sample.

²For example, one teacher-librarian reported that he used computers in excess of five hours per day. Further investigation revealed that this was largely in checking out books.

A total of 182 questionnaires were returned; however, as noted above, this represents part-time teachers, teacher-administrators, special needs assistants, teacher-librarians, and others, many of whom would be counted at more than one school ³. The 126 questionnaires returned by regular classroom teachers represents a return rate of 50.6%. Since it can neither be assumed that each classroom has a single teacher, nor that only one of the teachers responded in cases of shared classrooms the return rate is only approximate.

The three research questions guided the analysis of the questionnaire data. The results of all items were tabulated, including frequency and some cross-tabulations, and used to assemble as complete an answer as possible for each of the questions. The data were then discussed with various informants including the computer committee for the district. This feedback helped the researcher to develop the items for the interview protocol. Thus, in addition to providing much of the substantive data for the study, the questionnaire data served to inform and focus the interviews. Analysis of the questionnaire responses pointed out which factors were central in influencing teachers' decisions about computer use and which factors were irrelevant. This allowed the interviewer to focus on gaining an understanding of critical influences, rather than wasting time

³The survey item that was used to eliminate these people asked them to indicate whether they were a classroom teacher, librarian, computer specialist, or "other". If respondents indicated "classroom teacher" they were asked for the grade(/s) taught. Respondents indicating that they were classroom teachers but not identifying grades taught were not included (thus eliminating those who, while they are specialists, feel that they are still classroom teachers).

eliminating unimportant factors. In this way the questionnaire served to reduce considerably the quantity of data acquired during the interviews, while at the same time enhancing the ability to address the research questions.

Stratification of population into user levels

The questionnaire data also permitted the stratification of participants by their level of instructional use of computers, thus facilitating representation of all user levels in the sample interviewed. As the teachers had not been observed while teaching, there was no first-hand quantitative measure of frequency of use. Rather the assessment was based on a three-way cross-tabulation using self-reported computer use. The following three items were used: "How often do you have your full class use computers?" "How often do you have individuals or small groups of students use computers?" and "When was the last time you initiated an instructional activity which required students to use computers?" For the first two items teachers were given the option of indicating "never", "occasionally", "often" or "very often". For the third item the options were "never" "1 to 8 months ago", "1 to 4 weeks ago" and "within the last 7 days".

The "user level" variable resulting from the three-way cross-tabulation divides teachers into 4 categories of instructional users of computers: "high", "moderate", "low" and "nonuser". In addition a fifth category, "unclear", was created for any cases where data was missing

Table 1
Assignment of teachers to user levels using three-way cross-tabulation

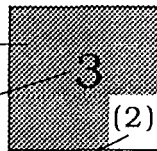
Used computers with part of class or individuals

		no data	never	occasionally	often	very often
Used computers with full class	no data	(3)	(2)	(2)	(0)	(0)
	never	(0)	16 (3)	8 (5)	8	2 (1)
	occasionally	(2)	9	18 (3)	6	1
	often	(1)	3 (2)	13	6	2
	very often	(0)	2 (1)	6 (1)	0	0

color = user level (see key)

number of teachers

of teachers assigned to UNCLEAR because their answers were not consistent



User Level	Total
UNCLEAR	(26)
NONUSER	16
LOW	35
MODERATE	32
HIGH	17

or inconsistent in one or more of the three variables. The most common inconsistency resulting in teachers being assigned to "unclear" was their indicating "never" for the last time computers were used but indicating some amount of use on the other two items. These cases are indicated by the numbers in parenthesis on Table 1.

Any of several combinations of the three variables could result in an individual being assigned to a user level. They are detailed below:

HIGH USER

- used computers "very often" with their full class regardless of how often they used them with individuals or small groups; or
- used computers "often" with their full class and "often" or "very often" with individuals or small groups; or
- used computers "occasionally" with their full class and "very often" with individuals or small groups.

MODERATE USER

- used computers "often" with their full class and "never" or "occasionally" with individuals or small groups; or
- used computers "occasionally" with their full class and "often" with individuals or small groups; or
- used computers "never" with their full class and "often" or "very often" with individuals or small groups.

LOW USER

- used computers "occasionally" with their full class and "never" or "occasionally" with individuals or small groups; or
- used computers "never" with their full class and "occasionally" with individuals or small groups.

NONUSER

- teachers responded with "never" in all three items

UNCLEAR

- failed to enter an answer on one or more of the three items; or
- entered "never" on the *last time you used a computer* item while indicating use on one of the other two items. ⁴

The determination of computer usage relies on self-reports. It is not possible to know if "often" meant the same thing to all teachers. The third item dealing with the last time teachers initiated an instructional activity which required students to use computers served as a check for gross inconsistencies between teachers' perceptions and actual use. As noted, anyone who failed to respond on any of the three items was labeled "unclear" and respondents had to state that they had never used computers on all three items to be categorized as a nonuser. In addition, as Table 2 shows, the third variable tends to corroborate the categories of extent of use with, for instance 88% of high users having used computers within the last week, as opposed to 45% of low users.

Table 2

User level × the last time teachers used computers for instruction

User Level	in last 7 days	between 1 and 4 weeks ago	between 1 and 8 months ago	never	TOTAL
High	88%	12%	0%	0%	100%
Moderate	63%	31%	6%	0%	100%
Low	45%	34%	20%	0%	100%
Nonuser	0%	0%	0%	100%	100%

⁴ These cases are indicated by the numbers in (parentheses) on Table 1

Description of interviews

The interviews were conducted between April and June 1991, at various locations of the teacher's choosing. Locations included their homes, their school, the researcher's office and the researcher's home. Interviews took between 35 minutes and one hour and were tape recorded. All followed the interview protocol, although some discretion was taken to explore interesting points. Although it was necessary to learn the respondent's name to arrange for the interview, all were promised that neither their names nor any information which might allow them to be identified would be disclosed at any time.

Creation of the interview protocol

With reference to the central questions of the study, the questionnaire data fell into three categories: (1) data needing no further explanation or follow up; (2) data needing some further explanation by study participants because its meaning was unclear; and (3) data which was "interesting" in some way and had the potential, when presented to teachers, to provoke discussion about their computer use. Interview items were built around the latter two forms, in order to illuminate and clarify how teachers come to their decisions and how those decisions are manifested in instructional use of computers. Items were added to fill in details relating to the specific questions of the study (see Appendix 6 for the interview protocol). Three interviews were done to field test the protocol and to provide practice for the interviewer. Upon analysis of the pilot results, the protocol was altered to elicit more complete answers. These trial data were not considered in the study.

Selection of teachers for interview

As noted above, in order to interview the broadest range of teachers possible, respondents were categorized according to their level of instructional use of computers. The 126 respondents to the questionnaire were clustered into "high", "moderate", "low", "nonuser" and "unclear" on the basis of the frequency of their instructional use of computers. Using a random number table, four teachers were selected from each of the five categories. All of the respondents to the original teacher questionnaire had been asked to specify a six digit number. It was suggested that they use the last six numbers in their social insurance number. As the questionnaires were anonymous, these code numbers and their schools were the only way of contacting those selected for interview. In April 1991, packages were sent to each of these schools. Each package contained three sets of materials: copies of a short summary of the tabulated results of the teacher questionnaires (see Appendix 7); copies of a letter containing the code numbers of the teachers selected for interview and explaining that the people whose code numbers were on the letter should contact the researcher to arrange an interview (see Appendix 8); and a note to school secretaries asking them to post the letters and circulate the results summary (see Appendix 9). This initial appeal yielded five responses. A second, very noticeable (fluorescent) copy of the request letter was then circulated, this time offering a gift certificate for dinner to those from the list of numbers who would volunteer. This elicited six more responses for a total of eleven from the twenty teachers selected for interviews.

Thus, the sample interviewed is a voluntary subset of the questionnaire participants, stratified by members' levels of instructional use of computers. The eleven teachers interviewed represent three high users, two moderate users, two low users, one nonuser, and three unclear users. Of the last group, based on information from the interviews, one is a nonuser, one is a low user and one is a moderate user.

Procedures for analysis of interview data

A set of descriptive codes was created prior to transcription of the interview tapes. These codes identified only the general research question which the portion of the response addressed (see Appendix 10, first-level codes). The researcher transcribed the interviews soon after they were conducted. During this time the first-level descriptive codes were assigned. Coding at this level was simply a matter of reading the informant's statement and deciding whether it fell within the scope of one of the three research questions: ie. What are the teachers' attitudes towards computers as an instructional option? (coded as **ATT**); What factors most influence their choices in instructional use of computers? (coded as **FAC+** or **FAC-**); and How are teachers' beliefs and attitudes reflected in their practice? (coded as **IUC**) Thus, for instance, the statement "*I know lots of teachers personally who are scared of them (they say) 'I won't use them, I won't touch them'*" was coded **ATT** because it related to the attitude question. A second reader then recoded fresh (uncoded) transcripts using the same descriptive codes. The researcher and the second reader then compared and discussed their codings. When there was not agreement on the coding an attempt was made to understand why.

Generally it was agreed that it was simply an omission. However, occasionally the disagreement was on the nature of the coded statement and discussion was required to achieve compromise. Finally a set of transcripts with an amalgamation of the two readers codings was created.

Miles and Huberman suggest that in studies such as this, where the intention is to answer a series of research questions, interview data should be regrouped in order to bring together evidence which "belongs together" (1984, p. 110). As they recommend, a "conceptually clustered matrix" was used. A grid was created with each informant's name at the head of a column. The questions about teachers' attitude and practice each had a row, while the question about factors influencing use had two – one for factors encouraging use and one for factors discouraging use. Thus a matrix with 44 cells was created (see Appendix 11). Typed copies of the coded statements were then separated from the transcriptions and placed in the matrix based on their descriptive codes. For example, all of the statements reflecting **ATT**itude were arranged in a row divided by informant.

The next task was to split the first-level descriptive variables into ones that were more informative by identifying more meaningful patterns within these first-level coded statements. Second-level codes were created by reading through the statements with common first-level codes and deciding when they needed unbundling; what the informant was saying; and how this could be summarized (see Appendix 10 for second-level codes). Statements which appeared to have the same theme were grouped and assigned a second-level descriptive code. In the example used above, *"I know lots of teachers*

personally who are scared of them [they say] 'I won't use them, I won't touch them', it was decided that the attitude being described was fear, thus the second-level code assigned was **ATT-Fear**. The second-level codes were then analyzed to decrease overlap and increase clarity of definition. Finally all of the transcripts were recoded using the list of second-level codes. Three additional second-level codes were created during this coding. Eleven pages of transcript were double-coded with an intercoder reliability of 0.75 ($\frac{24}{24+3+5}$). Typed copies of the newly coded statements were again removed from the transcripts and placed in a matrix with the informants on the columns and the second-level codes on the rows, grouped by the question they address (see Appendix 12).

Analysis of both the questionnaire and the interview data consisted of determining which data served to answer each of the research questions. In the next chapter, the results of the questionnaire and the interviews will be discussed.

CHAPTER 4

RESULTS

Introduction

This chapter provides a brief summary of the research procedures, then describes the major findings of the study. The study attempts to answer three questions regarding teachers' instructional use of computers: What are the teachers' attitudes towards computers as an instructional option?; What factors most influence teachers' choices in instructional use of computers?; and How are teachers' beliefs and attitudes reflected in their reported practice?. Each of these questions will be dealt with in turn, followed by the results which pertain to it. Study results are based primarily on questionnaire and interview data, and where pertinent on data from the survey of the principals.

The interviews were structured loosely around an interview protocol (see Appendix 6). Teachers talked around three themes: their attitude toward computers as an instructional option; the factors affecting their choices; and the decisions that they make about their students' use of computers. Many of their statements cited in the study were not in direct response to a specific question from the protocol. That is, while a guide was followed to ensure that all teachers addressed the target topics, the interviews had some leeway and sometimes digressed to cover interesting territory. Hence, when it is reported that seven of the teachers indicated a particular opinion it does not mean that the other four did not hold the same

opinion, merely that only seven teachers made statements regarding the issue.

Teachers' attitudes towards computers as an instructional option

When the interview excerpts indicating teachers' attitudes towards computers and their place in schools were clustered it was found that, while teachers clearly have some strongly held beliefs, not all beliefs were distributed evenly among the teachers. Cross-tabulating the attitudes with the teachers' levels of use showed that the responses fell into three categories. In the first category, five attitudes found to be commonly held by teachers at all level of use are discussed first below. These five had as a common theme reasons why computers should be used in elementary schools. In the second category, three attitudes common to the high and moderate users but not held by low and nonusers generally emphasized an enthusiasm for computers. Conversely, in the third category, low and nonusers commonly expressed three beliefs which emphasized their strong reluctance to use computers. The three categories of attitude are expanded upon below.

Attitudes commonly held by teachers at all levels of instructional computer use

Those attitudes found to be common to eight or more of the interview participants were: that computers, schools, and the future are inextricably linked; that teachers should be using computers for instruction; that Computers should be considered a subject like Gym or French and should be supported accordingly; and that computers

have the capacity to facilitate students working faster, with greater enjoyment and with superior results.

Computers are inextricably linked with the future and as such are unquestionably a necessary part of K-7 education

Both the questionnaire and interview data strongly suggest that teachers see students' future need for computer skills as the prime incentive for their current use of computers in schools. Responding to the questionnaire, 81 teachers (64% of those responding) checked that their "beliefs about the importance that computers will have in the future" encouraged their use of computers in instruction (see Table 6). When asked in an open-ended question to explain why they felt that computer should be used in schools, 50 of the 126 teachers responding to the questionnaire (40%) wrote answers indicating that they believe that their students must develop computers skills in preparation for future education and/or jobs (see Table 3). Nine of the eleven teachers interviewed explicitly linked computers with the future and associated this with an unquestioned assumption that computers belong in schools. As an example, this from "Janet" ¹ , *Well... ² computers are the future, if schools mean anything they have to prepare for that and that means computers in our classrooms. It*

¹Quotations from the 11 teachers interviewed will be presented in italics. During transcription each of the teachers was assigned a fictitious name. In some instances no source is cited because accumulated information from specific quotes might reveal the identity of the informant.

² In transcription of interview responses , the series of three dots (...) indicates a pause, not comments which have been omitted.

appears from both the questionnaire and interviews that teachers believe that: (a) computers will be a major component of life in the future, and (b) they should accommodate this by utilizing computers.

Ideally every teacher should use computers in instruction

There was an almost unanimous belief that under ideal circumstances all teachers should use computers within their curriculum. When asked "Should computers be employed for instructional use in K-7 schools?", 96% of respondents indicated that they should. All of the teachers interviewed endorsed this view. Each felt that, given sufficient support, all teachers should use computers with their classes. While all gave reasons for themselves or their colleagues not using computers, virtually none of these reasons had to do with computer use being educationally unsound. Even "nonusers" did not justify their lack of use on educational grounds, but gave more pragmatic reasons such as lack of time, administrative direction, or personal knowledge. The following is from Dana a teacher whose use of computers is minimal: *I'd be surprised if anybody said that computers didn't fit with them [their curriculum goals] I can't think of any reason why a teacher wouldn't use them and lots why they should.*

"Computers" is a subject like "Gym" or "French"

On the questionnaire and in the interviews teachers showed a strong conviction that the study of computers themselves represents a subject – a necessary area of curriculum content. As Table 3 shows, when asked to support their beliefs about computers in elementary schools, teachers' most frequently mentioned reason – offered by 40% of those responding – was that students should learn computer skills. A further, 11% of teachers felt students should learn to use computers

to ease future academic activity, while 9% felt that children should learn to use computers while they are young. In each of these cases the writers referred to the students need to learn "computer skills", "computer knowledge", "about computers", or simply to learn "Computers".

In interviews teachers were encouraged to expand on what it is that students needed to learn through computer use in school. The following are typical responses:

It is improving but I think the biggest problem is trained people especially in the elementary schools trained resource people who can teach computer (Mike).

Then they say they want me to teach the computers as well, it is just one more thing (John).

It doesn't matter what you do, as long as you use the computers (Dana).

While all eleven teachers believed that it was necessary for their students to know how to use computers, there was a wide range of opinion on what the nature of this computer knowledge should be. Teachers' specific references to how computers should be used varied, however, all but one of them reflected at some point the attitude that "Computers" is a distinct subject in the same sense as "Gym" or "French".

Computers speed up, make easier and otherwise enhance student writing

It was evident both from their written responses on the questionnaire and from the interviews that teachers are very impressed with the word processor's capacity to improve the

Table 3

Reasons computers should or should not be used in K-7

Reason (summarized)	# of Teachers Citing Examples	% of 126 Teachers	% of 178 Responses
Computer skills/knowledge are/will be needed for future education/jobs.	50	40%	28%
Computers enhance student writing - faster, more editing, better looking, more satisfying	41	33%	23%
Children are motivated to use computers, fun/enjoyment, engaging	25	20%	14%
Proficiency with computers simplifies/speeds up academic activities	14	11%	8%
Children should learn to use computers while they are young	11	9%	6%
Computers present another option for instruction	10	8%	6%
The teacher identifies specific computer use/s e.g., word processing, drill and practice, keyboarding	8	6%	5%
Children learn quickly/well using computers	6	5%	3%
Provides individual/small group instruction and/or frees up teacher	4	4%	2%
There is insufficient time on/numbers of computers to allow instructional use of computers to occur	3	2%	2%
Not appropriate at my grade level	2	2%	1%
Teachers should teach, computers are just tools	1	1%	<1%
It is too difficult/not possible to match curriculum goals to software	1	1%	<1%
Problems with hardware	1	1%	<1%
Unsure of the benefits to/impact on students	1	1%	<1%

Note. The questionnaire included an open-ended question asking teachers for the reasons computers should or should not be used in K-7. Their reasons were clustered and ranked by frequency. In cases where more than one reason was given, only the first two are included. Less than 5% of teachers gave more than two answers.

appearance of their students' writing. When the 121 teachers who indicated that computers should probably or definitely be used in elementary schools were asked to describe why, 41 of them (34%) mentioned some aspect/s of the computer's capacity to improve students' written work as a reason (see Table 3). Throughout the written responses on the questionnaire there are constant references to the ease and speed with which computers allow students to create and to edit written work; the quality appearance of the work that students produce with computers; and the change in students' attitudes towards editing that has resulted from this ease and quality. Some variation of the belief that computers made student writing easier, faster, and/or better was expressed by all teachers interviewed, including the nonusers. The following are typical examples of teachers' observations:

That's why I teach the kids a word processor...if they can see a use, an actual use of writing something down and then being able to change it without this horrendous task...If I were to choose between teaching the kids cursive handwriting and teaching them to use the computer I would definitely choose the computer because I don't think the handwriting is as important (Kathy).

What they produce can look so much better, that's really reinforcing to them (Janet).

Aside from teachers belief that students need to learn "computers", the only use of computers on which teachers showed consensus was word processing. While some of the teachers interviewed were clearly more experienced with a range of

instructional computing than others, all of them saw this need for students to learn to keyboard and to use the computers to write. There is currently a major emphasis on "the writing process" in K-7, and this was noted throughout the interviews. It is evident that many teachers see computers as being very important if not critical to students' writing activity and thus word processing, as a component of writing, is identified as a learning need.

Children are motivated to, and enthusiastic about, using computers

Teachers repeatedly expressed the view that using computers, irrespective of what they are using them for, is extremely appealing to children. None of the items on the questionnaire directly addressed the issue of childrens' enthusiasm; however, teachers indicated on other items that their instructional use of computers was encouraged by their students' positive reaction to them. Thirty-nine percent of the teachers responding to the questionnaire indicated that the expectations of their students encouraged them to employ computers. When asked in an open-ended question to describe why they thought computers should be used, 25 teachers (20%) responded with answers like "motivation factor", "they [students] relate to them so well", "they automatically increase the interest and motivation of the kids" and "the kids love 'em" (see Table 3). Eight of the teachers interviewed described some aspect of this pattern. Three spoke of how well students concentrated when working with computers, and the other five described how enthusiastic children were about going to the computer in their room or to the computers in the laboratory. Bonnie's is a typical report:

Because our computer time is just before lunch on Mondays it is often cancelled, when that happens the kids are really disappointed, they like it so much, for many of them it's the most enjoyable time in the week...I don't know why, I think kids just like to do things with computers.

Teachers are obviously impressed with the eagerness with which students approach computers and see this to be of some importance.

What is interesting about these five attitudes, held by teachers from across the spectrum of computer use, is that they are all supportive of computer use and yet with one possible exception they do not appear to be based on any evidence of educational value. The possible exception is teachers' belief that computers function to speed up production, or improve the appearance of, written material. One might make the argument that being able to write faster or more legibly could foster better writing and thus be of educational value. In the other four cases, teachers appear to be idealizing computers and while supporting their use, they seem unable to define their value or the educational benefit to be derived from their use. Teachers' attitudes show that they believe computers will continue to penetrate our lives, and that children enjoy using computers, but they offer little evidence that these things contribute to students learning more.

Attitudes held commonly by moderate to high users

Three attitudes were commonly found in moderate and high users of computers. As you will recall, a high user is essentially one who declared that he/she used computers "very often" in instruction, while a moderate user is one who "often" employed computers. The

three themes common to this group are: an obvious personal enthusiasm for using computers; a desire for more computer hardware and more software; and an impression that teachers who were previously reluctant are beginning to use computers and that the administration should foster this use. Each of these is expanded below.

Personal enthusiasm for the use of computers

In their responses to the questionnaire and in interviews, high and moderate teachers demonstrated a pronounced personal interest in using computers. As Table 4 shows, this group is more likely to be home users of computers than their low use and non-using counterparts. In the course of the interviews each of the high users and two of the moderate users voiced notable enthusiasm for the potential and existing uses of computers in schools. Their exuberance made it clear that they personally enjoyed using computers and felt computers had been a boon to their own lives, and further that computers had the potential to improve education. The following are examples of this enthusiasm:

They open up whole new possibilities....it's really exciting
(Bonnie).

We signed up for an extra half hour because nobody wants the last half hour before lunch on Friday...I'm happy to take it. Hey! the lab's empty, we run in (Kathy).

In contrast, none of the low or nonusers showed a personal enthusiasm for using computers. While they recognized a value in students using computers, as will be demonstrated below, their personal reaction was more likely to be one of fear than of enthusiasm.

Table 4

Number of times teachers used computers at home in a two week period, cross-tabulated with level of instructional use of computers.

Frequency of use	Moderate & High users	Low & Nonusers	Total (N=100)*
no data	6 (12%)	3 (6%)	
never	23 (46%)	36 (72%)	59 (59%)
1-4 times	7 (14%)	11 (22%)	18 (18%)
5-9 times	6 (12%)	0 (0%)	6 (6%)
10 times or >	7 (14%)	1 (2%)	8 (8%)
total	49 (49%)	51 (51%)	100 (100%)

Note. * Responses from 26 teachers in the "unclear" category are not included.

Desire for more computer hardware/software

While teachers at all levels suggested factors restricting their practice involving computers (these will be fully discussed below), high and moderate teachers were far more likely to mention impediments related to the quality and quantity of computer hardware and software. Two of the high users and two of the moderate users argued that more hardware and software was required to increase instructional use of computers in their school. The following demonstrate the tone of their sentiments:

What would be ideal would be 30 in the lab and then others in my room. With 15 it is really hard to give busy work to the other half (Kathy).

Lack of software is a real problem, we have Number Munchers and Word Munchers and I've got some old MECC that I use for drill and practice (Blake).

In contrast, low users and nonusers rarely identified specific hardware or software shortcomings. And they were less likely to be concerned about the number of computers. As will be shown below, they were much more likely to complain of lack of direction and the need for support from informed personnel.

It appears that the high and moderate users are more aware of the scarcity of hardware and software because they make more use of it. Kathy had stated that it was getting harder to get into the lab as more teachers began using it. When asked if she would like to see more computers or more resource time, she answered:

More computers. I don't think more resource time would help. We've only got 25 hours a week and we're going to have twenty classes next year so that's not going to change and you see the thing is of that half hour you've only got 15 computers so for each kid that's only 15 minutes and switch. More computers.

The evidence from the low users and nonusers is that they would not make the same choice.

Computer use is increasing and should be encouraged further

The fact that there were only 16 nonusers is evidence that teachers are beginning to use computers. A group of high and moderate users appeared to take a solicitous interest in the change, citing evidence of it, and urging that administration should encourage it. Three of the high users and one of the moderate users described

how nonusers among the staff in their schools had begun to use computers. In each case they emphasized the need for administration to nurture these developments in order to increase computer use.

Some of them have become comfortable putting their marks into the computer, if they get help they'll be doing their own computers next year (Anna).

There are probably twice as many using them this year as there were two years ago. I think most of them want someone to walk them through it [pause] somebody on school time (Bonnie).

Although some low users and nonusers noted the increase in the number of teachers using computers, it was never with the advocacy shown by this group of high and moderate users. The frequent users were clearly proponents of what they saw to be progress and were anxious that the change should be actively fostered.

The common element in these three themes expressed by the high and moderate users is the sense of advocacy. Most of these high and moderate users personally use computers and support changes which they believe will bring other teachers to use computers.

Attitudes held commonly by low and nonusers

Three themes were found to be common in low and nonusers. As you will recall, low users are teachers who used computers only "occasionally" in instruction, while nonusers never employ computers. The three themes common to this group are the belief that computer use is a luxury – it is unnecessary to meet their immediate instructional needs; the fear that they may be unable to use computers or be proved incompetent in their attempts; and finally, the belief that

if administration want them to use computers there needs to be a comprehensive program of teacher instruction and support. Each of these attitudes is expanded below, with examples from the teachers.

At this point in time computers are a luxury and instructional goals can be met without them

Although, as Table 5 shows, low and nonusers were almost as likely as high and moderate users to say computers should be used in elementary schools, the former group voiced a notable reluctance to actually use computers. Two low users and one nonuser explained that, although they might like to use computers, they did not need to. This attitude was also identified by two of the high users and two of the moderate users as a motivation for their colleagues' non-use. The following quotes exemplify this belief.

I can do what I have to do without using them, they're great but they're something extra (Don).

I know a lot of people who would love to use them but they don't, that's what's happening, they're not using them.....I think they're finding that there is lots of subjects where you really don't need them (Mike).

I think they see it as, if not a luxury, at least something that's not a necessity (Kathy).

The reluctant teachers apparently felt that the potential benefits of computer use were considerably less than the commitment necessary to use them.

Table 5

Teachers' belief about whether students should use computers in K-7 cross-tabulated with level of instructional use of computers

Should computers be used in K-7?	Moderate & High Users	Low & Nonusers	Total (N=100)*
no data	0 (0%)	1 (1%)	1 (1%)
definitely NOT	0 (0%)	0 (0%)	0 (0%)
probably NOT	0 (0%)	1 (100%)	1 (1%)
probably YES	13 (26%)	15 (54%)	28 (28%)
definitely YES	36 (72%)	34 (49%)	70 (70%)
total	49 (49%)	51 (51%)	100 (100%)

Note.* Responses from 26 teachers in the "unclear" category are not included.

More curriculum direction, training, and assistance of skilled personnel must be provided before teachers will become more involved with instructional computing

It became apparent during the interviews that all of the low and nonusers held one or more levels of educational administration largely responsible for their level of computer use. All of the low and nonusers felt that they were ill equipped to deal with computers and that administration would have to remedy this deficit before there would be any marked increase in the use of computers by most teachers. The specifics of which level of administration would need to intervene varied among teachers, but included the Ministry of Education, the school district and university teacher training programs. Although the specifics of the required intervention varied

or were not always clearly articulated, they included the following: the need for clearly defined curriculum objectives for computers; the need for computer instruction provided to teachers during school time; the need for substitute teachers to free teachers to attend computer instruction; the opportunity to observe other teachers using computers for instruction; the need for trained personnel to teach children how to use computers; and the need for trained support personnel to install hardware and software and to provide technical support for teachers implementing computers.

All but one of the high and moderate users supported the call for more direction in the use of computers. However, rather than offer it as a rationale for their own lack of use they appeared more concerned that it was necessary to make their non-using colleagues more comfortable with computers.

Fear of implementing computers in instruction

The questionnaire data gave no hint that teachers might be afraid of implementing computers, yet it appears from the interviews that for some teachers this is so. One nonuser and one low user expressed fear at the prospect of using computers in instruction. In addition, all three low users, the second nonuser, two moderate users and two high users volunteered that they believed there were teachers who were afraid of computers or of using computers with their students.

I think at some level I am afraid to start using them... I don't know a thing about them, and frankly I'm not sure that I want to (Don).

I think a lot of us are afraid we are going to be told to use them, I know how to turn them on but that's about it... it worries me (Cindy).

A lot of teachers are afraid of them and won't use them (they say) 'You take my kids, I don't want anything to do with them because I'm scared of them' (Anna).

It's not clear how widely felt is this fear of using computers. Among the teachers interviewed there were only the two (18%) who indicated that they were afraid of some of the implications of using computers. However, these two, combined with the observations of the seven others suggest that some teachers are fearful of using computers in instruction.

Summary of question one

Teachers were stratified initially into user levels as a way of ensuring a balanced sample for interviewing. The discovery that some attitudes appear to be related to how much teachers use computers was largely serendipitous, but an examination of the themes associated with the three categories suggests an interesting dynamic (see Figure 1 for a summary of the attitudes of the three categories of users). The general attitudinal climate across all user levels is very supportive of the introduction of computers – even going so far as to champion the creation of a distinct curriculum area for them. The solidarity seems to break down when it comes to pursuing actively increased instructional computer use. One group, represented by more active users, appear to champion increased use. At the high end these teachers are pushing for more hardware and software. It seems likely that if innovative uses of computers occur, these will be the teachers

involved. Meanwhile a second group, represented by less active teachers, seems willing to accept the status quo until told exactly what to do with computers. As one of the teachers noted, "they want someone to take them by the hand and walk them through it".

Although the potential seems to exist, there is no indication that the two groups are antagonistic to each other. The high users attitude towards the low users is essentially one of paternal concern as demonstrated by the following remark by Kathy,

I don't think there is a lot of pressure put on teachers by other teachers to do it. There is a lot of encouraging, 'Oh it's okay, you can do it, I'll show you how to do it, it's easy c'mon I'll show you'. That kinda thing.

The low and nonusers seem relieved that there are teachers who are able to use computers and who can thus provide computer instruction for the students of teachers who are not active computer users. The prevailing sense seems to be one of balance, with the high users ensuring that sufficient computer instruction takes place by taking students from nonusers, while the low and nonusers can appease any guilt they might feel, confident that experts are taking their charges and waiting for the day when "the administration" comes through with guidance and support.

As noted above, also of interest is the appearance that rather than teachers' attitudes and beliefs being influenced by the educational merits of computer use, they seem to be based on such factors as the belief that computer use is becoming commonplace. The next section explores the factors which influence teachers' decisions involving computers.

Figure 1

Summary of teachers attitudes towards computers as an instructional option, sorted by user level

<u>Attitudes commonly held by teachers, at all levels</u>
<ul style="list-style-type: none"> • Computers are inextricably linked with the future and as such are unquestionably a necessary part of K-7 education. • Ideally every teacher <u>should</u> use computers in instruction. • "Computers" is a subject like "Gym" or "French". • Computers speed up, make easier and otherwise enhance student' writing. • Children are motivated to, and enthusiastic about, when using computers.
<u>Attitudes commonly held by moderate and high users</u>
<ul style="list-style-type: none"> • Personal enthusiasm for the use of computers • Desire for more computer hardware/software • Computer use is increasing and should be encouraged further
<u>Attitudes held commonly by low and nonusers</u>
<ul style="list-style-type: none"> • At this point in time computers are a luxury and instructional goals can be met without them • Fear of implementing computers in instruction • More curriculum direction, training, and assistance of skilled personnel must be provided before teachers will become more involved with instructional computing.

Factors most influencing teachers' choices in
instructional use of computers

The question of which factors influenced teachers' decisions about instructional uses of computers was addressed directly in the questionnaire. Teachers were first asked an open-ended question, "In your opinion, what factors most influence your use/lack of use of computers as an instructional resource?". In this case they wrote in their answers. Their answers were coded and summarized and are indicated by the numbers in parentheses on Tables 6 and 7. In addition, teachers were later supplied a list of 20 possible factors (with spaces to write in any that we did not anticipate) and asked to "check all those factors that encouraged [their] instructional use of computers". This item was followed by a parallel item in which they were asked to check the factors which discouraged their instructional use of computers. These selections are indicated by the numbers in italics on Tables 6 and 7. Tables 6 and 7 are the two resulting lists of factors, ranked by their frequency of selection, one showing the factors encouraging use and the other showing the factors discouraging use. These were then reflected back to the teachers during the interviews, for their reactions and analysis.

Tables 6 and 7 are the lists which teachers were shown in their interviews. The tables combine the results of three items. The numbers in italics indicate the number of teachers that checked that factor as encouraging or discouraging their use of computers for instruction. The numbers in parentheses indicate the number of teachers that wrote an answer which indicated that factor encouraged

Table 6

Factors encouraging teachers' instructional use of computers: ranked by frequency of selection

Rank	Factor ENCOURAGING Use	Responses		
		#	%	written
1	my beliefs about the importance that computers will have in the future	***81	*64%	**{1}
2	my beliefs about the educational merit of students using computers in learning activities	74	58%	{1}
3	the availability of computers in my school	72	57%	{11}
4	the availability of software in my school	61	48%	{2}
5	the availability of a computer resource person in my school	55	44%	{3}
6	the physical arrangement of the computers in my school	50	40%	{1}
7	the expectations of my students	49	39%	
8	my knowledge of how to employ computers for instructional purposes	44	35%	{1}
9	the way the computer resources in my school are scheduled	42	33%	{1}
10	my past experience with instructional activities involving the use of computers	38	30%	
11	my opinion of how computer activities fit my curriculum goals	37	30%	{1}
12	my students' capacity to work independently	36	29%	
13	the expectations of parents	35	28%	
14	the amount of experience that my students have previously had with computers	30	24%	
15	the expectations of society	28	22%	
16	my impression of the level of support within my school for the instructional use of computers	27	21%	
17	the expectations of the school administration	26	20%	
18	the expectations of my fellow teachers	18	14%	
19	the expectations of the district administration	13	10%	
20	the amount of time that I have available to plan for implementing computers as an instructional resource	10	8%	

Note. N=126

* percent of 126 responding teachers

** responses to open-ended question asking what factors influenced use of computers - coded then fitted into previously prepared list

*** number of teachers who checked this item as a factor discouraging their use of computers

Table 7

Factors discouraging teachers' instructional use of computers: ranked by frequency of selection

Rank	Factor DISCOURAGING Use	Responses		
		#	%	written
1	the availability of computers in my school	***66	*52%	**{62}
2	the amount of time that I have available to plan for implementing computers as an instructional resource	62	50%	{11}
3	my knowledge of how to employ computers for instructional purposes	56	44%	{27}
4	the physical arrangement of the computers in my school	55	44%	{5}
5	the availability of software in my school	44	35%	{14}
6	the way the computer resources in my school are scheduled	38	30%	{9}
7	my students' capacity to work independently	33	26%	{2}
8	the availability of a computer resource person in my school	28	22%	{5}
9	the amount of experience that my students have previously had with computers	18	14%	{1}
10	my past experience with instructional activities involving the use of computers	16	13%	
11	my impression of the level of support within my school for the instructional use of computers	12	10%	
13	my beliefs about the educational merit of students using computers in learning activities	4	3%	{1}
13	the expectations of my fellow teachers	4	3%	
13	the expectations of the district administration	4	3%	
16	the expectations of my students	2	2%	
16	the expectations of society	2	2%	
16	the expectations of the school administration	2	2%	
19	the expectations of parents	1	<1%	
19	my beliefs about the importance that computers will have in the future	1	<1%	{1}
20	my opinion of how computer activities fit my curriculum goals	0	0%	{1}

Note. N=126

* percent of 126 responding teachers

** responses to open-ended question asking what factors influenced use of computers - coded then fitted into previously prepared list

*** number of teachers who checked this item as a factor discouraging their use of computers

or discouraged their use of computers. The factors are ranked according to the frequency with which the factor was checked.

Interview items were specifically designed to encourage explanation of surprising rankings and more generally to encourage teachers to speculate on the key factors that influenced their decisions and those of their colleagues. Factors were selected for reporting here on the basis of their frequency of selection on the questionnaire and the frequency and assurity with which they were mentioned in the interviews. Where possible the factors are reported in the order determined by their frequency of selection on the questionnaire, however, some factors have been collapsed and some added to incorporate unanticipated data obtained from questionnaires and interviews. The six factors which appeared to have the greatest weight in encouraging teachers' use of computers for instruction were the perceived importance of computers in the future; the felt need to get on the "computer bandwagon"; the educational merit of computers; access to computers; the presence and ability of a computer resource teacher (CRT); and the teachers' familiarity with computers. The six factors which appeared to have the greatest weight in discouraging teachers' use of computers for instruction were lack of access to computers and software; lack of time; lack of knowledge of computer use and resources; lack of direction; the belief that the benefits of computer use do not equal the cost in time and effort; and fear of using computers. All these are expanded upon below.

Factors which most encourage teachers'
instructional use of computers

The perceived importance of computers in the future

As has already been noted, many of the teachers believe that computer use in society is increasing significantly. Many also believe that students' future work in school and future employment will almost certainly involve computers. Over 85% of the computer using respondents to the questionnaire indicated that their beliefs about the future importance of computers encouraged their instructional use. During the interviews, teachers were asked about the impact in the future of their students use of computers in K-7. All of the teachers believed that it was necessary that students become comfortable with computers because students would need to use them in the future. In addition, several teachers believed that it was the responsibility of grades K-7 to train children in the skills necessary for their future use of computers.

Eight of the teachers interviewed responded that their students would be comfortable with computers as a result of their use of computers in K-7. *They'll use computers like we use telephones, and probably a lot more often* (John). The two nonusers had both indicated that computers should be used, and were asked how this use would impact on students' future. Both teachers felt that their students would not face the problems that they themselves were having because their students would be comfortable with computers.

When asked on the questionnaire to give the reason for their position on the use of computers in K-7, 50% of teachers indicated that students needed to acquire computer skills to be successful in

their future schooling and employment. In addition to their students becoming comfortable with computers, four of the teachers interviewed identified specific skills training that their students were receiving and which would be necessary for future work with computers. *Even for somebody who's going to be a secretary, they are going to be using a word processor, not a typewriter. I can't think of any profession that won't or couldn't be using a computer* (Blake).

Whether they believe that it is sufficient that students simply experience, and become comfortable with, computers during their time in elementary school, or that students should be trained in specific skills, it is clear that these teachers are clearly encouraged to use computers today by the belief that their students will need to use them in the future.

The computer bandwagon

Whether or not they are currently using computers with their students, all of the teachers interviewed believe that computers will be used extensively in schools. *I think you have to...that's what's in, ...computers are in, everybody's using them, everybody wants to use them and you know you should.* (Kathy) Further, there was an accepted belief that all schools were now computerized to some degree and, while some still had insufficient numbers of machines, all schools would eventually have enough. Cindy describes this as a "computer bandwagon" which all teachers will have to get on:

There has been a big rush, everyone says ' Oh, we gotta get on the computer bandwagon, computers are it, computers are going to do this for us, we have to have computers';

and suddenly all the schools have labs and we need one too...then we gotta use it.

At no time did any of the teachers give the impression that they entertained the possibility that the role of computers in schools might decrease in the future. The belief that computers had become an inevitable part of schooling is clearly a major factor encouraging teachers to use computers in instruction.

Merit

Teachers appear to have two conceptions of the educational merit of computer use: the computers' merit in facilitating students production of high quality drafts of their writing; and the computers' potential to provide students with unique learning experiences. When asked to support their opinion that computers should be used in K-7 schools, 41 teachers (33%) described some capacity or capacities of the computer to speed up, make easier, make more engaging or improve the results of students' written work (see Table 3). All of the teachers interviewed recognized that computers improved the appearance of students' written work, while nine teachers described specific improvements which computers could bring to students' writing activity. One teacher observed: *When you see the work that students do with them you can't help but recognize how useful they are...and it's so easy for them to edit and do peer revision...they were made for the writing process* (Janet). Clearly teachers were encouraged to use computers by this perception that computers had merit in improving the appearance of students' writing.

Eight of the teachers interviewed also described what appears to be an educational merit of computers distinct from the somewhat

instrumental purposes described above. These teachers indicated a belief that computers have a potential to enrich students' learning in ways which previously hadn't been possible. The following are examples of this sort of endorsement:

Being able to do the 'What if?' sort of scenarioing that's the real thing That's what they'll really be able to do for us
(Steve).

You know, won't it be neat if you can have a program like a Roman every day going through his day to day in Rome and they could watch this little guy going through and there he is in the Parthenon...very lifelike, almost take your there, almost like a television show or something like a game you know giving them choices (Mike).

Three teachers cited examples of specific computer applications which demonstrate this potential: National Geographic's *KidsNet*, *The Voyage of the MIMI*, and an Education Technology Centre (ETC) sponsored project using *Hypercard*. In these cases the computer was one component of a large scale package integrating computer-based activities with other media and with a curriculum provided by the designers. Less specific examples cited included software which would teach creative thinking, multiple computer activities focusing on a single topic such as the study of whales, and large databases or test banks available at the teachers' desk. The perceived merits of computers in promoting learning beyond the facilitation of producing written work appeared to be more fully developed in the high and moderate users. It was these teachers who provided the specific examples mentioned above. However, one nonuser and two low users

also described scenarios which indicated that they believed that computers had this potential to provide enriched learning activities. All eight of the teachers described this as a potential merit, thus suggesting it encouraged their support of instructional use of computers.

Access to Computers

Access is defined here as the distribution of computers within the school and the assignment of their use. The affect of access appears paradoxical. Although some availability encourages teachers, and thus access is discussed here as a factor encouraging use, many teachers remain discouraged by the limitations on computer access, therefore it is also discussed as a factor limiting use. As the following comments indicate, some teachers are encouraged by their access to computers, but access is still far from optimum.

Well, if they aren't available, we can't use them, whether you want to or not and I think that's the big thing right now...we would all like to have computers in our classrooms if we could. And so we're saying, if they're available we'll use them (Anna).

I don't know [whether it is better to have computers in the classrooms or a lab]. If they are in the lab it is out of sight out of mind but if they are in the classrooms there is nobody to gauge whether they are being used...they might just be wasted when there are people who would love to have them (Bonnie).

The specific arrangements for placement of the computers and the scheduling of class access varied greatly among schools. While

some schools had separate computer laboratories with 17 computers, others distributed their computers across classrooms or had small clusters of computers in the hallways or library. Some classrooms had two computers whereas most had none. In one school the principal required each teacher to ensure their students went to the lab for 30 minutes per week; in other schools the schedule was unstructured and teachers took their classes to the computer lab when convenient and available.

Fifty teachers (39%) indicated that the arrangement of computers in their schools encouraged them to use them, while 42 teachers (33%) were encouraged by the scheduling of computer use. As more schools get computer labs, thus allowing entire classes to take instruction at once, these figures will probably increase. Kathy comments:

I think with the computer labs being in most schools now is really encouraging people and instead of being just two or three it is like 15 and you can go and take all your kids.

I think that really encourages people to use them.

Before computers were readily available, teachers who were not inclined to use them could feel little compunction to do so. One teacher described a situation in the years prior to the school computer lab, when all of the computers were in a single classroom. When the students were in that grade they got their "computers". *It didn't seem to put pressure on anyone, nobody said 'How come there is no computers now', they had a year of it and that seemed to satisfy everyone.* It now appears that increasing access is placing more onus on teachers to use computers. One teacher describes this change.

There was just a couple of old, I don't know what they were, old Apples I think. Some people used them. Then we got a few new ones, but not enough that you could send your whole class to. So you could do it if you wanted to but you didn't have to. Now we are supposed to get a lab and we don't know who'll run it, we'll probably have to take them.

Whether increased access provides an opportunity, increases nonuser anxiety, or facilitates principals dictating use, it is clearly a factor in encouraging use.

Computer resource teacher

Many schools have designated a Computer Resource Teacher (CRT) a part of who's teaching load is devoted to computer instruction. Of the schools studied, three had a CRT 20% of the week, one 30%, six 40% and one had a teacher with 76% of his/her time assigned to computer instruction. *All of the kids get computers...we have a resource teacher part time and parents help him (Janet).*

Fifty-five teachers, 44% of those who completed the questionnaire, indicated that they were encouraged by the availability of a computer resource teacher in their school. The need for a knowledgeable teacher in a resource role within the school was a common factor in comments such as this one from a questionnaire.

Having a knowledgeable computer resource person on staff helps keep the lab in order, keeps it updated, creates a positive attitude towards computers, generates interest by students and provides needed inservice.

Seven of the ten schools from which the interviewed teachers came had a teacher with a part time assignment to work with computers. However, there is little evidence that the teachers interviewed currently use the CRT in a consultative role. Two of the informants spoke quite disparagingly about the CRT's ability to help them. [The CRT] *sometimes brings a piece of software into the staff room or sends a memo that he can help us with something, but I don't really think he knows much about what he's doing* (Dana).

Although the evidence suggests that there are mixed feelings about the effectiveness of CRT's acting in a consulting role, CRT's play a significant role by taking other teachers' students for their computer time. For instance, in Kathy's school, approximately 80% of the students had their computer time planned and supervised by the CRT. *A lot of teachers know 'yeah its really good, I'm really glad my kids are doing it but I don't want to do it with them', so they have the computer teacher take them.* Whether in a consultative role, or actually taking the students for their instruction on computers, it is clear that in many instances the presence of a CRT encourages instructional use of computers.

Familiarity with computers

The questionnaire focused on instructional use and didn't consider changes in teachers' computer knowledge in the recent past. Thus, it missed a phenomena which became apparent in the interviews: teachers increasing familiarity with computers gained through non-instructional use. Four users reported that more teachers in their schools were becoming familiar with the use of computers and were beginning to use them for both personal and

instructional work. Three of these teachers reported that this familiarity was gained through the teachers using computers to prepare report cards. In describing their own instructional use, all three of the low users indicated that preparation of reports, report cards or classroom materials lead to increased confidence with the technology. Thus it appears that increased familiarity with the use of computers encourages use. Further it appears that a common course to that familiarity is through non-instructional use.

Summary of encouraging factors

Figure 2 summarizes the factors which, from the evidence in the interviews and questionnaires, appear to increase the likelihood that teachers will use computers with their students. If we consider the themes represented by these six factors, there is an indication that a transition is occurring in the factors influencing teachers decisions about computers. While the major influences are still largely untested assumptions, the more recent influences are based on teachers' increasing personal experience with computers.

The first two factors – the perceived importance of computers in the future and the belief that there is a "computer bandwagon" which all teachers must get on – are both personal opinions based on assumptions about the world. Teachers don't refer to them by citing specific examples or policies; they assume that we all share the knowledge on which they are founded – the inevitable movement of computers into most aspects of modern life. The third factor – the educational merit of computers – has two aspects and represents a transition in the factors influencing teachers. One aspect of the educational merit which teachers see in computers is the potential for

original learning activities. Teachers provided examples of this, but not out of their own practice. Rather, they described high-profile, high-technology examples they had heard about, or they described imaginary examples of the sorts of applications they would like to see. Much like the first two factors, this aspect of merit appears to be based, not on the teachers' experience, but on a belief that sometime in the near future computers will bring high-tech marvels to their classrooms.

Figure 2

A summary of factors encouraging teachers use of computers in instruction

Perceived importance of computers in the future	• the belief that students need to become comfortable with computers and/or be trained in specific skills to facilitate future advancement
The "computer bandwagon"	• the belief that computers have become an inevitable part of schooling
Merit	• (a) merit in improving written products • (b) potential for original learning activities
Access to computers	• increased access: provides opportunity, increases nonuser angst, facilitates principal prescribed use
computer resource teacher	• taking students for instruction on computers and acting as consultant
Familiarity	• increasing experience with computer use

In contrast, the second aspect of the educational merit – the computers ability to produce quality printed drafts of students work – is very much based on the teachers' own observations of students

work. Similarly the last three factors encouraging teachers' use – access to computers, availability of a Computer Resource Teacher, and an increasing familiarity with computers – are each based on teachers own experience. Further, each of the last three factors is a comparatively recent influence on teachers.

This increasing influence of more practical factors suggests that teachers' experience and understanding of computers is growing. We can speculate that with this increased influence of factors based in classroom practices, the sway held by such preconceptions as the inevitability of computer use, may diminish.

Factors which most discourage teachers'
instructional use of computers

Lack of access to computers and software

Lack of access is without a doubt the most frequently referred to factor limiting use of computers. Anna's response is typical of those from virtually all of the teachers interviewed:

Well, there is the lab now but there is only 17 and what are you supposed to do with the other half of the class? We only get an hour a week and by the time I get half of them settled down doing something else 15 minutes are gone. They end up only getting 15 minutes before they have to switch. I had an old Iie in my room last year and that was okay but ideally I'd like two...GS's or Macintosh's, then students could go to them all day. What we really need is another lab with 30 machines (Anna).

Some teachers see the problem specifically as one aspect of access, for instance the number of machines available, or the way that

their use is scheduled. Most teachers, like Anna, appear to see the problem as a complex set of issues. For the purpose of description these issues will be described as three distinct components of access: the number of computers, the way computers are distributed within the school and their scheduled use, and the quality and quantity of software available in the school.

Number of computers

It is perhaps not surprising that teachers cited the absence of computers as discouraging their use of them. Lack of computers was the most commonly indicated factor discouraging instructional use of computers, cited by 52% of teachers. However, the evidence suggests that even teachers who have access to computers feel restricted because they want more.

We've got five computers in the library, what we need is a lab with fifteen (Blake).

The reason it is discouraging is because there is only fifteen computers and I want thirty (Steve).

There is (a lab) but I think what teachers really want is a couple of them in their rooms as well (Dana).

As the quotations above show, teachers have varied views about the number of machines they need for optimal instructional use. The survey asked what the minimum number of computers required for effective instructional use was for an elementary school of 300. As Table 8 shows answers ranged from four to 300 with a mean of 42, but a standard deviation of 54. It is clear that this is not a detail on which teachers have consensus.

Table 8

Teachers' suggestions for the minimum number of computers necessary for effective instruction with 300 students

Minimum Number	# of Teachers (N=126)	% of Teachers	Ratio of Students to Computer
no data	5	4%	
4	1	<1%	75:1
10	1	<1%	30:1
12	2	2%	25:1
15	6	5%%	20:1
16	2	2%	19:1
17	2	2%	17:1
18	3	2%	16:1
20	11	9%	15:1
24	1	<1%	12:1
25	19	15%	12:1
30	44	35%	10:1
35	3	2%	9:1
40	5	4%	8:1
45	2	2%	7:1
50	4	3%	6:1
60	4	3%	5:1
80	1	<1%	4:1
100-300	10	8%	<3:1
Total	126	100%	

Some teachers suggested that what was needed was for all schools to have computer laboratories. Seventy percent of responses to the question about how many computers were needed fell between 15 and 30 computers – a range most new labs would fall within. This might suggest that a lab would meet most teachers' perceived needs. However, many schools in the study have well over 300 students,

suggesting a need for two labs. Since many schools do not yet have one lab, it will probably be some time before any schools get two.

The wide range of responses shown in Table 8 suggests a more serious concern. Teachers may not be thinking in terms of a lab but of the number of students per computer. Fifty percent of teachers indicated that 25 or 30 was a minimum number of computers for 300 students, thus indicating a student-computer ratio of approximately 11:1. If teachers expect ratios approaching 11:1 then it is little wonder they are discouraged, for only one of the 20 schools in the study had a student to computer ratio of less than 12:1, and they ranged as high as 60:1. In fact the mean ratio of students-computer for the schools studied was 26:1. If teachers' responses indicate a concern for student-computer ratios, then given their responses to the question the existing mean ratio of 26:1 would satisfy less than 8% of them.

Thus, whether they believe that they need one lab of 25 computers for every 300 students, or a student-computer ratio of 11:1, until there are more than twice the number of computers there are now in Centerville's schools, many teachers will remain discouraged.

Arrangement and Scheduling

Even when there is sufficient computers, teachers can be discouraged from using them if the distribution in the school or the schedule for their use is incompatible with the way and time teachers wish to use them. Fifty-six teachers, 44% of those responding to the questionnaire, felt that the arrangement of computers in their school discouraged them. There are as many ways of distributing computers

in these schools as there are schools. The survey of the principals shows that there are computers in laboratories, classrooms, libraries, hallways and learning assistance rooms (See Appendix 5, item 8). From personal observation at many of the schools it is clear that computer laboratory is a generic term applied to any grouping of computers in a single location. The location of the "laboratory" was often a former storage room, the back of the stage or a corner of the library. As noted in the description of factors encouraging instructional use, the shift towards having more computers in labs motivates teachers to use them. However, it appears that this arrangement also discourages many because of the problem of distributing lab access among teachers. Three of the teachers interviewed reported that the limited time available was insufficient for much meaningful educational activity. *How much are you going to get done in fifteen minutes...it's far more trouble than it's worth...Um...they get their computers but I don't think they get much out of it (Anna).* Two other teachers felt that the necessity of sending small groups out of the room on a rotating basis was disruptive and detracted from classroom activity.

Finally, three teachers described the difficulty of attempting to work classroom activity around short fixed lab sessions.

Say you plan on using them in writing about the Haida, you do some work in the classroom but then you have to say 'Hold that thought, we'll write about it on Thursday on the computers'. I have to spend a half hour reviewing before I send them to the computer teacher, because they have forgotten everything...only half of them get it printed out

and I edit them but it is a week before they can change it...

a little writing assignment lasts for weeks (Cindy).

Of these eight teachers, three also noted that the inability to use the computers on a spontaneous basis was restricting to them. Five teachers felt that not having them in their classrooms discouraged their instructional use of computers.

Software

Once teachers have gained access to computers they must still get appropriate software. Thirty-five percent of the teachers responding to the questionnaire noted that the availability of software in their school was a factor discouraging their use of the computers. Complaints over access to software included the amount, the variety, and the quality of available programs. *Lack of software is a real problem, we have Number Munchers and Word Munchers and I've got some old MECC that I use for drill and practice...We've got Tyrannosaurus Rex but there isn't enough student disks. Some of the stuff, its just games (Blake).* Seven of the teachers interviewed reported that the teachers in their school lacked knowledge of what software was available and that this was a factor restricting use. One of these teachers described the lack of knowledge of available software and what it could do as, *the single most important thing keeping us from using the computers (John).*

For respondents to the questionnaire, access in one or more of its forms – the number of computers, the way they are distributed or the amount and quality of software – was far and away the most frequently identified factor discouraging their use of computers. When asked the open-ended question "What factors influence your use/lack

of use of computers as an instructional resource?", 62 teachers, 50% of those responding to the questionnaire, indicated lack of access. This was verified by the teachers interviewed, and the frequency and clarity of their response leaves little doubt that in these teachers' minds lack of access is the paramount factor limiting their instructional use of computers.

Lack of time

Lack of access was the most commonly noted factor discouraging teachers use of computers; however, lack of time ranked very close and in the long run may be a far more intractable problem for teachers wishing to use computers. More computers and software can be purchased, but how do we get more time?

Forty-nine percent of teachers responding to the questionnaire indicated that they were discouraged from instructional use of computers by the amount of time they had available to plan for implementation. Interview participants identified two ways in which lack of time is a factor discouraging instructional use of computers: lack of time to learn, plan and prepare for implementation; and lack of time within the day to use computers in instruction. Teachers saw time to plan as being the time to learn to become comfortable with the computers; to take courses or training if necessary; to learn what software was available; to develop lesson plans and to implement lessons employing this new knowledge and technology. As reflected in the two examples which follow, eight teachers indicated that the time required to learn how to use the computers and to change the way that they teach was dissuading teachers from incorporating computers.

It's not having the time to learn to use it and get familiar (Kathy).

I think that what's happening is that they haven't had the opportunity to spend as much time as they'd like on computers, they know its good but they've kinda gotten into a rut of their regular teaching routine and haven't had the freedom to change, it takes time to change your routine (Mike).

Five of the teachers interviewed stated that planning to use computers in instruction took markedly more time than traditional methods.

First you have to learn to use the computers, then to use the programs, that takes months sometimes and you have to do that before you can even think about bringing your students in...and.....and boy when you think about that... [laughs] it takes a lot longer organize to yourself to use computers than to use flashcards (John).

Six of the teachers also perceived lack of available time within the school day to be important in restricting teachers' inclinations to implement computers. This understanding of time as "time within the curriculum" was the second form identified by the teachers. This concern seemed linked with the tendency to see computers as a subject, and therefore another thing to be taught. *Then they say they want me to teach the computers as well, it is just one more thing. If they told me what I am supposed to take out it would be nice, as it is we don't have enough time. I love to do it but ...(John).* Both of the nonusers, two of the low users, one of the moderate users and one of

the high users expressed this concern that instruction with computers would take more time within the school day. The concern appeared to be more strongly felt by the low users and nonusers.

Teachers' strong feelings about the limitations imposed by lack of time were obvious both from the questionnaire and interviews. References to lack of time were frequent and often marked by frustration as indicated by Blake's response to a question about what would be necessary to increase use of computers: *TIME! That's what we'll need, lots more time... but where the hell is it going to come from?* Teachers gave the impression that while access is a problem they are seeing moves to correct it. They seemed much less hopeful that lack of time would soon diminish as a restriction to computer use.

Lack of knowledge of computer use and resources

It has been suggested above that many teachers do not feel prepared to use computers in instruction. Forty-five percent of the teachers who responded to the questionnaire indicated that their lack of knowledge discouraged their employment of computers for instruction. All of the teachers interviewed made some reference to this issue. They described a range of knowledge-related factors of which their unfamiliarity interfered with their ability to implement computers in instruction. These factors included lack of knowledge of how to use computers, how to teach with computers, how to teach about computers, how to use software, what software was available, and how to integrate computers into their lessons.

Lack of direction

As noted in the section on teachers' attitude towards computers as an instructional option, many teachers, particularly the low and nonusers, felt that they would need a great deal more support to use computers effectively in instruction. One aspect of this lack of support – the lack of clear direction on what the goals of their instructional computer use should be – was prominent and was expressed by users at all levels. Specifically, teachers noted that there were neither provincial curriculum guidelines for computer use nor district requirements specifying at what grades computer use should take place. The following are examples of their responses:

I guess some teachers know what they are supposed to be doing with them, I sure don't, its not in the curriculum.

There is no room in the day for them to just play games (Don).

They tell us to teach computers but they don't tell us what to teach, they did the keyboarding, that was good, but then what? We do writing but what else is there...? (Dana).

Nobody, There is nobody that says that you have to use computers right now as far as I know (Mike).

Seven of the teachers interviewed articulated this belief that there was little or no guidance or direction from any level of administration. Several expressed the view that this showed a lack of commitment and that teacher non-use was a reflection of this. *People want to use them, but don't know how, and its no wonder because they aren't being told (Bonnie).*

The only times during the interviews when teachers showed anger occurred when they described the perceived lack of direction in how to use computers. As the following remark from Mike indicates, they appear to be angry at being unprepared for the coming of this new technology: *They're here but we don't, at least I don't know what to do with them and nobody is telling us. I didn't learn one thing about computers in university...They've offered a couple of workshops...big deal.* Their anger suggests that teachers perceive lack of direction to be a serious limitation to computer use.

Limited benefit for the necessary time and energy

It appears that some teachers having weighed the cost in time and effort, decide that they lack sufficient interest to invest the energy necessary to use computers in instruction. *I think you are running into the barrier that people aren't sure about computers, [they say] 'Sure I can do it on the computer but I can do it in the classroom easier, I've been doing it for years'. It's not that they aren't interested, but you have to really be interested to spend the time* (Blake). Cindy, who's instructional use consists of sending her students to the computer resource teacher, reports:

I guess it's terrible but I have to think that we have too much on our plates, I have too much on my plate what with the new primary program, I think about it but there is always something I would rather do than spend the time to learn.

Clearly, other factors such as lack of time and lack of knowledge weigh on whether teachers are inclined to spend the time to become actively involved in using computers with their students. However, all

teachers are under many of the same constraints and yet some are high users and invest considerable energy, while others do not. It appears from the interview data that one of the determining factors here is simply that some teachers weigh the cost of using computers and decide that the benefits are worth the time and energy, while others are not as interested and are deterred by the necessary commitment.

Fear of implementing unfamiliar technology

Although not one of the factors identified initially in the questionnaire, fear of using computers for instruction was introduced by nine teachers during the interviews. Two of these teachers described their own fear at using or being told to use computers with their classes, while seven described their belief that other teachers were afraid of using computers. Anna outlines some of the possible reasons for the fear, *They're afraid of looking stupid, of not understanding,...uh...of not being able to do it.* The consensus appears to be that the fear is both discouraging nonusers from any attempts to use computers and discouraging other teachers, whose instructional use consists of sending their students to another teacher in the lab, from taking charge of their own instruction involving computers.

Summary of question two

Figure 3 summarizes the factors which from the interviews and questionnaires, appear to decrease the likelihood that teachers will use computers with their students. There is one theme linking the six factors identified as most discouraging use of computers – teachers' lack of knowledge. Teachers' lack of experience with computers, particularly with the use of computers in instruction, is

clearly daunting them. It was demonstrated above that teachers are unsure of many things: of how many computers they need, of how they should best be arranged or scheduled, of what kind of software they need or what is available, of how to use computers, or how to employ them for instruction, and finally, of what they are supposed to teach with or about computers and why. Each of these may or may not be a real limitation to the use of computers. Many teachers simply don't yet have the experience to judge. Thus, they may be speculating about, for example, how many computers they need or how much time computer use will take up in their curriculum. In the end, as they have demonstrated, some wonder whether any benefits will be worth it. Some of them are clearly frightened by the prospect.

Figure 3

Summary of factors discouraging teachers' instructional use of computers

Lack of access to hardware/software	<ul style="list-style-type: none"> • (a) number of computers (b) arrangement and scheduling of computers (c) availability of software
Lack of time	<ul style="list-style-type: none"> • (a) lack of time to learn, plan, prepare (b) lack of time in day to implement
Lack of knowledge	<ul style="list-style-type: none"> • lack of knowledge of many factors considered necessary for implementation
Lack of direction	<ul style="list-style-type: none"> • absence of goals or direction for instructional computer use
Poor cost-benefit payoff	<ul style="list-style-type: none"> • no interest in investing the time and energy
Fear of computers	<ul style="list-style-type: none"> • fear of implementing unfamiliar technology

Teachers' instructional use of computers

It would take a more extensive study to chart teachers' use of computers; however, several items in the questionnaire and interviews allow characterization of the teachers' computer use and the ways their beliefs and attitudes are reflected in what they do with computers. This section focuses on two aspects of teachers' use of computers: the instructional intent of their use, and their clarity of purpose. The first aspect – instructional intent – describes activity for which some intentional curricular motives are obvious or can be surmised. The second aspect - clarity of purpose – describes the considerable activity involving computers for which the instructional purpose is unclear.

Instructional intent of computer use

Computer activity for which there was some apparent instructional purpose fell into four categories: word processing, drill and practice or games, basic computer operation, and other. Each of these categories is further divided into activity devoted to traditional subjects ("subject specific"), and activity intended to develop computer skills or provide computer experience. For example, word processing was used both for Language Arts and to learn the skill of word processing.

Word processing – subject specific

It is obvious that the greatest amount of instructional use of computers involves word processing. The questionnaire asked teachers to give examples of their students' computer activity in the past year. Table 9 shows that 68 teachers, 54% of teachers responding to the questionnaire, reported activities which involved

Table 9

Examples of typical instructional uses of Computers in the last year
sorted by computer activity

Type of Computer Activity	# of Times Cited	% of Responses	% of * Teachers (n=126)
<i>Word processing</i>			
word processing, editing or publishing work	68	45%	54%
<i>Drill and Practice/Games</i>			
drill and practice or games for math	31		25%
drill and practice or games for language arts	11		9%
drill and practice for unstated subject	7		6%
games for unstated subject	3		40%
Total for D&P/Games	52	35%	
<i>Basic Computer Operation</i>			
keyboarding, computer familiarization	17	11%	13%
<i>Other</i>			
artistic or graphic work	5		4%
administrative tasks	2		2%
database	2		2%
spreadsheets	1		1%
computer assisted instruction for unstated subject	1		1%
problem solving	1		1%
Logo, programming	1		1%
Enrichment/remediation	1		11%
Total for Other	14	9%	
Total	151	100%	

Note: If they used computers teachers were asked to describe a typical example. Where teachers cited more than one example, only the first two examples are represented as less than five percent of teachers gave more than two examples. If teachers described more than one example from a single category, only one was coded.

the use of a word processor. This represented 45% of all the computer activity reported. The writing activities described included poetry, journals, letters, stories, and reports.

As was demonstrated above, the interviewed teachers showed unanimous support for students using word processors; thus, it is not surprising that when they were asked about their instructional activities during the previous year they spent much of their time describing writing activities. Their descriptions help to outline the two most common curriculum foci of the students' word processing activity, Language Arts and Social Studies/Science.

Word processing in Language Arts

It should come as no surprise that the majority of word processing activity occurred in Language Arts as much of this curricular area involves writing. The questionnaire asked teachers to check in which of ten curriculum areas they had used computers during the last year. As Table 10 shows, Language Arts was the most commonly indicated, being checked by 83 respondents representing 77% of the teachers who indicated that they had used computers that year. Some of this activity will have been other than word processing, however only 11 teachers (9%) gave examples of drill and practice or games for Language Arts (see Table 9). Thus, a large percentage of the 83 cases will have involved word processing.

Four of the interviewed teachers described writing exercises related to the Language Arts curriculum, including these examples:

Most of the time they do some sort of word processing, often they're creating the stories right there. I'll be there,

they'll type it on, I'll help them type, we'll edit and next week they'll go back and edit again (Anna).

They copied their favorite poem then printed them and illustrated them. We're going to make a book of them (Blake).

Table 10

Curricular areas in which teachers had in the last year initiated instructional activities involving computers

Curricular Area	Times Checked	% of Teachers (n=126)
Language Arts	83	66%
Mathematics	59	47%
Computer Studies	25	20%
Social Studies	24	19%
Art	12	10%
Science	10	8%
(other) [use not stated]	7	6%
ESL	2	2%
second language	2	2%
Drama	2	2%
Music	0	0%

Note. Teachers were supplied a list with these 11 choices and asked to indicate all the curricular areas that their instructional activities using computers that school year had addressed.

Word processing in Social Studies/Science

Social Studies and Science are considered together because so little is known about how the word processor was used with them and because what is known makes it difficult to distinguish one from the other. During the interviews one teacher described activities which were more extensive, involving various writing exercises associated with studying a single unit (e.g. whales or the Haida) and involving a variety of pre-writing activities, peer or teacher critique, and editing. The two units described by the teacher were associated with the Social Studies and Science curriculum. Three survey responses also indicated use of word processing with Social Studies or Science: "writing - natural science", "learning journals for Science and Socials" and "wrote historical newspaper". When indicating the curricular areas in which they had used computers, 19% of teachers checked Social Studies and 8% checked Science (see Table 10). While the availability of many pieces of computer software in both of these areas could account for this activity, the interview suggests that some of the activity, perhaps most, may instead involve word processing.

Word processing:technical skill

You will recall from the discussion of teachers' attitudes towards computers that 33% of teachers cited word processing capabilities to facilitate faster, cleaner written work to justify their contention that computers should be used in elementary schools. During their interviews three teachers described structured word processing activities in which students "did worksheets" on the computers, "practiced copying paragraphs" and "practiced correcting" documents created by the teacher. It appears that these activities were intended

to teach students to use a word processor, rather than to produce written work in a specific subject area. The teachers' descriptions may clarify the examples given by many questionnaire respondents who indicated that their students used the computers for "word processing skills" or to "practice word processing". In other words some teachers see the use of a word processor as a distinct skill which students need to develop. This is perhaps not surprising if we remember the fact that typing has been a distinct subject in schools for many years.

Drill and practice/games – subject specific

Because they are easy to program and simple to use, drill and practice and games programs are generally inexpensive and often represent the bulk of the software available to teachers. The availability of these forms of software is fostered by an agreement between the Provincial Educational Media Center and the Minnesota Educational Computing Consortium which makes MECC's large catalog of Drill and Practice and Games software available to B.C. teachers for only the cost of the disk (approximately \$1.50). As a result of this agreement many titles such as *Word Munchers* and *Number Munchers* are found at most schools. Drill and practice is the term commonly used to describe any piece of software in which questions are presented and the user responds. Games refers to programs which have educational content (although it is often obscure) delivered in a context where the student is competing against the computer or other students.

In addition to using drill and practice and game software for Mathematics and for Language Arts, teachers also cited use of these

forms of software without indicating any curricular intent. I will offer some support for the speculation that in some cases teachers are not concerned with the subject of the software because their intent is only to provide students with opportunities to gain experience using computers.

Drill & practice/games in Mathematics

Math activities are the second most frequently cited use of computers. Thirty-one teachers, 25% of those answering the questionnaire, gave examples of activities such as "math games", "math drills" and "number drills" or specific software titles, most commonly "*Number Munchers*" (see Table 9). Fifty-nine teachers (47%) checked that their students had done mathematics using computers during the year (see Table 10). Although some of the latter activity may have involved more comprehensive instructional activity, none of the examples cited in questionnaire responses indicated use of math software other than for games or drill and practice. Five of the teachers interviewed referred to the use of math software. However, only one teacher indicated she had used a software package intended to address specific content. The following examples are representative of the other four teachers' descriptions of their students' activities using computers to do math.

*They've done a lot of the software games...math drills
...stuff like that (Anna).*

*The kids like using Number Munchers so I've done a little
bit of drill and practice (Steve).*

They do some math games (John).

I know there are some math games there, they use them
(Dana).

Most math drill and math games software has content restricted to specific areas, for instance, fractions or addition of whole numbers. Thus teachers may be selecting software appropriate to their instructional needs. The four comments quoted above do not tend to indicate much discrimination in the choice of software, but it is not possible to preclude it given the data available.

Drill & practice/games in Language Arts

The use of drill and practice or game software for Language Arts is very similar to the use for Mathematics, only the content is different. As noted above, 11 teachers cited examples of the use of this category of software in some Language Arts related activity. Examples included "spelling practice", "reading drills", "word games" "hangman", and "*Word Munchers*". As in the use of this kind of software for math, it is not possible from the available data to determine whether the selection of this software was determined simply by its availability or by its match with curricular needs.

Drill and Practice/games – technical skills

There appears to be quite a bit of computer activity which cannot be attributed to teachers intent to teach a specific curricular area or to teach basic computer skills. As shown in Table 14, teachers cited "drills" or "games" without saying why they were assigning them. As a phenomenon this lack of clear purpose for activity will be discussed below; however, there is evidence that some of this use of drill and practice/games software without regard to its content is intentional – the intent being to give students computer experience.

Two teachers indicated in interviews that they know teachers who believe that any use of computers is a learning experience because it constitutes practice with the technology: *A lot of teachers just let them play games but they say ' That's okay they're using computers aren't they' (Bonnie). Three other teachers described their own assignment of activities which while to an observer might appear to be the indiscriminate use of drill and practice of games was really intended to offer students further experience on the computers. They use a lot of different programs, mostly MECC stuff, but they're learning a lot about computers while they do it (John). According to these teachers, the motivation is simply to have students use computers. They are apparently unconcerned about what students do, as long as they do it on computers. The following comment from Anna suggests that in some cases this rationale might be constructed after the fact to explain assignments without obvious educational merit: I might use computers for drill, for thinking gam...[laughs] thinking strategies, not games, but I wouldn't use it to teach a concept, I don't think I could.*

Basic computer operation – technical skill

It was demonstrated earlier that many teachers consider the study of computers and their operation to be a subject akin to French or Gym. In light of teachers' belief that computers constitute a subject it is tempting to describe teachers practice in this area under the heading "Basic computer operation – subject specific". However, as yet, computer operation is not recognized by the Ministry of Education as a subject and thus this activity is discussed as technical skill.

When describing their year's activity on the questionnaires, 17 teachers (13%) gave examples of activities specifically intended to increase students competence with computers, including "computer literacy", "keyboarding", and "computer familiarization". During the interviews two teachers described basic computer instruction activities such as turning the computer on and handling software while six (including the previously mentioned two) described keyboarding instruction as being part of their students' activity with the computers. While the basic instruction was confined to grade one students, the keyboarding instruction and practice was evident in grades two, four, and six.

Other - subject specific

In addition to those described above, teachers noted several other uses of computers. However, in each case only a small number of teachers cited the use (see Tables 9 and 10). References to other uses took two forms: computer activities including, administrative tasks, databases, spreadsheets, computer assisted instruction ("CAI"), LOGO, and graphics; or subject area including, Art, Drama, second language, ESL, problem solving, or enrichment. Of these only one, graphics/Art was cited by more than 2% of the teachers.

Five teachers (4%) cited Art activities or the use of graphics software when asked for example of their use of computers. Two of the teachers interviewed also described the use of "paint programs". On the questionnaire 12 teachers (10%) checked that they had used computers for Art. It is difficult to gauge the merit of this activity as a means of learning Art. Two teachers described using graphics/paint

programs to illustrate other work, while the rest simply stated that the students had used the software.

Clarity of purpose

Some instructional intent is clear or at the least can be construed for all of the activity described above. However, there is considerable computer activity for which the teachers' intention is a mystery apparently even to themselves. For example, one teacher commented:

I send my students to the computer teacher for forty-five minutes a week, I don't know what he does with them, I'm not allowed in the lab. This comment from a questionnaire represents what appears to be a large group of marginal users who are (while perhaps not as dramatically as this teacher) removed from their students' computer instruction. As was noted when discussing CRT's, according to Kathy's estimates approximately 80 % of teachers in her school send their students to the computer teacher for their computer instruction. *A lot of teachers know 'yeah its really good, I'm really glad my kids are doing it but I don't want to do it with them', so they have the computer teacher take them* (Kathy). While only four of the teachers interviewed had other teachers do most of their instruction involving computers, nine of them mentioned that it was common practice for teachers in their school to send their students to another teacher for computer instruction. There is evidence that at least some of these teachers are sending their students to the computers without having previously identified anything they want their students to learn from this opportunity. Two high users, who had assumed the role of helping other teachers with their computer

instruction, voiced concern that the teachers they helped did not know what their students were going to get from computer use.

They're not even sure what they want their kids to get out of it. If you sit down with them and say 'What would you like them to do?' they say 'Oh whatever you feel is good' (Kathy).

Summary of question three

Fifty-four percent of the questionnaire respondents and 82 % of the teachers interviewed, volunteered that their students had used computers for word processing. The content of this activity appears to range from structured drills intended to increase facility with the technology to the use of word processors to prepare major projects in curricular areas such as Science and Social Studies. Based on the interviews, it would appear that more of the activity was at the simple end of the range with the typical activity being a short initial session of writing or transcribing at the computers, and possibly a follow-up session to edit. The second most frequent use of the computers was for math activities. Forty-seven percent of questionnaire respondents and 45% of the teachers interviewed reported that their students had done some mathematics with the computers. While there was a single example of a teacher using an instructional package to teach a particular arithmetic concept, generally the activity seems to have been drill and practice or games with little evidence that specific content was considered. A collection of activities falling under the rubric of basic computer operation, and intended to familiarize students with specific aspects of the computer, were reported by 14% of questionnaire respondents. The most common activity seems to have been keyboard practice. There is evidence that some computer

activity is intended to give students experience using computers. The content of these activities seems to have been secondary to the fact that students were spending time on computers. Finally, there was a collection of other activities with a variety of curricular foci, only one of which was cited by more than two percent of the teachers. Ten percent of the questionnaire respondents indicated that they had used computers for Art.

In addition to those activities for which there was some apparent instructional intent there was a class of activity for which the educational motivation is unclear. Generally this involved the teacher sending the students to another teacher for computer time without consulting on what occurs in that time. It is not clear how widespread this pattern is; however, two of the eleven teachers interviewed took other teachers students for computer instruction under these conditions and one reported sending his students to another teacher without knowing what they were doing.

The overall impression left by the teachers' use of computers is that it is comparatively simple. The majority of the activity is word processing. In most cases this is characterized by short sessions at the computer attempting to produce written copy which looks better than its handwritten counterpart. Adams says of word processors in schools that "the language arts have been dramatically altered by this new electronic medium" (1985, p. 73). He argues that because students can now change fonts and obtain help from electronic dictionaries we are seeing the "emergence of a new literature" (p. 73). Adams grossly overstates the case. The implication that removing the necessity for handwriting or page turning will somehow change what

students write is fallacious. Surely the work in writing is in imagining, researching, synthesizing, and revising, not in typing, spelling, and selecting typefaces. Teachers' use of word processors seems entirely appropriate. But, while improving legibility and appearance will undoubtedly make writing more appealing to students, it hardly heralds the dawn of a new age in literature.

Second in frequency to word processing was teachers' use of computers for Mathematics. More properly, this might be described as activity in which the students go to the computer and use programs which have something to do with mathematics. The evidence suggests that rather than being purposefully selected as appropriate to the current math lesson, much of the math activity is the result of the students using the software that was available during their computer time and that happens to be a math game. Because it is much easier to get a computer to manipulate numbers than to manipulate text or ideas, math software is the easiest to write and the resultant low cost has led to a preponderance of simple math drill and practice and games programs in many schools. One can make an argument that these programs are useful in review of previous material, as indeed most writers of introductory computer textbooks for teachers do (e.g., Kinzer, et al, 1986; Lockard, et al, 1990). The argument is that these programs "afford additional review in a highly motivational and interactive format. Interesting and fun programs can help dispel apprehension about mathematics" (Mandel & Mandel, 1989, p. 96). The reality is that many of these programs are essentially video games in which children add fractions, rather than, or in addition to, learning to shoot spaceships to get a high score. This activity seems

marginal as mathematics education. While it is possible to see a place for them, as the second most frequent use of computers, math drill and games programs appear a rather mundane use of the technology.

Activities to promote familiarity with computers and to provide computer experience were also common. Like the mathematics activities much of this activity also involves the use of drill and practice programs or games. Again, while spending time at the computer might increase familiarity, the educational value is uncertain.

Chapter summary

This chapter describes the results of a study to answer three questions regarding teachers' instructional use of computers: What are the teachers' attitudes towards computers as an instructional option? What factors most influence their choices in instructional use of computers? and How are the teachers' beliefs and attitudes being reflected in their practice? Three categories of attitude were found: those held by teachers regardless of how much they used computers; those held by frequent computer users; and those held by infrequent or nonusers. Teachers at all levels were found to be overwhelmingly positive about the idea of computers in elementary schools. They saw computers as representative of the future and as forming the core of a new subject in the curriculum. Finally, they believed that children approached computers with enthusiasm and found them inherently motivating. Attitudes common to the high level users were a personal enthusiasm for computers and a belief that their nonuser colleagues were becoming more enthusiastic, but would need support on school time before their use would increase markedly. The high and

moderate users felt that the biggest impediment to computer use was a shortage of quality hardware and software. The low users and nonusers generally felt that at this point in time computers were a luxury and that they were not necessary to meet their immediate instructional goals. Some of this group indicated a fear of implementing computers. The low users and nonusers believed that considerably more direction, training and technical assistance are needed before their instructional use of computers will increase.

Three factors most encouraged teachers' use of computers: the belief that students would need computer skills to be successful in the future, the belief that computer use had become an inevitable part of schooling, and the belief that computers had merit in, as well as the potential to create, original learning opportunities. These three factors were based only loosely on teachers' experience with computers. They appear to extend from generally-held beliefs about the importance and inevitability of computers. Teachers were also encouraged by four factors which were based largely on their own experience: computers' merit in improving students' written work, the increasing numbers of computers in schools, the presence of computer resource teachers, and their own growing familiarity with the technology.

On the other hand, access to computers and software, in terms of the number, quality and placement in schools continues to discourage teachers from using them. Further, teachers were discouraged by their lack of time to learn about, plan for, and implement computers; and their lack of knowledge about computers and their instructional use. They perceived a lack of goals and

direction regarding computers from school authorities at all levels and this left them unsure what to do with the technology. Finally, fear of failure and the belief that there was insufficient value for the amount of energy required to become knowledgeable about computers kept many from trying.

It appears that teachers' practice involving computers is hindered more by the factors discouraging their use than it is encouraged by their beliefs about the future and the importance of computer use. While only 13% of teachers had never used computers, at least 28% more had used them very rarely. The use that did occur was predominantly word processing, and a great deal of this was simple activities such as worksheets, or transcribing stories. Non-word processing activity was predominantly drill and practice and games. Some teachers are trying to use computers for the sorts of activities which one would expect of a technology which held so much promise for the future. However, in the main, teachers' current practice involving computers gives little indication of having the potential for significant impact on the education of their students.

CHAPTER 5

DISCUSSION AND INTERPRETATION OF RESULTS

Introduction

This chapter discusses the major issue arising out of this study: the disparity between, on the one hand, the largely mundane use teachers in Centrevale actually make of computers. and, on the other hand, the real and potential revolutionary change which the literature attributes to the use of computers in education. The discussion draws upon the findings of the three research questions: teachers' attitudes and beliefs about computers in elementary schools, the factors that influence instructional use of computers; and the realities of teachers' practice involving computers. Following this discussion, I will discuss briefly the limitations of the study and the implications of the research including questions for further research. I will conclude with a summary of the findings.

Disparity between promise and practice

Although the literature portrays revolutionary transformations in education as a result of computer technology, the evidence suggests that in Centrevale computer use is relatively modest.

While someone looking at the instructional use of computers by the K-7 teachers in Centrevale might describe it as interesting, it is doubtful that they would use a more effusive adjective. Over 50% of the teachers reported some use of computers for word processing. While this improves the appearance of student writing, neither the teachers in the study nor researchers in the area appear convinced that word processing brings notable improvements to the quality of students' writing

(Hawisher, 1986; Zarry, Hamberg & Mailer, 1991). Other common uses by the teachers included keyboard practice, drill and practice for Math and Language Arts, and games. While students may find these activities interesting, these uses have limited pedagogical benefit.

Contrast what the teachers in the study are doing with what the literature promises is happening or will happen with computers in schools. The review of the literature revealed three common assertions: one, computers and associated "information technologies" represent the solution to an information age explosion of facts; two, through endless patience and ability to focus on specific student's needs, computers are the solution to many dropout problems; and three, computers are creating a revolution in the nature and potential benefits of education.

I will consider three possible explanations to account for this discrepancy between what the literature says should be occurring and what this study found is actually occurring in Centrevale. The first possibility is that teachers, having no faith in the exaggerated promise of computers in education, reject the rhetoric and are restricting their use of computers to a more realistic, more modest level. The second possibility is that teachers have faith in the promise, but are restricted to simple use by practical impediments, most notably, lack of equipment, lack of knowledge and lack of time. The third possibility is that the teachers' faith in the promise of computers is limited, and that underlying that faith is a sketchy vision of how computers fit in education and a lack of commitment to realizing their promise.

Teachers reject the rhetoric

In deference to teachers' experience and training I will first consider the possibility that the disparity between what the literature says teachers should be doing and what they are doing in Centrevale is the result of their considered rejection of higher levels of computer use. I located three meta-analyses of the body of research into the educational effects of computers in elementary grades (Kulik, Kulik, & Bangert-Drowns, 1985; Niemec & Walberg, 1985; Roblyer, Castine & King, 1988). With isolated exceptions, the findings of the analysts were that researchers had failed to demonstrate significant educational benefit from the use of computers in K-12 education. If teachers are aware of these analyses it might reasonably represent justification for teachers' rejection of the exaggerated promise of computers. The teachers might well ask why, if it cannot be demonstrated that computers have noteworthy educational benefit, should they commit considerable classroom time to their use?

Michael Apple (1987) suggests another reason for teachers to reject the incursion of computers into their classrooms. He argues that computers and related technologies contribute to a deskilling and depowering of many teachers, particularly at the primary and elementary school level. He contends that the complexity and quantity of hardware and software will lead to increasing reliance on manufacturers and a few specialists to make decisions about childrens' experience with computers. Further, he suggests that some current teachers' jobs may be threatened as computers become more important in the curriculum, supplanting more traditional choices and making technical skills more necessary.

Despite these arguments, there is no evidence that teachers are consciously restricting their use of computers. I found evidence that some teachers feel that they need not use computers at this time to meet their instructional goals. However, they continued to support in principle the use of computers in K-7 classrooms. If teachers were aware of the research calling into question the educational effectiveness of computers or believed that computers may represent a threat to their jobs, then I would expect to find some critical attitudes against computers. On the contrary, I found an almost unanimous faith that K-7 education needed computers. Thus, it appears unlikely that the disparity between what the literature promises and what teachers actually practice is the result of teachers' conscious rejection of the potential of the technology.

Practical impediments to computer use

The second explanation for the disparity between what the literature promises and what teachers do is that they are restricted by three practical impediments which are largely beyond their control: lack of access to computers and software; lack of time to learn about, plan for, and implement computers; and lack of knowledge about computers and instructional computing. Each of these factors will be considered for its contribution to the disparity.

Lack of access

Sixty-two teachers (50% of teachers responding to the questionnaire) wrote that the major factor discouraging their use of computers was lack of availability. As Table 11 shows, this group represents teachers of all user levels, from nonusers to high users. The 24 high and moderate users who felt restricted by access suggests that,

in addition to limiting the quantity of use, inadequate access (as defined by the teachers) may also be restricting the quality of use.

Table 11

Teachers identifying lack of access to computers as a factor discouraging their instructional use of computers by user level

User Level	# Indicating lack of access	% of 62
high	8	13%
moderate	16	26%
low	18	29%
nonuser	10	16%
unclear	10	16%
TOTAL	62	100%

An examination of a hypothetical "average" school in Centrevale indicates that the current low level of access may contribute to the current low level of practice. The profile of the average school is as follows. Based on the mean of the schools in the study, it would have 13 classrooms and 15 computers. It is interesting that the PACC report (1987, p. 39) recommended that each elementary school in the province have a minimum of one microcomputer per classroom. Thus our hypothetical school is slightly above the suggested provincial minimum. Because this was the most common arrangement we will assume all of the computers are arranged in a single lab. In a typical week it is possible to fit 25 blocks of 45 minutes duration in the lab. Using these figures and a fixed schedule, with two students at each computer almost every class could have two sessions per week. Alternatively, each student could have their own computer for 45 minutes per week if teachers chose to split the class. In 45 minutes students could practice

the keyboard, play math games, or type out a story . However, this would be completely inadequate according to the Intermediate Program document:

The learner's experience with technology should be integrated with real and meaningful activities in all areas of the curriculum. Students should have experiences with a range of technological tools that promote creativity, flexibility, and communications skills. (BCME, 1990, p. 35)

Forty-five minutes per week (or an hour and a half sharing a machine) is not a great deal of time, but that is not the most serious restriction. The biggest deterrent to the sort of learner-centered use of computers promised in the literature, is the fixed schedule required to ensure that each student in the school gets the same amount of time.

A teacher could not accomplish this range of activity and link it to the rest of her lessons if, for example, she only has access to 15 computers from 8:45 until 9:30 on Tuesday and 11:15 until noon on Friday. In view of this constraint, access can clearly be a factor limiting teachers to low level uses of computer technology.

Lack of time

According to Fullan (1991, p. 121), teachers' lack of time is a major factor inhibiting any educational innovation. Thus, it is perhaps not surprising that lack of time was the second most commonly identified factor restricting teachers' use of computers. Sixty-two teachers (50% of those responding) checked that lack of time discouraged their instructional use of computers. Teachers identified four aspects of lack of time as limiting computer use: time to learn how to use computers,

time to learn how to use them for instruction, time to plan for their implementation, and time to implement them.

To understand the amounts of time involved and the potential impact on teachers, consider the time it might take a teacher to go from being a complete nonuser to developing a high level of facility. The estimates here are based on my own experience over the last four years teaching teachers to use computers.

It takes between four and ten hours to become comfortable with a computer and learn the basics of a wordprocessor. This time will be all but wasted if it is not accompanied by an equivalent length of time practicing. At this point a teacher is probably prepared to take her students into a lab, and coach them through an introduction to word processing. She will not have the flexibility to deal with much in the way of problems.

Getting to the next stage often requires more comprehensive study. Most institutions that train teachers have credit courses intended to prepare teachers for instructional use of computers. In general they serve three functions: to introduce teachers to the range of utility programs, such as word processors, spreadsheets and databases; to expose them to some instructional software; and to allow them to explore some of the issues surrounding computers in the classroom. These courses generally require between 35 and 50 hours of classroom/lab work and, at least, the equivalent amount of time in practice with computers. At the end of such a course a teacher would probably be more comfortable teaching word processing, and be better able to deal with some of the moment-to-moment problems which arise. She could also identify some commercial instructional programs and get the

students started with them. However, she would probably not be ready to teach a lesson on databases or implement their use in a Social Studies unit.

The next stage of proficiency involves developing a high level of facility with one or more pieces of software. The length of time it takes to achieve this degree of facility depends on the software. We will assume, as an example, that the teacher wishes to have her students work with *HyperCard*, a database/programming environment highly touted in the educational computing literature. To attain a basic understanding of the program would take between 15 and 30 hours of work. To become truly fluent would take hundreds of hours of work with the software. At this level, one doesn't really stop learning so much as branch out to other related software. However, if, as the *Intermediate Program* (BCME, 1990, p. 35) indicates, the goal is to prepare teachers to use a range of technological tools throughout the curriculum, teachers will need to become accomplished users of many such applications in order to be able to implement the appropriate one at the appropriate time.

In summary, it can take the teachers between 10 and 20 hours of training and practice simply to become comfortable with a wordprocessor. It can take hundreds of hours more to attain the depth and breadth of computer knowledge necessary for the sort of flexibility that is implied in the literature. It is hard to understand how anyone who is not an enthusiast or is not paid to accomplish such activities could find the time. Dana, one of the teachers interviewed in the study, indicated her frustration at how restricting these time requirements are.

I spent a lot of time trying to learn AppleWorks [a wordprocessor]. We did it two Pro-d days and weekends and

(the CRT) sat and helped me lots of times. Now I have to start all over with the Mac. And that's just for writing comments. Where are you supposed to get the time?

The amount of time required to learn how to use computers, then learn how to use them to teach with, then plan the lessons, and finally to actually instruct with them is truly daunting. It is little wonder so many teachers saw lack of time as limiting their use of computers. Perhaps the wonder is that the other 50 % of teachers did not indicate that lack of time is discouraging. Their lack of hindrance notwithstanding, it is clear that for many teachers the instructional practice involving computers is seriously limited by lack of time.

Lack of knowledge

As has been discussed above, teachers' knowledge of computers is largely a function of the time they spend with them. The degree of knowledge required for advanced use extracts a heavy toll in teachers' time – a toll which many are unwilling or unable to pay. Forty-five percent of the teachers responding to the survey felt that lack of knowledge impeded their use of computers.

Our question is whether this lack of knowledge can be a factor restricting Centerville's teachers to their relatively low level use of computers. The teachers impeded by lack of knowledge might simply have been nonusers or low users who lack even the knowledge for simple use. However, as Table 12 shows, while not evenly distributed, many teachers who feel that they lack the knowledge for the use they would like to make of computers are, in fact, already using computers. Eighteen of the teachers, 32% of those who felt restricted by lack of knowledge, were actually moderate to high users of computers. This,

combined with the evidence that the activities promised in the rhetoric require a high degree of knowledge, suggest that lack of knowledge of computers does contribute to the disparity between what the teachers are doing and what the literature suggests.

Table 12

Teachers identifying lack of knowledge as a factor discouraging their instructional use of computers by user level

User Level	# Indicating lack of knowledge	% (n=56)
high	3	5%
moderate	15	27%
low	15	27%
nonuser	8	14%
unclear	15	27%
TOTAL	56	100%

Unsubstantiated faith

The most obvious finding in the survey of teachers' attitudes was their belief that K-7 classrooms needed instructional use of computers. The results suggest a resolute faith in the inevitable value of computer use. Of the 126 teachers completing the questionnaire only five were opposed, one teacher did not respond, one teacher said definitely no because they were "not appropriate at my grade (kindergarten)", and three teachers said "probably no". Of the remaining 121 teachers, 39 stated that computers should probably be used and 81 stated that computers should definitely be used in instruction of K-7 students. When interviewed, some of the teachers expressed reluctance to use computers because they felt unqualified or felt that it added too much to

their load, but none of the teachers suggested that computers might not belong in classrooms. In contrast, some enthusiastic teachers took their support of computers near the level of iconolatry, repeatedly expressing such beliefs as "computers are the future".

The teachers' apparent faith in the value of computers in K-7 classrooms resonates with the literatures' message that computers have revolutionary potential in education. This would seem to add to the question of the disparity between the literature's promise and teachers' practice. Not only is the literature saying computers have revolutionary potential, teachers appear equally sure of the value of this technology. However, my third hypothesis for the disparity promise and practice is that the teachers' faith is limited by a lack of vision of how computers should be used and a lack of commitment to anything more than perfunctory use of computers.

Lack of vision

It is evident from what they have said that teachers feel that computers are important. The most commonly identified reason for this feeling was their belief in the *importance that computers will have in the future*. In addition to checking this as a factor encouraging their instructional use of computers, teacher after teacher, when asked to give reasons for their support of computer use, wrote "the future" or some variation as the prime motive. Yet when the teachers interviewed were asked to describe how their students' use of computers would impact on their lives in the future, several teachers responded with short vague replies such as "They won't be afraid to use computers." None of the interviewed teachers articulated more than the obvious observation that computer use was increasingly prevalent and children today would have

to use computers when they grew up. Ten of the eleven teachers expressed the vague belief that somehow the things they did now were preparation for something to do with computers in the future. Teachers appeared at a loss to explain exactly what students would do with computers which would effect the outcome of their education or their lives.

The following remark from Janet exemplifies the lack of a clear vision for computer use underlying teachers' faith in the potential of computers: *We know that they [students] are really going to need them but we need workshops or something to tell us what for.* Rather than their faith in computers being supported by a clear understanding of the role of computers in elementary education and by knowledge of specific approaches to realizing that role, it appears that many teachers' faith is supported by a vague vision of the future and a belief that somehow students should use computers to prepare for that future.

Lack of commitment

The second factor calling into question the resoluteness of teachers' faith is their limited commitment to increasing their instructional use of computers to a level more consistent with the promises of the literature. My examination of teachers' commitment considers four factors: teachers' enthusiasm for using computers; their need to use computers to meet their instructional goals; the amount of pressure they feel to use computers; and their reliance on other teachers for computer instruction.

Enthusiasm

It is difficult to judge the depth of conviction behind a response on a questionnaire. The interviews allowed some opportunity to assess how

enthusiastic teachers were about their beliefs. One group, including two of the high users and two of the moderate users, were clearly very interested in computers, and enjoyed using them. Their enthusiasm showed in the quality and quantity of their responses to questions. The description of their use of computers was both detailed and spontaneous. In contrast, both of the non-users, two of the low users and one of the moderate users were clearly unenthusiastic about using computers. They tended to focus on the reasons why they did not use computers and were clearly uninterested in increasing their personal use. One of the nonusers and two of the low users stated that they felt computers in K-7 were a luxury which they could do without.

The passion which the enthusiastic group showed for the subject tends to support their apparent faith. These three teachers all had computers at home and used them frequently. It is likely they would be enthusiastic computer users irrespective of their profession. This group shows a commitment to computer use, at least at the personal level. The non-enthusiasts show a lack of commitment to computer use. It appeared that each of these teachers had considered using computers more extensively and rejected the idea. This lack of enthusiasm from half of the teachers interviewed is the first evidence of a general lack of commitment to increased use of computers in instruction.

Need

Approximately half of the teachers felt that students need to learn to use computers in order to prepare them for future education and employment. There are, however, "a growing list of studies" that suggest that such preparation is unnecessary, at least for advanced education. Stallard (1987, p. 154) cites studies demonstrating that even students

going into university programs in Computer Science are not disadvantaged by lack of school related experience with computers. Apparently, many instructors feel that it takes more time to unlearn bad computer habits. In instances where students need to use computers in post-secondary education, the increasing degree of "user-friendliness" in computers and software often make it possible for students to pick up the necessary skills in just a few hours (p. 156).

The increasing presence of computers in the workplace will necessitate many workers' use of them. The question, however, is whether or not experiences that students have with computers in K-7 will prepare them for computer use in the workplace. Most students leaving grade seven will have five years before they enter the workforce full time. If recent trends continue, computer skills that students acquire in grade seven will be largely obsolete by the time they graduate. For instance, in the past five years graphic interfaces have almost completely replaced command line interfaces and skills acquired on one are virtually useless on the other. While such major transformations of the user-interface will probably not occur every five years, what we have seen occurring, often on a yearly basis, are major changes in the operation of even the most popular application software. Thus, user knowledge for one version of a program may be obsolete in only a few years.

Teachers also felt that students needed to learn to use a word processor. Writing with computers has clearly become a fact of modern school life. Thus, it is appropriate that these teachers see a need for their students to develop some level of "keyboarding" skills. However, learning to use a word processor is not like learning to play a piano. It does not take years of training and constant practice. Children can be

taught to type in a relatively short period of time and, with occasional chances to use a keyboard for writing, their skills can be maintained at a level adequate to their needs in elementary school. Word processing software is becoming more "user friendly" almost by the day, with a corresponding drop in the required skills. One teacher in the study reported that her grade three students could touch type and typed better than grade seven students. If nothing else, this should be a testimony to the fact that while students probably need to learn to type, it is not a need to which these teachers need to devote a great deal of attention.

Not only are teachers' perceptions of needed computer skills often erroneous – or at the least greatly exaggerated—they are also mundane. The sorts of needs they describe are essentially clerical skills. They seem a far cry from the revolutionary promises of the literature and again appear to indicate minimal commitment to computer use.

Pressure

When this study was initiated, I hypothesized that, given the quantity and tenor of the published assertions about computers in schools, teachers would feel a great deal of external pressure to use computers. This turned out not to be the case. In fact, on the ranked list of factors which promoted use, the expectations of society, school and district administration, and fellow teachers were ranked at the bottom (see Table 6). Although several teachers felt that others might be feeling pressure, only one of the teachers interviewed acknowledged that he felt any external pressure to use computers.

Teachers not feeling external pressure does not in itself indicate lack of commitment. However, because the result was surprising I asked teachers if they could explain, in light of all the advocacy from media,

parents and other interest groups, teachers felt so little pressure. Their answers were interesting and speak to this question of a lack of commitment. Seven teachers acknowledged that the pressure from "the district" or "administration" existed. But nine of the eleven teachers indicated that they believed that teachers gave external pressure little credence because it was not backed by any commitment on the part of the people exerting the pressure. The following are typical of their responses.

Because there is no directive saying you must, you shall, I think a lot of teachers are saying 'Unless you plop one here in my room I'm not going to do anything extra to get one'. My expectation as a teacher might be that 'If they want me to do this give me one'. The school board is saying 'Yes you should be using it but we don't know how to give you one' (Anna).

The district, uh the district doesn't really, I mean they expect things but that doesn't really effect what happens in the real world (Kathy).

If [administrators] wanted it bad enough, they'd do something about it. (Cindy).

The indication is that teachers don't feel pressured because the talk is not backed by hardware and a mandated curriculum. Lacking internal commitment to computers, they are awaiting evidence of external commitment before they will respond with efforts to increase their use.

Reliance on others

The survey did not ask teachers whether they did their own computer instruction or whether they relied on someone else. This is an

unfortunate oversight. Evidence from the interviews suggests that relying on other teachers for instruction involving computers may be a common practice. Four of the eleven teachers interviewed sent their students to another teacher for all of their computer instruction. The four indicated that this was common practice in their schools and one reported that approximately 80% of the teachers in her school sent their students to the CRT for anything involving computers.

The practice of teachers passing students over to another teacher for their computer instruction suggests a personal lack of commitment to computers. Further, some teachers show an apparent willingness to hand over responsibility for the material covered during computer instruction; even if that material relates to other areas in the curriculum. Of the four teachers who sent their students away for computer-based instruction, only one seemed to have any input into what the students did in their time out of the classroom. She assigned the students writing and sent them to the lab where a parent volunteer helped them with their word processing. Of the remaining three teachers, one could describe what the students did, while two had only a vague idea of what their students did while at the computers. If the sample interviewed are representative of the other teachers, then this may explain why greater than 50% of the questionnaire respondents almost never consider the possibility of using a computer as a feature of instruction despite their regarding computer use as important. If these teachers don't know or don't have control over what happens in their students' computer period, it would make sense that they are not spending time planning for it.

Two of the teachers interviewed provided other teachers' computer instruction. Their experiences support the suggestion that the practice

of sending students to the CRT for their computer activity limits the integration of computers with the rest of the curriculum. One of the teachers who had recently been assigned a position as half-time computer teacher describes his experiences:

I'd like to have integrated what I did more with what the classroom teacher was doing. I mean, at the moment the kids go to computer the way they go to PE or whatever, and it doesn't come back into what the classroom teacher is doing. The teacher basically says 'It's my spare, it's your hour go away.' Next year I'm going to try to get them to talk to me a little more about what they want me to do.

Summary – unsubstantiated faith

When teachers state their belief in the necessity of bringing computers into their classrooms for instruction to prepare students for the future, they are expressing a faith in the capacity of computers to improve education. I believe the teachers are sincere in this. That is, they have faith in computers. Their faith, however, is often unsupported by either an understanding of how to employ computers, or a strong commitment to instructional computing. Without a vision of what instructional computing will look like in practice and without the commitment to advancing computer use in elementary schools past the current level, teachers' faith in computers is educationally insignificant.

Summary – disparity between promise and practice

Evidence has been presented that, broadly speaking, two conditions restrict teachers' practices and contribute to the disparity between their low level instructional use of computers and the revolutionary uses predicted in the literature. First, even strongly

committed teachers are impeded by three practical limitations: lack of access to computers; lack of time to learn, plan and implement; and lack of knowledge about computers. Second, many of the teachers' practice is hindered by their vague vision of the practice of instructional computer use and their lack of commitment to moving past their current limited use. It appears that in many cases teachers use of computers is informed by what is, in effect, an untestable view of the future, rather than a rationally justified curriculum. Further, many of the teachers show little motivation to change the current situation. Lacking a clear understanding of how to use computers to benefit their students and impeded by lack of equipment, time and knowledge, it appears that many teachers' practice involving computers either gravitates to simple activities intended to study the machine itself, or to word processing for which they have had some direction and from which they have seen some results.

There is another possibility which may contribute to the disparity. When promising revolutionary transformations, the literature is likely exaggerating the potential merits of computers. Many proponents of computers in the classroom simply assert their value, but where evidence is given it is often anecdotal with little scholarly rigor. Reviewers of published studies of computer-based instruction often complain that the research is poorly designed, lacks adequate controls, and fails to report data or adequately describe the design (Becker, 1986, p. 88; Roblyer, Castine & King, 1988, p. 20). As noted earlier in the chapter, I located three meta-analyses of the body of research into the educational effects of computers in elementary grades (Kulik, Kulik, & Bangert-Drowns, 1985; Niemec & Walberg, 1985; Roblyer, Castine and King, 1988). Some

of the studies analyzed showed specific applications of computer to have educational merit, for instance, drill and practice with learning disabled children. However, none of the cases in which computers were found superior seemed sufficiently educationally significant to build a revolution upon. Thus, while the three practical impediments, and teachers lack of vision and commitment contribute to the disparity between teachers' practice and the promise asserted by the literature, lack of research to support the promise also makes it a questionable standard. It is possible that, should research substantiate the rhetoric of the literature, teachers would respond with increased commitment to the use of computers.

Concluding remarks

Before summarizing, I will discuss briefly the limits of the study then outline the need for two streams of research, one to investigate the efficacy of current practice involving computers, and a second to investigate the promise of computers as touted in the literature. I will conclude with what I consider to be the three significant risks raised by the thesis: first, that current practice may be wasting valuable classroom time in educationally meaningless activity; second, that current practice may be wasting an educational resource if the promise of computers is real; and third, that the uncertainty raised by the disparity between their current practice and the perceived promise of computers places unnecessary stress upon teachers.

Limitations of the Study

This study was devoted to understanding instructional computing use by K-7 teachers in a single British Columbian school district. No

generalizations can be made other than to the respondents in the Centrevale school district.

In retrospect, three changes in the design of the study might have improved the ability to describe teachers' use of computers. First, case studies of computer use in schools including observation of the teachers' practice involving computers in labs and classrooms would have provided for richer description of the quality and amount of computer use. Second, the addition on the questionnaire of an item asking whether teachers did their own computer teaching or sent students to another teacher and, if they relied on others, their motivation for the practice, would have allowed us to judge better the scope and nature of this phenomenon. Third, because the questionnaire was designed to provide preparatory data for the interviews, rather than to allow for inferential statistics, little statistical analysis could be done with the data. This was shortsighted. Questions could have been designed to gather the data in a form which would have facilitated more detailed quantitative analysis.

Further Research

It appears that the most pressing need in setting a responsible agenda for instructional use of computers is to determine whether computers can do what it is claimed they can do. The paucity of practice in Centrevale in no way precludes the possibility that computers offer the promise which is suggested of them. Most research to date has been concerned with a very narrow range of the curriculum and such uses of the technology as drill and practice (Becker, 1986, p. 84). Thus, even in those cases where benefit is shown, it does not support the sorts of revolutionary computer use promised in the literature. It appears that two streams of research are required, one to demonstrate conclusively

whether or not the activities in current practice are educationally sound, and two, to systematically investigate whether or not the promise touted in the literature is real. This need is not restricted to Centrevale.

According to the last provincial survey, there are in excess of 40,000 computers in British Columbia schools (ETC, 1991). At a conservative estimate these would have had an average cost \$1500.00 each. This means that between 1980 and 1991 the B.C. public paid over 60 million dollars for computers not including the cost for the associated hardware, software, service and personnel. While the results of my study cannot be generalized outside of Centrevale, the need for research can. There is a great need in British Columbia to spend some of the money currently being spent on hardware, on comprehensive research to determine what educational benefits can be derived from this hardware. We need to know if the real promise of computers is commensurate with the rhetoric.

Such research is not likely to be completed in the near future. It has been called for many times in the past and the range, quality, and quantity of research into the use of computers in schools is increasing very slowly (Sheingold, 1983; Becker, 1986; Futrell, 1986; Maddux, 1988). Thus, if Centrevale is to do anything about the situation as I have described it, they will not be able to wait for conclusive research. It is difficult to envision a scenario in which computers will be taken out of the schools, at least in the foreseeable future. In fact, in Centrevale, as in most districts, the movement of computers into elementary schools continues apace with the construction of dedicated computer labs in many schools and the replacement of older computers with new networked machines. While the number of computers increases and the literature continues to tout the revolutionary potential of computers in

schools, teachers' use of those computers is largely restricted to word processing and simple packaged activities.

Of course, it may be that the teachers are simply at an early phase on a course of development that will eventually see them using computers in ways as yet not imagined. Computers have been in the district less than ten years and have only become readily available in the last four to five years. I indicated that four of the interviewed teachers believed that their fellow teachers were becoming more comfortable with computer use. Perhaps, as more hardware and software becomes available, most teachers will gradually become high users.

Risks

Notwithstanding the last remark, I would suggest that a *laissez-faire* approach to the situation which this study describes has three risks: one, considerable time may be wasted or ill-used during educationally unsound use of computers; two, educational opportunities may be missed while waiting for teachers to grope their way to optimal computer use; and three, the disparity between the literature and teachers' practice may be placing undue stress upon teachers. Each of these risks is described below.

The study suggested that, in addition to word processing and keyboard practice, many teachers' instructional use of computers consists of games and drills. Such activity may have educational value in some instances, however, teachers indicated that this activity often arose out of their lacking knowledge of alternatives and the perceived need to provide students with some computer activity, even if it had little foundation in the curriculum. Maddux (1988, p. 5) describes this as the "Everest Syndrome", the belief that the computers should be used

"because they are there". He contends that the pressure is to get the computers and ensure the students spend time with them, and that the aims and goals of education take a back seat to these priorities.

This tendency towards computer activity for the sake of computer activity should not go unchecked. Teachers complained, both on the questionnaires and in the interviews, that there was too little time in the day to meet all of the goals of the curriculum. This given, it would be inappropriate to waste time with activities which are pedagogically meaningless.

Conversely, computers *may* offer the sort of revolutionary potential which so many people seem to feel they do. The computer has irrevocably changed many forms of human endeavor and may offer the same sort of transformation for education. If so, then teachers, schools and students need to be prepared to use computers, and the evidence of this study is that they are not. If computers can provide better learning environments, then it behooves educators to capitalize on these opportunities. If computers offer revolutionary potential, then a great deal of work needs to be done in researching how that potential can be achieved, particularly in the areas of curriculum planning, and teacher education.

Finally, despite their contention that they don't feel external pressure to employ computers, there is considerable evidence that many teachers are not comfortable with their level of instructional use. As indicated by the following comments, there are indications of a range of reactions including: guilt at not using computers, anxiety at not taking full advantage of the resource, fear at being asked to do things they are

not prepared for, and anger at training institutions and administration that have not prepared them to use computers:

Computers are in, everybody's using them, everybody wants to use them and you know you should (Kathy).

They tell us to teach computers but they don't tell us what to teach, they did the keyboarding, that was good, but then what? we do writing but what else is there...? I know there's more (Dana).

I think a lot of us are afraid we are going to be told to use them, I know how to turn them on but that's it...it worries me (Cindy).

They're here but we don't, at least I don't know what to do with them and nobody is telling us. I didn't learn one thing about computers in university. They've offered a couple of workshops...big deal (Mike).

These feelings make the introduction of computers and evaluation of their educational potential more difficult. They also waste teachers' energy at a time when they can ill-afford it. If teachers are to become more comfortable with using computers they will need: clearly defined goals for computer use; greater access to the technology; more time to work with the hardware and software and to plan for curriculum integration; and opportunities to develop computer skills and learn how to use computers in instruction.

Conclusion

The world is fast-becoming a single marketplace. And in order to compete successfully with all the global players, Canadian children will need to know one tool very, very, well.

The Computer. [sic] . . . Computers must become more accessible to Canadian students. (Maple Ridge/Pitt Meadows Times, 1992, pg. 9)

The quotation above is part of an advertising campaign for a major food chain. In the course of the campaign hundreds of similar advertisements ran in the print and television media throughout British Columbia. The message in all of these advertisements was essentially the same – students must make extensive use of computers in school if they are going to succeed in the future. It is a message which is echoed by the popular and educational press, by the provincial government, and by school districts. This study found that it is a message teachers believe.

And yet, despite teachers' perception that computers are a necessity, the study found that many teachers in Centrevale make only minimal use of them. It appears that teachers' belief in computers is not sufficient to ensure their use. When it comes to putting their faith into practice many teachers lack both the vision to implement computers, and the commitment to change their current practice. Teachers are also faced with several practical impediments. Teachers identified lack of access, lack of time and lack of knowledge as contributing to their limited use of computers.

If, as they contend, the provincial government and the school district are committed to full integration of computers in the curriculum they already have a major point in their favour – most teachers already believe in the change. However, assuming such integration is possible, the evidence is that a great deal of money and effort will need to be invested to bring about the change. Primarily, a commitment must be

made to improving teachers' understanding of why computers should be used, and how they should use them. It was apparent that many teachers were unwilling to make a significant personal commitment until the Ministry of Education and the school district made a serious commitment including clear policy, curriculum development, and the provision of equipment, time, support, and training. Two implications follow: (1) Until such a commitment is made, it appears that for many teachers in Centrevale, instructional use of computers will remain a low priority. (2) Until the real promise of instructional use of computers can be assessed, it is not obvious that the level of computer use ought to be more than this.

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APPENDIX 2

Instructional Use of ComputersPrincipal Questionnaire

Name _____ School _____

In addition to determining demographic information, this questionnaire attempts to identify the relative level of computer usage in your school.

- 1) What is the total number of teachers in your school?
_____ teachers
- 2) What is the total number of classrooms of students in your school?
_____ classrooms
- 3) What is the total number of students in the school?
_____ students
- 4) If your school has a teacher (*or teachers*) with time specifically dedicated to working with computers, what is the percentage of his/her full time assignment?
teacher #1 _____ percent
teacher #2 _____ percent
teacher #3 _____ percent
- 5) If you have adult non-teacher assistants who help students work with computers, approximately how many hours would they do this in one week. (If there is more than one, give a total for all assistants.)
_____ hours
- 6) What percentage of your school's teachers would you estimate have used computers as part of their instruction an average of one or more times per week during the current school year (since Sept. 89). (check one)
 _____ 0-25% _____ 26-50% _____ 51-75% _____ 76-100%
- 7) If your school has a computer club, how many members does it have?
 _____ students
 _____ N/A

- 8) How many computers does your school currently have for instructional use in: (please note number in each type of location)
- | | |
|---------------------|------------------|
| _____ computer labs | _____ classrooms |
| _____ music room | _____ L.A. room |
| _____ (other) _____ | |
| _____ (other) _____ | |
- 9) How many computers does your school currently have available for student use **outside of regular class time**?
_____ computers
- 10) In an average week, how many hours would at least one of these computers be available to students outside of regular class time?
_____ hours
- 11) Relative to the other goals that you and your staff may have set for this school year, what priority does your school place on increasing the instructional use of computers? (check one)
_____ lesser priority than most goals _____ equal priority with most goals _____ greater priority than most goals
- 12) Approximately how many hours of scheduled in-service training on computer-related subjects were offered to your schools' teachers within the school since September 1989
_____ hours

Thank you for your attention to this questionnaire. If you have questions about the questionnaire or the research of which it is a part, please contact Kevin Akins at Simon Fraser University, 291-4892.

APPENDIX 3

Request for permission to do study

Dear Mr. [Name of District Superintendent]

90/2/12

I am a graduate student in the Faculty of Education at Simon Fraser University and a laboratory instructor in the faculty's Educational Technology Centre. I am writing to ask your permission to do a study in the [Centervale] school district. The study that I propose would be part of my masters thesis and would center on the factors influencing teachers' decision-making regarding the instructional use of computers. Although participation would of course be voluntary, I would hope to have all of the teachers in your K-7 schools spend approximately 5 minutes completing a questionnaire, with twelve of these teachers to be interviewed subsequently for approximately 30 minutes. In addition, I would need some information on computer and software inventory from each of the schools.

Several of the issues pursued in the study would be of interest to your district in planning for instructional computer use. Examples would include: non-curriculum factors deterring teachers from including computer activities in lesson plans, a description of the amount of instructional computer use in each curriculum area, and an analysis of teachers' attitudes about computers in schools. Within the guidelines of confidentiality, I would, of course make the results of the study available to you. If you have specific questions related to instructional computer use in your district I would be willing to explore how I could include them in the study.

I hope that I may arrange a meeting with you to discuss your district's participation in my study. At such time I will provide you with the research proposal, copies of the draft questionnaires and interview guide. The purpose of this letter is to provide you with advance background to aid your decision on whether you would be willing to meet with me and discuss this study. I propose to telephone your office Monday the 19th of February to inquire if you would be willing to discuss this further, and if possible to arrange an appointment with you. Should you wish to contact me or obtain more information prior to this I can be reached at (work) 291-4892, (home) 942-0456, (fax) 291-3203. I look forward to meeting with you.

Sincerely,

Kevin Akins

APPENDIX 4

Questionnaire cover letter**May I have your cooperation?**

I am a graduate student in the faculty of education at Simon Fraser University. The attached questionnaire and subsequent interviews will form the basis of my Master's thesis. The goal of the study is to ascertain the factors which influence teachers in their decisions to use or not use computers for instruction. All of the teachers in elementary schools in [Centrevale] are being asked to complete this questionnaire. In addition, at a later date, twelve teachers from this group will be approached to be interviewed to gather more extensive information on teacher decisions about computer-based instruction.

Although I would very much appreciate your help, you are under no obligation to complete this questionnaire, and completion of the questionnaire is in no way an agreement to be interviewed. Any teacher selected may decline to be interviewed. You are asked on the questionnaire to provide the last six digits of your social insurance number. This provides a number unique to you, and easy for you to recall. This information is simply to allow the researcher to contact you should you be selected for interview. Following the selection of the teachers to be interviewed, the numbers will be removed from all questionnaires. The twelve numbers selected will be posted in the schools along with a telephone number for the selected teachers to arrange an appointment. Data will be coded in such a way as to protect the anonymity of all participants and all schools in any publication based on this data. At no time will the identity of any teacher or school be disclosed to another party.

Those findings which might be useful in making decisions regarding the instructional use of computers will be made available to the school district. Further, a summary of the key findings will be provided to every participating elementary school.

If you have questions about the questionnaire or the research of which it is a part, please contact the researcher, Kevin Akins, Simon Fraser University at 291-4892.

If you have concerns about the questionnaire or the research, feel free to contact Dr. A.J. (Sandy) Dawson at 291-4326.

APPENDIX 5

School data from principal questionnaire

1) What is the total number of teachers in your school?

	# of teachers	# of schools reporting
	5-10	3
	11-15	5
	16-20	6
	21-25	3
	30	3
Total	342	20

2) What is the total number of classrooms of students in your school?

	# of classrooms	# of schools reporting
	1-5	2
	6-10	7
	11- 15	6
	16- 20	2
	21-25	2
	26	1
Total	249	20

3) What is the total number of students in the school?

	# of students	# of schools reporting
	100-200	3
	201-300	7
	301-400	5
	401-500	1
	501-600	3
	609	1
Total	6560	20

4) If your school has a teacher (or teachers) with time specifically dedicated to working with computers, what is the percentage of his/her full time assignment?

	% of one teacher	# of schools reporting
	0	9
	20%	3
	30%	1
	40%	6
	76%	1
Total	406%	20

5) If you have adult non-teacher assistants who help students work with computers, approximately how many hours would they do this in one week. (if there is more than one, give a total for all assistants)

	assistant hrs/week	# of schools reporting
	0	8
	1-5 hrs	8
	6-10 hrs	1
	10-15 hrs	3
Total	54.5 hrs	20

6) What percentage of your school's teachers would you estimate have used computers as part of their instruction an average of one or more times per week during the current school year (since Sept. 89). (check one)

8 0-25% 3 26-50% 1 51-75% 8 76-100%

7) If your school has a computer club, how many members does it have?

students in club	# of schools reporting
0	18
5	1
20	1

- 8) How many computers does your school currently have for instructional use in: (please note number in each type of location)

Number of schools

# computers	lab	class	halls	library	l.a. room	other
0	5	7	19	13	13	14
1-2		4		4	7	6
3-4	2	5				
5-6	2	2		3		
7-8		6				
9-10			1			
11-12	2	1				
13-14						
15-16	2					
17-18	6					
19-20						
20-21	1					
Total	197	52	10	20	9	7

Note: The total number of computers for instructional use in the 20 schools was 296

- 9) How many computers does your school currently have available for student use **outside of regular class time**?

	computers available	# of schools reporting
	0	1
	1-5	5
	6-10	4
	11-15	2
	16-20	7
	27	1
Total	234	20

10) In an average week, how many hours would at least one of these computers be available to students outside of regular class time?

	hrs/week available	# of schools reporting
	no data	2
	0	1
	1-5	10
	6-10	5
	11-20	2
Total	118	20

11) Relative to the other goals that you and your staff may have set for this school year, what priority does your school place on increasing the instructional use of computers? (check one)

7 lesser priority than most goals

9 equal priority with most goals

4 greater priority than most goals

12) Approximately how many hours of scheduled in-service training on computer-related subjects were offered to your schools' teachers within the school since September 1989

	hours training	# of schools reporting
	0	9
	2	1
	3	2
	4	1
	6	1
	7	1
	10	4
	25	1
Total	90	20

APPENDIX 6

Interview protocol

Aggregate Data Questions

Show the teacher the ranked lists of factors. Explain again how the factor list worked on the questionnaire and that the rankings are based on the number of teachers who checked that item.

1. We found it interesting that one factor **the availability of computers in the school** is both the third most important factor in **encouraging** teachers to use computers and the most important factor **discouraging** them. Do you have any thoughts on why this might be.

Probe: Do you think that teachers are sufficiently convinced of the usefulness of computers that they are saying "just give us more" or are they saying that they haven't had enough to judge their efficacy?

2. The second and third most frequently selected factors discouraging use were essentially time factors, either teachers had insufficient time to plan to use computers, or they had insufficient knowledge which one might assume also means time to learn how to use and implement computers instructionally. Why do you feel these items were so often a factor in discouraging use?

Probe: From your experience, do you think that teachers have tried to implement computers and found they have insufficient time, or have they had insufficient time to even try?

3. The single factor which no teacher checked was that "**(their) opinion of how computer activities fit (their) curriculum goals**" discouraged them from using computers. Does it surprise you that apparently no teachers have found computer activities incompatible with their curriculum goals?

Probe: [If YES] How does it surprise you?

4. Most of the teachers seemed to believe in the educational importance of using computers for instruction. For example, 65% of the teachers felt that computers should definitely be used for instruction in K-7 schools, and of the remaining 35%, 31% felt that they should probably be used.
One of the interesting findings was that of these teachers who appear to be supporting the use of computers instructionally, many have

never done so themselves. For example 11 teachers who said computers should definitely be used, had never used computers and an additional 23 had rarely used them.

What sense do you make of this inconsistency between what some teachers say about computers in the school and what they are doing with them?

Probe: Can you think of any specific factors which might be contributing to the inconsistency?

5. Equally interesting to us was that of the 121 teachers who felt that computers should probably or definitely be used instructionally in K-7 classrooms over 50% indicated that when they prepared their lessons they "almost never... consider the possibility of using a computer as a feature of instruction". Even among those teachers committed to the instructional use of computers, only 19% thought of computers as an instructional option more than occasionally when they planned their lessons.

It appears from their responses that many teachers, when asked, believe that computers have a place in K-7 instruction, yet very few teachers seem to consider them when planning lessons. What do you think is happening here?

Probe: Can you think of a scenario where teachers committed to using computers instructionally might not even consider using them?

6. Only one teacher in the study indicated that they felt computers shouldn't be used with K-7 students. Have you seen any indication that others might hold such views?
7. There seems a lot of evidence that many levels of the community are interested in promoting the use of computers. Most teacher magazines and journal have started a technology section. There are regularly articles on educational uses of computers in newspapers. The government and school districts seem to have money to allocate to computers with such programs as "Funds for Excellence" and to hire personnel such as computer helping teachers and district technology coordinators. Many parent groups have been directing funds to the purchase of computer equipment. There are several province and district-wide teacher conferences devoted to the use of computers each year. Yet despite this seemingly strong interest in educational uses of computers, very few teachers indicated that such factors as the expectations of school administrators, fellow teachers, society, or district administration promoted their use of computers.

We felt that such factors would be more prominent in encouraging use. Can you think of any reasons why they were not?

8. From the reports of most teachers it appears that the majority of instructional use of computers was for word processing. Why do you think that there was not a wider spectrum of computer use?

Individual Questions

Thanks for the insights into the general results. I'd like to ask a few questions about your own use of computers and your views on instructional uses of computers.

9. I'd be interested to hear how you have made use of computers instructionally this year

Probe: Over the course of a week, what would the typical student use of computers be like?

10. Has your pattern of instructional use of computers changed since you completed my questionnaire last April?

Probe What has brought about the change?

11. Are you satisfied with your level of use this year?

Probe: [if not] In what way? / How might this be changed?

12. [P.R.N.]

You, along with three quarters of the other teachers, identified the important role that computers will have in the future as a factor encouraging your instructional use of computers. Can you describe for me how your students' use of computers now will impact on their dealings with computers in the future?

- 13 You identified that you use computers for... , , . What factors have contributed to your choosing computer assisted activities over activities which do not involve computers to achieve your instructional goals.

- 14 You have indicated that your instructional use of computers is encouraged by the educational merits for students . Do you feel that your current pattern of instructional use takes advantage of the potential benefits of computers?

- 15 Some critics argue that there has been an unfounded enthusiasm about computers in schools. They argue that their benefits have not been demonstrated and that the expense and commitment is not matched by the results in student learning. How would you as a classroom teacher respond to this kind of criticism?

APPENDIX 7

Questionnaire results distributed to schools

The results which follow are the aggregate of 126 K-7 teachers' responses to a questionnaire distributed in the spring of 1990. Each of the teachers indicated that they were currently a classroom teacher and noted the specific grade/s that they taught. Questionnaires not meeting this criteria were not used in this analysis of the data. In cases where individuals chose not to reply to items this is indicated by an N (for number of cases) of less than 126.

The results of the questionnaire are presented in three sections. The first section summarizes the biographical items relating to the individuals' teaching and computer use. The second section describes the results obtained on those items where teachers indicated their own instructional use of computers and beliefs about the future use of computers in K-7 classrooms. The final section ranks the factors which teachers felt influenced their instructional use of computers

Section 1Teaching and Computer Use**GENDER**

N = 126

99 female 27 male

NUMBER OF YEARS TEACHING

N = 125 (number who responded to this item)

range 1 - 35 years*

mean 10.6 years

standard dev. 7.9

*(teachers in their first year were considered to have taught a year)

NUMBER OF YEARS AT SCHOOL

N = 124

range 1 - 20 years

mean 3.6 years

standard dev. 4.1

53 teachers were in their first year at the school, 20 in their second and 18 in their third

NUMBER OF HOURS AT COURSES OR WORKSHOPS IN THE USE OF COMPUTERS

N = 119

range 0 - 264 hours
 mean 25.2 hours
 standard dev. 37.9

This item asked how many hours of courses of any kind in the use of computers the teachers have taken. This would include courses not directly related to teaching. They were also asked for the percentage of these hours which were specifically directed to instructional uses of computers. The figures below are a function of these two items.

NUMBER OF HOURS OF COURSES OR WORKSHOPS DIRECTED TO INSTRUCTIONAL USES OF COMPUTERS

N = 117

range 0 - 127 hours
 mean 12 hours
 standard dev. 20.6

As the standard deviation shows, a small group of teachers with extensive training (5 with over 60 hours) skew the results and result a large mean. The following table puts this in some perspective

Teachers having 0 hours training	22
Teachers having 0 - 1 hours training	14
Teachers having 1. - 5 hours training	31
Teachers having 5.-10 hours training	18

In fact, 74% of the teachers responding had 12 or less hours of courses or workshops in instructional uses of computing

NUMBER OF BOOKS OR MANUALS READ WHICH RELATE TO INSTRUCTIONAL USES OF COMPUTERS

N = 124

none = 52 one to two = 56 three to four = 10 five or more = 6

NUMBER OF TIMES THE TEACHER USED A COMPUTER FOR ANY REASON IN THE PAST 14 DAYS

N = 116

	none	1-4 times	5-9 times	10-19 times	20+ times
AT HOME	73	25	10	6	2
AT SCHOOL	52	44	13	6	2

THE LAST TIME THE TEACHER INITIATED AN INSTRUCTIONAL ACTIVITY THAT REQUIRED STUDENTS TO USE COMPUTERS

N = 122

Within the last 7 days	55 teachers
Between 1 and 4 weeks ago	24 teachers
Between 1 and 8 months ago	12 teachers
Never	31 teachers

If they used computers instructionally the teachers were asked to describe a typical example. In many cases the teachers gave more than one example. In cases where more than 2 examples were given only the first two examples were coded. The list below reflects in ranked order the examples given. The numbers beside indicate the number of times an example fitting that category was cited.

Category of use	Examples Cited
wordprocessing, editing or publishing work	68
drill and practice or games for math	31
"keyboarding", computer familiarization	17
drill and practice or games for language arts	11
drill and practice for unstated subject	7
artistic or graphic work	5
games for unstated subject	3
administrative tasks	2
database	2
spreadsheets	1
computer assisted instruction for unstated subject	1
problem solving	1
Logo, programming	1
Enrichment/remediation	1

Teachers were also asked to indicate the curricular areas which any of their instructional activities using computers that school year had addressed.

Curricular Area	Times Checked
language arts	83
mathematics	59
computer studies	25
social studies	24
art	12
science	10
(other)	7
ESL	2
second language	2
drama	2
music	0

TEACHERS WITH FUNCTIONING COMPUTER/S IN THEIR CLASSROOM

N = 123

YES = 33 (27 have 1 computer, 2 have 2, and 3 have 3)

NO = 90

HOW OFTEN TEACHERS HAD FULL/PART CLASS USE COMPUTERS AS PART OF PLANNED INSTRUCTIONAL ACTIVITIES

	NEVER	OCCASIONALLY	OFTEN	VERY OFTEN
N = 120 FULL CLASS	44	39	27	10
N = 121 PART CLASS OR INDIVIDUALS	39	56	20	6

Section 2

Beliefs about K-7 Instructional Computer Use

FOR THOSE WHO USED COMPUTERS AS AN INSTRUCTIONAL RESOURCE - WHAT IMPACT HAS IT HAD ON THE QUALITY OF THEIR STUDENTS' EDUCATION?

N = 100

A MAJOR
NEGATIVE
IMPACT

NO
IMPACT

A MAJOR
POSITIVE
IMPACT

1

3

12

61

23

IN PREPARING LESSONS, HOW OFTEN DO YOU CONSIDER THE POSSIBILITY OF USING A COMPUTER AS A FEATURE OF INSTRUCTION?

N = 122

ALMOST
NEVER

OCCASIONALLY

OFTEN

ALMOST
ALWAYS

61

46

12

3

**WHAT IS THE MINIMUM NUMBER OF COMPUTERS THAT AN
ELEMENTARY SCHOOL WITH 300 STUDENTS SHOULD HAVE FOR
EFFECTIVE INSTRUCTIONAL USE?**

N = 121

MINIMUM COMPUTERS	TEACHERS
4 - 10 computers	2
11-20 computers	26
21-30 computers	64
31-40 computers	8
41-50 computers	6
51-60 computers	4
80 computers	1
100 computers	4
150 computers	1
200 computers	1
300 computers	4

Note: The responses have been collapsed to increase clarity

range	4 - 300 computers
mean	42.6 computers
standard dev.	54

SHOULD COMPUTERS BE EMPLOYED FOR INSTRUCTIONAL USE IN K-7 SCHOOLS?

N = 125

DEFINITELY NO	PROBABLY NO	PROBABLY YES	DEFINITELY YES
1*	3*	39	82

Teachers were also asked to describe their reason for their opinion. Their responses are summarized below. In some cases teachers entered more than one reason however in this table only the first response is indicated.

* see clarification following table

Reasons (summarized) Supporting Use	Teachers
Computer skills/knowledge are/will be needed for future education/jobs.	50
Computers enhance student writing - faster, more editing, better looking, more satisfying	41
Children are motivated to use computers - fun/enjoyment, engaging	25
Proficiency with computers simplify/speed up academic activities	14
Children should learn to use computers while they are young	11
Computers present another option for instruction	10
The teacher identifies specific computer use/s eg. wordprocessing, drill and practice, keyboarding	8
Children learn quickly/well using computers	6
Provides individual/small group instruction and/or frees up teacher	4

Reasons (summarized) Not Supporting Use	Teachers
There is insufficient time on/numbers of computers to allow instructional use of computers to occur	3
Not appropriate at my grade level	2
Teachers should teach, computers are just tools	1
It is too difficult/not possible to match curriculum goals to software	1
Problems with hardware	1
Unsure of the benefits to/impact on students	1

* The teacher who indicated that computers should "definitely not" be employed instructionally in K-7 schools was a grade 1 teacher who stated that it was "*not appropriate at my grade level*". Of the three who selected "probably not", one indicated that *computer skills would be needed in the future*(the inconsistency may indicate a mistake), one felt that *teachers should teach*, and one cited *problems with hardware*.

Section 3
Factors Influencing Use

The tables below combine three items. In the first item teachers were asked to write out the factors that most influenced their instructional use/lack of use of computers. Their answers were coded and the frequency of each factor is indicated on the tables by the numbers in (#). Teachers were later asked to check all of the factors on a supplied list which **Encouraged** their instructional use of computers. The table below reflects these two items.

Rank	Factor ENCOURAGING Use	Teachers	
1	my beliefs about the importance that computers will have in the future	81	{1}
2	my beliefs about the educational merit of students using computers in learning activities	74	{1}
3	the availability of computers in my school	72	{11}
4	the availability of software in my school	61	{2}
5	the availability of a computer resource person in my school	55	{3}
6	the physical arrangement of the computers in my school	50	{1}
7	the expectations of my students	49	
8	my knowledge of how to employ computers for instructional purposes	44	{1}
9	the way the computer resources in my school are scheduled	42	{1}
10	my past experience with instructional activities involving the use of computers	38	
11	my opinion of how computer activities fit my curriculum goals	37	{1}
12	my students' capacity to work independently	36	
13	the expectations of parents	35	
14	the amount of experience that my students have previously had with computers	30	
15	the expectations of society	28	
16	my impression of the level of support within my school for the instructional use of computers	27	
17	the expectations of the school administration	26	
18	the expectations of my fellow teachers	18	
19	the expectations of the district administration	13	
20	the amount of time that I have available to plan for implementing computers as an instructional resource	10	

On a second copy of the factors list, teachers were asked to check the factors which **Discouraged** their instructional use. The tables are sorted by the frequency with which the factors were checked. Again, the numbers in { } indicate written answers which fell within that factor, while the unbracketed numbers indicate the frequency with which that factor was checked on a supplied list.

Rank	Factor DISCOURAGING Use	Teachers	
1	the availability of computers in my school	66	{62}
2	the amount of time that I have available to plan for implementing computers as an instructional resource	62	{11}
3	my knowledge of how to employ computers for instructional purposes	56	{27}
4	the physical arrangement of the computers in my school	55	{5}
5	the availability of software in my school	44	{14}
6	the way the computer resources in my school are scheduled	38	{9}
7	my students' capacity to work independently	33	{2}
8	the availability of a computer resource person in my school	28	{5}
9	the amount of experience that my students have previously had with computers	18	{1}
10	my past experience with instructional activities involving the use of computers	16	
11	my impression of the level of support within my school for the instructional use of computers	12	
13	my beliefs about the educational merit of students using computers in learning activities	4	{1}
13	the expectations of my fellow teachers	4	
13	the expectations of the district administration	4	
16	the expectations of my students	2	
16	the expectations of society	2	
16	the expectations of the school administration	2	
19	the expectations of parents	1	
19	my beliefs about the importance that computers will have in the future	1	{1}
19	my opinion of how computer activities fit my curriculum goals	0	{1}

APPENDIX 8

Request for teachers to be interviewed**Instructional Use of Computers
SURVEY FOLLOWUP**

Most of you will remember the questionnaire on your Instructional Use of Computers which was circulated last year. Here (finally) is the promised summary of the preliminary findings. I provide this for your interest and so that you may get some sense of where you stand in comparison to the other teachers in the district. To remind you, the questionnaire was distributed to all of the teachers in most of the K-7 schools in the district. My thanks to the 182 teachers who completed and returned questionnaires. In order to focus on instructional use, for this analysis I have selected from the total returned, 126 teachers who at that time actually had a classroom. The results which follow represent the experience of those 126 teachers.

When you completed the survey most of you included at my request the last 6 digits of your social insurance number or a similar number which you could easily identify. This was to allow me to contact you for a follow-up interview. Below is a list of these numbers which were selected at random. **I am asking that these teachers contact me as soon as possible in order to arrange a time and place when I can meet you for a half-hour interview.** These interviews are extremely important to the completion of the research. While the data as it stands is informative, as an experienced teacher, your commentary on it would greatly enrich the findings. As with the questionnaires, the contents of the interviews will be completely anonymous. I need not even know your name, and no data which would allow you to be identified will be included in any publication resulting from this research.

These are the selected six digit numbers as you entered them on your questionnaire. To arrange an interview please contact me at **291-4892 (days)** or **942-0456 (evenings)**. Interviews can be arranged at a time and place of your convenience.

773501	724873	760985	998711
930453	589079	814132	007007
472966	367851	465564	865674
910258	451073	214826	279114
627583	800704	698753	194503

Once again, thanks to all who completed questionnaires. If you have any questions on the research or results, please contact me. In advance I would like to thank those who volunteer this extra time to be interviewed.

Kevin Akins
Simon Fraser University

10/3/91

APPENDIX 9

Data package cover letter**Instructional Use of Computers**
SURVEY FOLLOWUP

Enclosed you will find two copies of the "Instructional Use of Computers Survey: Preliminary Results" with attached cover letters. These are for circulation among your teachers with our thanks for their participation in the survey last year. In addition, the envelope contains two copies of a letter headed "Please Post". We would be grateful if you could post these in a prominent location. The letters ask at least one teacher among your staff to contact the researchers, however, as the survey is anonymous we do not know the teachers' name. Thus it is very important to us that all of your teachers have the opportunity to read the letter, in order that we might conclude the research.

Thank-you for your assistance with this

Kevin Akins
Faculty of Education
Simon Fraser University
291-4892

APPENDIX 10

First and second-level codes

First-Level Codes

What are teachers' attitudes towards computers as an instructional option?

Any reference indicating an attitude or belief about computers or the use computers in schools coded **ATT**.

What factors most influence their choices in instructional use of computers?

Any reference indicating to something which encouraged or discouraged teacher with respect to computers coded **FAC+** and **FAC-** respectively.

How are the teachers' beliefs and attitudes reflected in their practice?

Any reference to student use of computers coded **IUC**, (for Instructional Use of Computer.

Second-Level Codes

Second level codes reduced from **FAC+**

- | | |
|---------------------|------------------------------------------------|
| +ACCESS | - increased access – number, time, arrangement |
| +CRT | - assistance with computers |
| +FAMILIARITY | - teacher experience with computers |
| +ENTHUSIASM | - student enthusiasm for using computers |
| +MERIT | - some identified instructional benefit |
| +BANDWAGON | - belief in the ^ use of computers in schools |

+FUTURE - general beliefs about the future need for computer skills

Second level codes reduced from **FAC-**

-ACCESS - limited access to computers/software, – number, time, arrangement

-FEAR - fear of computers

-TIME - lack of time (other than on computers)

-INTEREST - lack of interest

-KNOWLEDGE - lack of computer knowledge

-MERIT - belief in the lack of educational merit

-CURRICULUM - lack of policy, direction, curriculum

Second level codes reduced from **ATT**

CHANGE - attitude changing towards acceptance

ZEAL - strong personal advocacy for computers

NEED - children need to know about computers

FEAR - afraid of using computers or employing them in instruction

GYM - analogy to gym or another subject

NINTENDO - kids love to use them, enthusiasm, motivation

LUXURY - instructional goals can be met without them

MORE soft/hard - changes in software or hardware needed

SHOULD - teachers should use computers

HELP - increased support in teacher training, curric. planning will be necessary for instructional use

WRITE - make writing better - speed, appearance, quality

Second level codes reduced from **IUC**

NONUSE - teacher non-use described

DEFLECT - students directed to others for instruction involving computers

- C.A.S.** - Computers As Subject - computer literacy, "take computers", "go to computers"
- SUBJECT** - use of computers for any traditional subject
- W.P.** - Word Processing, writing with computer, stories, publishing
- KEYBOARDING** - keyboarding, keyboard practice, typing practice
- GAMES** - use computer for games, game software
- D&P** - Drill and Practice, drill, drill software

APPENDIX 11

Layout for first-level conceptually clustered matrix
interview respondents × first-level codes

		Teachers Interviewed			
		Anna	Blake	Cind	Steve
ATT	"All of Anna's responses with the ATT Code"	"All of Blake's responses with the ATT Code"	"All of Steve's responses with the ATT Code"		
FAC+	"FAC+ response 1" "FAC+ response 2" "FAC+ response 3"	"All of Blake's responses with the FAC+ Code"	"All of Steve's responses with the FAC+ Code"		
FAC-	"All of Anna's responses with the FAC- Code"	"All of Blake's responses with the FAC- Code"	"All of Steve's responses with the FAC- Code"	*	
IUC	"All of Anna's responses with the IUC Code"	"All of Blake's responses with the IUC Code"	"All of Steve's responses with the IUC Code"		

*The actual matrix was seven feet by eight feet. Even this example would have been 18 inches wide if all 11 informants were included

First-level Codes

APPENDIX 12

Layout for second-level conceptually clustered matrix interview respondents (columns) by second-level codes (rows)

CODE	Anna	Blake	Cin
CHANGE	<i>"All of Anna's references coded CHANGE "</i>		<i>"All of Cin coded</i>
ZEAL		<i>"All the excerpts in which Blake shows personal enthusiasm for computers"</i>	
NEED			
FEAR			
GYM			
NIN			
LUX			
MORE			
SHOULD			
HELP			
WRIT			
+ACC			
+CRT			
+FAMIL			
+ENTH			
+MER			
+BAND			
+FUT			
-ACC			
-TIME			
-INTER			
-KNOW			
-MERIT			
-CURRIC			
NONUSE			
DEFL			
C.A.S.			
SUBJ			
WP			
KEY			
GAME			
D&P			

Note: The actual matrix is seven feet by eight feet and has 352 cells, one for each intersection of one of the 32 second-level code and one of the eleven teachers.