Impacts of Computer Use Upon Primary Classroom Routines

by

Stephen Joseph Campbell
B. Ed., University of British Columbia, 1978

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF ARTS

in

The Faculty of Graduate Studies
(Centre for the Study of Curriculum and Instruction)

We accept this thesis as conforming to the required standard

University of British Columbia
October, 1992

© Stephen Joseph Campbell, 1992
In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

(Signature)

Department of CURRICULUM INSTRUCTION

The University of British Columbia
Vancouver, Canada

Date October 9, 1992

DE-6 (2/88)
Abstract

The study investigated some of the difficulties of integrating a single computer into the curriculum of the primary classroom. It described, from the point of view of primary teachers, the nature and range of unanticipated impacts of computer use on classroom routines (both management and instructional routines) and on instructional purposes. These impacts were examined in the light of an hypothesis that they are barriers to successful implementation.

Four primary teachers (Kindergarten through grade three) and one computer helping teacher in one elementary school were interviewed five times each over a four month period to gather their perceptions on the impacts of computer use on their routines and purposes. The school was located in a large metropolitan school district in British Columbia. The interview transcripts were analyzed for similarities and differences in the teachers' reported experiences.

It was found that, although unanticipated impacts on routines and purposes occurred, they were not described by the interviewees as the only deterrents to implementation. A range of circumstantial, institutional, and attitudinal factors were also influential in shaping a particular level of computer integration for each teacher. Those teachers who held simple goals for the computer (such as drill and practice, and student motivation) reported fewer unexpected impacts upon their classroom routines and instructional purposes, whereas those teachers with more complex goals (such as word processing)
experienced more pervasive impacts. The study has implications for a school-based computer helping teacher whose role it is to facilitate computer implementation with colleagues.
# Table of Contents

Abstract ................................................................................................................. ii

List of Tables .......................................................................................................... vii

Chapter

1. Introduction ........................................................................................................ 1
   Purpose .................................................................................................................. 3
   Significance .......................................................................................................... 5
   Organization ......................................................................................................... 7

2. Review of the Literature .................................................................................... 8
   Barriers to Implementation ................................................................................ 8
   Classroom Culture and Routines ....................................................................... 14
   Types of Routines ............................................................................................... 19
   The "Trojan Horse" Thesis .................................................................................. 22
   Summary .............................................................................................................. 26

3. Methodology ....................................................................................................... 27
   Pilot Study .......................................................................................................... 27
   Selection of the School ...................................................................................... 30
   The Innovation .................................................................................................... 31
   Data Collection and Analysis ............................................................................ 33
   Limitations .......................................................................................................... 37
   Summary .............................................................................................................. 40

4. The Cases ............................................................................................................ 41
   Mrs. Freer .......................................................................................................... 42
   Background ........................................................................................................ 42
   Computer Experience ....................................................................................... 43
   Instructional Purposes ....................................................................................... 43
   Classroom Context ............................................................................................. 45
   Management Routines ....................................................................................... 45
   Instructional Routines ....................................................................................... 47
   Unanticipated Impacts on Management Routines ........................................... 50
   Unanticipated Impacts on Instructional Routines ........................................... 55
   Unanticipated Impacts on Instructional Purposes ........................................... 56
Seeking Assistance........................................................................................................59
Interpretive Summary..................................................................................................59
Mrs. Arthur..................................................................................................................61
  Background................................................................................................................62
    Computer Experience..............................................................................................63
    Instructional Purposes............................................................................................63
    Classroom Context...................................................................................................65
    Management Routines..............................................................................................66
    Instructional Routines..............................................................................................67
  Unanticipated Impacts on Management Routines....................................................68
  Unanticipated Impacts on Instructional Routines....................................................71
  Unanticipated Impacts on Instructional Purposes.....................................................73
  Seeking Assistance.....................................................................................................78
  Interpretive Summary................................................................................................78
Mrs. Douglas.................................................................................................................80
  Background................................................................................................................80
    Computer Experience..............................................................................................81
    Instructional Purposes............................................................................................82
    Classroom Context..................................................................................................83
    Management Routines..............................................................................................85
    Instructional Routines..............................................................................................86
  Unanticipated Impacts on Management Routines....................................................88
  Unanticipated Impacts on Instructional Routines....................................................91
  Unanticipated Impacts on Instructional Purposes.....................................................94
  Seeking Assistance.....................................................................................................98
  Interpretive Summary................................................................................................98
Mrs. Evans....................................................................................................................99
  Background................................................................................................................100
    Computer Experience..............................................................................................100
    Instructional Purposes............................................................................................101
    Classroom Context..................................................................................................103
    Management Routines..............................................................................................104
    Instructional Routines..............................................................................................105
  Unanticipated Impacts on Management Routines....................................................107
  Unanticipated Impacts on Instructional Routines....................................................110
  Unanticipated Impacts on Instructional Purposes.....................................................116
  Seeking Assistance.....................................................................................................118
  Interpretive Summary................................................................................................118
Discussion....................................................................................................................119
  5. Commonalties Across the Cases..............................................................................122
     Nature and Range of Unanticipated Impacts........................................................122
     Unanticipated Impacts on Management Routines................................................124
Unanticipated Impacts on Instructional Routines .................................. 127
Unanticipated Impacts on Instructional Purposes .................................. 129
Impacts and Levels of Use .................................................................. 131
Circumstantial Factors ...................................................................... 134
Institutional Factors .......................................................................... 136
Attitudinal Factors ........................................................................... 138
Summary .......................................................................................... 143

6. Summary and Implications .............................................................. 146
   Summary ..................................................................................... 146
   The Trojan Horse ........................................................................ 148
   Implications ................................................................................. 150
   Further Research .......................................................................... 153

References .......................................................................................... 154

Appendices
Appendix A ....................................................................................... 161
Appendix B ....................................................................................... 162
Appendix C ....................................................................................... 163
Appendix D ....................................................................................... 164
Appendix E ....................................................................................... 165
Appendix F ....................................................................................... 166
Appendix G ....................................................................................... 167
Appendix H ....................................................................................... 168
LIST OF TABLES

1. Table 1 - Unanticipated Impacts on Routines and Instructional Purposes ................................................................. 123

2. Table 2 - Factors Affecting Implementation ................................. 133
CHAPTER ONE

INTRODUCTION

Elementary school teachers do not always find that the computer is easy to integrate into their classrooms. It offers potential, but is also a source of frustration. Whereas much has been written about the educational advantages of computer technology, there is a growing literature which describes difficulties surrounding implementation (Weizenbaum, 1980; Shallis, 1984; Bork, 1985; Donnelly, 1985; Dreyfus & Dreyfus, 1986; Roszak, 1986; Olson, 1988). Despite the amounts of time, energy and money invested by school districts in hardware, software, and teacher in-service, a question arises: "Why is a computer often difficult to integrate into the elementary classroom?"

Some of the barriers to effective implementation of computers are discussed by researchers (Considine, 1985; Cheever et al., 1986; Dreyfus & Dreyfus, 1986; Hoot, 1986; Sheingold, 1987). They refer, for example, to factors such as:

- Limited or differentiated access for students due to the relatively high costs of hardware and software combined with substantial maintenance requirements.
- Inadequate availability of appropriate, high quality software.
- Lack of teacher expertise due to high training costs (including both time and money) and negative teacher attitudes.
- Scarcity of incisive research on the benefits of computers on instruction.

Another factor which has more recently come to light, however, is the complexity of the innovation and its effect on the culture of the classroom itself. The teacher often encounters unexpected impacts of computer use upon classroom organization, including its routines, norms, and relationships (Olson, 1988; Preskill, 1988; Trumbull, 1989).

In particular, Olson (1988) contends that the implementation of a computer in a classroom is not mainly a matter of access to hardware and software, or even of learning to use it, but of dealing with its unanticipated impacts. Teachers' classroom norms and organization, as manifested in routines, may be at stake:

Routines reflect judgements teachers make about how to structure daily life in their classrooms. They are routine only in that they recur, but they are not thoughtless or dull. Making sense of them is crucial to understanding the way teachers use resources like computers in the classroom (p. 90).

He argues that these routines are "challenged in complex ways when computers are used" (p. 107), and can be changed in ways not foreseen by the teacher. These unforeseen changes may also conflict with the teacher's instructional purposes, thereby adding to implementation difficulties. Those who are inexperienced with computer technology may become quickly frustrated with the number of unanticipated problems they encounter and the consequent modifications they may need to make to their classroom routines.
In other words, implementation difficulties occur, says Olson, because "The computer acts as a Trojan Horse bringing new ways of doing things into the classroom" (p. 107). It adds complexity to an already complex environment by adding to the base of unanticipated occurrences that arise in daily practice. Although stated in a very general way, this "Trojan Horse" thesis emphasizes the tension between teachers' instructional purposes for the computer and unexpected effects which may occur in daily practice. More research is called for in order to understand how teachers perceive this "Trojan Horse" and its impact upon computer implementation:

It is crucial to get behind the routines of classrooms to discover their significance. This is especially important if we are to understand the impact of computers because they have the potential to dislocate these routines (p. 93).

This study examines primary teachers' perceptions in one elementary school concerning the nature and range of unanticipated impacts upon classroom routines and instructional purposes resulting from computer use.

Purpose
The purpose of this study is to clarify Olson's "Trojan Horse" hypothesis (1988) that a computer in the classroom is difficult to implement because of unanticipated impacts on routines. The central question is: In an elementary school where one computer per primary classroom is being implemented, what are teachers' perceptions of the nature and range of impacts on routines and
instructional purposes? More specifically, this question includes the following sub-questions:

1. What are the instructional purposes that primary teachers try to achieve with one computer in the classroom?
2. What unanticipated impacts upon management and instructional routines occur as a result of one computer in the primary classroom?
3. How do unanticipated impacts affect instructional purposes for the computer?

These questions are examined within the context of an elementary school where one computer is implemented per primary classroom (Kindergarten through grade three), as opposed to schools where computers are only housed in a central location or grouped in various locations. Although the "Trojan Horse" applies to each of these models, the nature of unexpected outcomes, as well as their impact upon implementation, may differ across these approaches. This study therefore focuses on a single, but widely-used model - that of one computer per classroom - because its impact upon classroom practice is direct, and may be more pervasive than other models.

Since it is beyond the scope of this study to include all aspects of classroom practice when examining the impact of the computer, it is necessary to focus on a particular aspect of classroom organization. Routines are chosen because they are pervasive and necessary to the success of classrooms. Yinger defines routines as "established procedures whose main function is to control and coordinate specific sequences of behavior. Routines are an efficient and common mode
of operation in situations where action and behavior are repetitive" (Yinger, 1979, p. 165). He further distinguishes between two types: (1) instructional routines and (2) management routines. The first, he says, are "methods and procedures established by the teacher to carry out specific instructional moves. These routines are in effect strategies or styles of teaching that have been developed over time and occur in regular configurations and sequences". Management routines refer to "established procedures for controlling and coordinating classroom organization and behavior not associated with specific activities" (p. 166). "Unanticipated impacts" refer to the effects of the computer upon the teacher's purposes for the computer, and upon her classroom routines. They are expected or unexpected in terms of her beliefs about, and purposes for, computer use. The nature and range of these impacts may be construed by teachers as either positive or negative. When purposes and routines are brought into question as a result of the computer in the classroom, they may then need to be modified in some way. Teachers' perceptions are therefore central to this study because the "Trojan Horse" lies in their views about how the computer impacts their purposes and routines.

**Significance**

Since routines are critical to classroom life and contribute to many benefits for both students and teachers, Yinger encourages more educators to carry out research studies. "There is a need," he argues,
"for continued research on classroom teachers in the field to further investigate the use of routines by experienced practitioners" (p. 168). According to Fieman-Nemser (1986) such research must take seriously what teachers themselves say about routines:

The practical wisdom of competent teachers remains a largely untapped source of insight for the improvement of teaching. Uncovering that knowledge is a major task in research on the cultures of teaching and can lead to policies that build on what teachers know. (p. 505)

In response, educators have begun to examine the relationship between school culture and computer implementation. Trumbull (1989), for example, argues that "Any innovation introduced into a school or classroom will necessarily disturb the established culture. The innovation could prove too disruptive and be abandoned or the innovation could be so seriously modified to fit the culture that its benefits are lost" (p. 458). It is essential, she contends, to attend to culture in a study of any innovation:

An established classroom culture will lead to the smooth functioning of the classroom. To understand how computers may be used in schools, then, it is important to understand how computers as computers will affect standard practices and meanings. (p. 458)

When a computer is introduced into a classroom, the fate of the innovation and the nature of its use is shaped by the culture of that classroom. (Olson, 1988) However, this relationship between computer implementation and routines in primary school classrooms is largely unexplored in the literature on innovation. Herein lies the significance of this study.
Organization

The literature reviewed in Chapter Two provides a context for the study in terms of barriers to implementation, classroom culture and routines, types of classroom routines, and unanticipated outcomes of computer use. Each of these areas is explored in relation to the research question. A description of the school context and methodology for collecting data is provided in Chapter Three. Chapter Four depicts the impacts of computer use on the routines and instructional purposes of four primary teachers, while Chapter Five analyzes their commonalities and differences. The last chapter summarizes the study, and lists some implications for the support of computer implementation and for further research.
CHAPTER TWO

REVIEW OF THE LITERATURE

This chapter sets a context for the study in light of current literature in four areas relevant to the research question. First, some barriers to computer implementation in the classroom are presented. Second, a description of routines is provided, followed by, third, examples of types of routines. Finally, Olson's "Trojan Horse" thesis is explained and illustrated.

Barriers to Implementation

The implementation of a computer into the classroom presents a variety of challenges. On the positive side, researchers have emphasized the advantages of this new technology. Among other benefits, computers are motivating, and they can be used as tools to increase students' creative and productive potential in ways that would otherwise be impossible (Collis, 1988; Papert, 1980; Turkle, 1984). They can be employed by teachers to cut down on organization and planning time and by administrators to collect and synthesize data so that more informed policy decisions and predictions can be made (Bluhm, 1987).

From a negative perspective, implementation in classrooms is a multifarious undertaking and there are many and varied barriers. A major study in three American school systems, carried out by a team
of researchers from the Bank Street College, identified general "issues that cut across the specifics of implementation in each district". These included:

...differential access to microcomputers... the inadequate quantity and quality of software; the inadequate preparation of teachers for using microcomputers; and the lack of incisive research on the effects and outcomes of the instructional use of microcomputers... In most cases, they are more critical now than they were five years ago, since the number of microcomputers in schools has increased independently of solutions to the problems of quality software, effective teacher training, or research. (Scheingold et al., 1987, p. 67)

Researchers contend that these issues of differential access, lack of quality software, costs of teacher training, and lack of conclusive research will continue to remain relevant for many years (Lockard et al., 1990).

Differential access causes implementation problems for a variety of reasons. Computers are relatively expensive, which means that compromise often becomes standard in planning for their use (Hoot, 1986). Even when adequate numbers of computers are available, problems with software and equipment failure can prevent teachers from achieving their instructional purposes (Olson, 1988). Bluhm (1987) argues that there is "a hidden cost to computers" (p. 263); after the expiry of the warranty, he says, computers can become costly to maintain. Not only do breakdowns limit access, they cause teachers and students to become frustrated, increasing negative attitudes which run counter to the implementation. Simply distributing greater amounts of hardware and software is not likely
to solve implementation problems as many policy makers originally thought. Conversely, Sheingold (1987) points out that increasing access for students without careful planning may exacerbate these problems.

Unavailability of appropriate, high quality software can also be problematic to successful implementation (Bluhm, 1987). Although new software titles come on the market each year, Forman and Pufall (1988) contend that a significant barrier to implementation may be that hardware and software are not currently designed to meet the needs of the individual learner. They contend that computers and software are designed as "universal... systems that function as tutors of the universal, not the individual, learner" (p. 244). Until software is developed that also caters to the needs of the individual, then, the potential of the innovation will not be met.

Inadequate teacher training is also problematic to implementation. Some teachers find the level of skill required to make effective use of the technology to be intimidating (Dreyfus & Dreyfus, 1986), and lack of appropriate technical training has been cited as a major concern of teachers (Preskill, 1988; McCarthy, 1988; Knupfer, 1988). Advocating cross-curricular uses, although widely accepted as a positive use of the technology, has the potential to create problems on staffs where teachers are not trained for curricular integration (Schwartz, 1987). Unfortunately, the very enthusiasm that drives the growth of computer use can sometimes be detrimental to positive change. If teachers are encouraged by colleagues, administrators,
students, parents, and other outside interest groups to incorporate computers into their curriculum delivery, without adequate training and support, the result can be negative teacher attitudes and narrowed vision (Sheingold, 1986; Collis, 1988).

Although new research is conducted each year, Sheingold (1987) points out that a lack of conclusive findings on the instructional effects continues to be a barrier to implementation. Collis (1988) elaborates on this point:

Despite all the activity associated with computers in education, there is little evidence of many, or even any, significant overall changes in the essential aspects of education, that is, in what students learn, in how they learn, in what they are tested and graded on, and in how teachers teach. (p. 3)

Although these barriers make for significant problems, researchers have recently demonstrated that other factors also warrant consideration when planning for computer use. For example, Mathinos and Woodward (1987) observed a school which had been chosen as exemplary in its implementation of computers. The staff had access to an abundance of computers which had been distributed to individual classrooms and also centralized in a lab. The observers reported a profusion of software as well as an impressive program of teacher support, including a building computer coordinator and aide, and extensive in-service. The school was observed over 13 weeks and during this time, the observers noted that 60 percent of the students never used a computer at all. Of those who did, half used them one time only during the term. "Computer use was rarely
integrated, but rather a reward for finishing work early with students free to select software to use. Teachers complained that equipment was scarce, but the researchers found at least five computers unused at all hours of the day" (Lockard et al., 1990, p. 362).

Even when teachers have ample hardware and software, and are well trained in computer use, they may be reticent to use the innovation to enhance their programs. This indicates that there are still other factors involved in successful implementation. One such factor, Sheingold (1987) claims, is the trend towards increased complexity of the innovation:

There is a marked shift in priorities for how students and teachers use computers toward tool uses of the computer and integration of the computer with the curriculum, in contrast to earlier emphases on the computer as an object of study and as a device for drill and practice. These are encouraging trends, since tool uses appear more likely to support the kind of learning, problem-solving, and information-management skills required of citizens and workers in the information age. (p. 83)

Although it may be desirable to shift priorities for computer use to more complex applications, Fullan (1982) warns that complexity is an important factor influencing implementation. "Complexity," he states, "refers to the difficulty and extent of change required of the individuals responsible for implementation" (p. 58), although the actual amount of complexity is dependent on the point from which the individual or group is starting. For some, computer use may require considerable skill development, and extensive alterations in
beliefs, teaching strategies, and use of materials" (p. 58). As an example, Shiengold suggests that "a teacher guiding students working together on computers in pairs or in groups requires observational and management skills different from the ones she normally applies, as well as new understandings about when and how to intervene in the student-based activity" (p. 74). Beyond the simple addition of equipment to the available classroom resources, fundamental changes in the role of the teacher may be implied, hence teachers need a variety of forms of support to achieve successful integration. Planners of such support need to consider "such factors as classroom size (students per classroom, as well as physical space for computers), student and teacher competencies, academic objectives and materials, computer and software resources, and areas of conflict and consistency between school and community experience" (Simmons, 1980, p. 99).

In summary, successful implementation of computers into classrooms is not a simple matter. Barriers such as differential access, the quality and quantity of software, inadequate teacher preparation, and lack of conclusive research have contributed to uncertainty. Even where these difficulties have apparently been overcome, however, successful integration has not always occurred. The complexity of the innovation in terms of daily classroom life has combined to create a variety of substantial obstacles. Further study of the computer's impact on classroom culture is needed in order to gain an understanding of this problem.
Classroom Culture and Routines

In this section, classroom culture and routines are defined. Some reasons why routines are important - their benefits for both teachers and students - are also examined.

Classroom culture is described by Schein (1985) as "the solution to external and internal problems that has worked consistently for a group and is therefore taught to new members as the correct way to perceive, think about and feel in relation to these problems" (p. 20). These solutions, he says, gradually become general assumptions and eventually come to be taken for granted. Classroom routines are an example of such solutions, and thus provide a way of understanding culture.

Routines are defined by researchers in a way that is consistent with the well cited studies of Robert Yinger (1980). He defines them as:

Established procedures whose main function is to control and coordinate specific sequences of behavior. Routines are an efficient and common mode of operation in situations where action and behavior are repetitive. (1979, p. 165)

These established procedures, says Doyle (1986), "provide a continuous signal for organizational and interpersonal behavior" (p. 412). They indicate to participants that they are pursuing shared goals in the classroom. For this reason:

It is important to distinguish between rules and routines. Although some rules are also routines, most rules are statements of what is not permitted or are explicit or implicit constraints. Routines, on the other hand, are fluid, paired, scripted segments of
behavior that help movement toward a shared goal. Routines can have explicit descriptors, can be modeled or, more commonly, can simply evolve through a shared exchange of cues. (Leinhardt et al., 1987, p. 136)

In short, the role of routines is to make classroom life more predictable and manageable by reducing complexity:

The complexity and unpredictability that characterizes the teaching environment impose many demands on the teacher, and it becomes necessary to find methods to decrease the amount of information to be processed at any one time. One method to cope with these demands is by developing routines. The routinization of action fixes certain aspects of behavior and thus reduces the number of characteristics that must be evaluated, decided upon, and manipulated. (Yinger, 1979, p. 167)

As well as reducing complexity, Doyle (1986) suggests that they are also important in "sustaining classroom order" since "routinization makes classroom activities less susceptible to breakdowns during interruptions because participants know the normal sequence of events" (p. 412).

In recent studies, researchers have outlined a variety of specific benefits for both teachers and students to establishing routines in classrooms. For example, Leinhardt et al. point out that routines allow more "cognitive processing space" for student and teachers alike. They contend that routines make automatic some of the cognitive processing tasks that otherwise need to be decided upon afresh each time problems are encountered and solutions required. By lowering the number of ongoing problems to be solved,
complexity is reduced, and teachers and students are able to pursue higher level thoughts about teaching and learning (1987, pp. 135-6).

Another benefit for teachers is that routines can help cut down on the amount of time necessary for planning. In describing the planning of an elementary teacher, for example, Yinger (1980) notes that:

Routines were mechanisms that (the teacher) used to establish and regulate activities and to simplify planning. Routines played a major role in the teacher's planning. She used them so often that her planning could be described as decision-making about the selection, the organization, and the sequencing of routines. (p. 111)

Much of the curricular planning that teachers do takes place after school and on evenings and weekends. Routinization reduces the amount of time needed for ongoing planning and gives teachers more time to plan special activities such as field trips for which established routines may not be feasible (Yinger, 1979, pp. 167, 123).

Successful routines also help free the teacher from managing the group in order to give more focus on individualized evaluation. Yinger (1979) found that because of routines "much preactive teaching time was involved in keeping track of individual progress in math and reading" (p. 168). More time is thereby made available for assessing students and prescribing for their needs.

A teacher's flexibility and effectiveness can be increased as the time and energy put into carrying out decisions are reduced; "the routinization of action fixed certain aspects of behavior and thus
reduced the number of aspects of instructional situations that she had to evaluate, make decisions about, and manipulate" (Yinger, 1980, p. 112). This is particularly evident in how teachers deal with the many transitions from one activity to another. Leinhardt et al. (1987) state that "it is clear that expert teachers utilize a large repertoire of routines during transition" (p. 168), thereby enhancing the flow and order of the class and improving rapport with students. Without a few simple routines for transitions, they say, chaos can result, creating a loss of instructional time and student attention (p. 168).

According to Olson (1988), routines enhance the teacher's influence in the classroom. "The routine is the context in which the teacher can exert influence " (p. 106) because it provides a way of handling large numbers of decisions, solutions, and student needs. "Routines take the place of tutorials" (p. 106) by helping the teacher attend to the needs of students without having to provide them with individual instruction for mundane or repetitive tasks.

In terms of student benefits, routines cut down on interruptions and "increase the predictability and reduce the complexity of the classroom environment" (Yinger, 1980, p. 112). This structure enables them to better perceive the larger context of activities and to understand teacher expectations for their participation. Less time is spent on reviewing procedures because students are able to anticipate upcoming activities without instruction. This increases students' time on task while lowering anxiety levels (p. 168).
Student attitudes can be thus positively affected, says Olson (1986), because routines "furnish the student with stability and context... it is the context in which students can make sense of what the teacher is asking of them." (p. 106)

Leinhardt et al. (1987) claim that all routines must be established, both explicitly through overt teaching and implicitly by modeling and reinforcing correct use. More specifically, routinization occurs: (a) by calling for the action and supporting correct usage; (b) by describing or showing the actions and supporting correct use and discouraging incorrect use; and (c) by responding to incorrect use (p. 173). They note how quickly students incorporate new routines into their day to day interactions: "By fourth grade, most support and exchange routines were fine tunings of an already existing system, and many management routines were school-wide." (Leinhardt et al., 1987, p. 173)

In summary, the word "routine" may bring to mind negative images of inflexible or unthinking, repetitive action. On the contrary, because routines help to make planning easier and simplify classroom management, they afford teachers more flexibility in the selection and execution of other activities. Reduced is the need to plan each activity anew, thereby allowing the teacher more time to plan complex or unique activities, evaluate individual students, and enhance the flow and order of the class. For students they lower anxiety levels by increasing predictability and stability in the
classroom, cut down interruptions, and furnish an orderly context for learning.

Researchers have proposed that classroom culture, as embodied in routines, needs to be studied more thoroughly in order to increase understanding of complex innovations. In particular, Olson (1988) asserts that it is critical to consider the impact on routines when implementing computers into the classroom because he has linked classroom culture as manifested in routines to computer implementation. Understanding routines, he says, is important to studying the implementation of an innovation because:

Routines reflect judgements teachers make about how to structure daily life in their classroom. They are routine only in that they recur, but they are not thoughtless or dull. Making sense of them is crucial to understanding the way teachers use resources like computers in the classroom. (p. 90)

Types of Routines

While several researchers have defined and categorized types of routines in order to increase understanding of classroom culture, Yinger's (1979) model is used here because it is widely cited in the literature. He categorizes four types of routines, including those for activity, instruction, management, and executive planning:

*Activity routines* (all routines that occur during instruction, including both instructional and management routines) controlled and coordinated the features of instructional activities...
*Instructional routines* are methods and procedures the teacher established to carry out specific instructional moves. The teacher used instructional routines for questioning, for monitoring, and for giving instructions, among other purposes...
Management routines are the procedures the teacher established for controlling and coordinating classroom organization and behavior not specifically associated with or occurring during an activity. Management routines regulated behavior such as transition between activities, passing out or collecting materials, leaving the room, cleaning the room, and starting in the morning or after lunch...

Executive planning routines are established thought patterns set off by specific planning tasks...Executive planning routines - unlike activity routines, instructional routines, and management routines - do not occur during instruction. (pp. 111-112)

Because the present research is concerned with the impacts of computer use on daily classroom life, only two types of routines from Yinger's model, namely instructional routines and management routines, are highlighted here.

Instructional routines may be developed to simplify planning and preparation and to reduce the amount of specific sets of instructions and tutorials to be given in a day. Examples of instructional routines include procedures for questioning, monitoring, reviewing, instructing, demonstrating, and giving instructions. For instance, teachers may give instructions several times to a large group before asking students to repeat them, as may be the case when introducing a new software program to the whole class at once. When dealing with small groups such as may be found at the computer, instructions may be given only once, after which the teacher monitors individual students to determine whether the instructions were understood. While the teacher works with a small group at the computer or helps students individually, routines may be in place for other students to deal with questions and problems they encounter with their seatwork.
Routines exist in some form in every classroom, but around the computer, the teacher may need to be explicit about instructional routines because they could have a direct impact, either positive or negative, on implementation. For example, a teacher described the following instructional routines for computer use:

When the students need help they must wait for a pause in the teaching and try to work the problem out for themselves, or ask another student. Occasionally the printer is used during lesson time but students will make eye contact to ask if they can print. Most of the time, the students are sensitive to what is happening in the rest of the class and do not disturb the flow of the lesson. Sometimes the student at the computer is asked to pay attention to the rest of the class but normally students at the computer are not interrupted. (Olson, 1988, p. 40)

In an interview with another teacher, Olson inquired about the establishment of instructional routines for monitoring students who required assistance with the computer while other things were going on in the class. The teacher responded as follows:

Students seek out help when they need it and sometimes I go over to see how they are doing. I use quiet moments in the class for this but will interrupt if the student needs help and there is no one else in the class who can help. Sometimes I ask the rest of the students to wait for a little while which they accept. (p. 41)

Examples of management routines include transitions between activities (i.e., switching from hands-on inquiry to writing in journals), distribution of materials (i.e., software or math manipulatives), beginning or ending the day, leaving the room, or
accessing resources. Carol Cummings (1983), in her book on classroom management, states that:

Teaching a class a routine for regular activities such as bathroom trips, preparation for lunch, and collecting papers can save precious minutes when compared to repeating elaborate directions. The time saved in better management leaves more time for quality instruction... These routines eliminate wasted time and misbehavior. (pp. 3, 13)

Management routines may be in place for students to access the computer, thus making better use of the limited time available for each student:

Each student has a 40 minute turn on the computer. A schedule is prepared well in advance so that they know when their turn is coming up... The machine is constantly in use while [the teacher] is in the room. (Olson, 1988, p.40)

Of all routines identified by researchers, management and instructional routines are of particular importance for the successful operation of classrooms. These can be impacted by the introduction of a computer to the classroom and, in the next section, specific impacts are discussed.

The "Trojan Horse" Thesis

John Olson (1988) links classroom culture as manifested in routines to computer implementation. Difficulties occur, he argues, because the computer adds to the complexity of the classroom through unanticipated impacts on routines. While it may seem attractive to bring a computer into the classroom, with it comes a variety of unanticipated impacts:
... how the teacher routinely teaches may be challenged in complex ways when computers are used. The computer acts as a Trojan Horse bringing new ways of doing things into the classroom. (p. 107)

An example of an implementation difficulty brought about by unanticipated impacts is a weakening of teacher influence. While using the computer, students may begin to explore in various directions, requesting aid from the teacher without being able to articulate their problem or describe the nature of their difficulty. That they are unable to "diagnose and remedy problems quickly concerns these teachers - it undermines their influence" (p. 55), and may therefore make computer implementation more difficult:

Teachers solve classroom problems quickly and reduce the demand for individual support to a minimum. They have to do so. Given class size and scope of curricula, it is not surprising that they do. In this way they maintain influence over the direction of the class. Computer based learning, however, creates more rather than less diffuseness in teaching and threatens teacher influence. Control of diffuseness is critical for teachers. (p. 55)

Another example of a difficulty brought on by unanticipated impacts on routines is that they may highlight discrepancies between a teacher's values and practice:

Mrs. Everett wants children to write extensively... Extensive writing, called for by the language arts doctrine she subscribes to, is also a burden on her students. They do not have sufficient access to computers to do all the writing they should. Not all students have equal access. Not all are adequately prepared. To insist on extensive writing leads her students to impossible queues at the computer and to frustration for her. Her avante-garde doctrine has flaws which are exacerbated by introducing the computer. (p. 57)
Corresponding to the "Trojan Horse" is Fullan's notion of the complexity of innovations. "Many changes require a sophisticated array of activities, diagnosis, teaching strategies, and philosophical understanding if effective implementation is to be achieved" (1982, p. 58). Innovations often have implications for many aspects of teachers' roles and classroom practices which are not initially recognized. This complexity is further exacerbated by unexpected impacts of the computer.

While unexpected impacts may lead to implementation difficulties, they can also stimulate further change. Fullan argues that: "While complexity creates problems for implementation, it may result in greater change because more is being attempted" (p. 59). One example of how impacts of computer use can induce change in routines is described by a teacher who took part in the Apple Classrooms of Tomorrow study:

Children are somewhat noisier as they become familiar with the equipment, and they talk a lot. Some of the moving about routines could be smoothed out to keep a good learning environment. There are many management changes with computers, disks, new and unfamiliar responsibilities for both students and teachers. (Dwyer et al., 1990, p. 26)

That the introduction of the computer can have an impact on a teacher's doctrine was further noted in this study on the effects of "high access to technology classrooms." Dwyer et al. claim that adding one computer per student creates an innovation complex enough to initiate a change in teachers' beliefs and values. And since
"teachers' beliefs about instruction and school is an important factor that underlies the institution's resistance to change...this fact must inform planning and implementation of significant change efforts" (p. 36).

Further instructional benefits were described by a teacher in Olson's study:

I like the idea of being able to sit down with a small group of students who are working on a particular task while others are at the computer, or even being at the computer and helping them individually. You are acting as a tutor rather than a teacher at the front of the class. (Olson, 1988, p. 47)

Challenges to routines can also have the beneficial effect of stimulating teachers' reflections on their basic assumptions and values:

Computer experience calls into question apparently settled assumptions about how the teacher exerts influence in the classroom. Although the ambiguity is unsettling for teachers, it is a basis for reflection on what really is important in practice... Teachers are called upon to re-evaluate existing planning and teaching routines and resource access in relation to the demands of computer-based learning - to find an accommodation between the essential values of the former and the potential of the latter. Teachers are challenged to reconsider what it is they value as reflected in what they do. (Olson, 1988, p. 107, 122)

In summary, Olson argues that introducing a computer into a classroom impacts on routines. Some of these impacts are unanticipated, which adds to the complexity and therefore the difficulty of the implementation. He provides examples of both benefits and difficulties brought on by these unanticipated impacts.
Since routines are critical to the functioning of the class, Olson's "Trojan Horse" thesis concerning unanticipated impacts on routines is worth examining in more detail.

Summary
The purpose of this chapter was to clarify what selected literature states about four related areas of computer use. First, some barriers to implementation and the complexity of the innovation were examined. Of these barriers, one particularly important factor is the complexity of computer use, including its implications relative to classroom life. Second, classroom routines were defined and their importance to teachers and students described. Research over the past two decades has shown how crucial classroom routines are for the smooth operation of the classroom. Bringing a computer into a classroom may have some important impacts on structures and expectations. Third, types of routines were described and examples of management and instructional routines supplied. Finally, according to the "Trojan Horse" thesis, some of the impacts on routines are unanticipated, which adds to the complexity of the innovation. The next chapter describes the methodology used to explore the impacts of introducing a single computer to each of the classrooms in an elementary school.
CHAPTER THREE

METHODOLOGY

This chapter describes the study's methodology, including the pilot study, selection of the school, data collection, and limitations. The study took place in a large urban school district in which the researcher was an elementary school vice-principal. Previously, he worked for three years (1988-1990) as a district teacher consultant, helping teachers in both elementary and secondary schools with computer implementation.

Pilot Study
In order to focus the direction of the research, a pilot study was undertaken in June, 1991. Its purpose was threefold:

1. To determine whether the Trojan Horse hypothesis had sufficient empirical evidence to merit further study.

2. To find out whether teachers could easily discuss the range and nature of unanticipated impacts of the computer upon their instructional purposes and classroom routines.

3. To develop and refine a questionnaire and an interview schedule.

The elementary school for the pilot study is in the same school district as the school selected for the study proper. It had a
population of just over five hundred students, in eighteen divisions taught by twenty-two teachers. The administration explained that the staff had come to a consensus on the direction of professional development, that they had created a cooperative, learner-centred environment, and that students represented a range of ethnocultural and socioeconomic backgrounds. All teachers were given computers for use in their individual classrooms in September 1990.

Nine volunteers completed a survey which asked them to describe a) their purposes for computer use, b) perceived difficulties in achieving their purposes, c) any unexpected difficulties brought about by computer use, and d) any unexpected benefits. (Appendix A). It had been previously piloted by four teachers not in the school to ensure clarity of purpose and meaning, and to establish an appropriate sequence for questions. Participants expressed no concerns about understanding the questions.

On the basis of the questionnaire findings and in the light of Yinger's model of routines, interview questions were developed (Appendix B). Four volunteer interviewees (grades 1/2, 2/3, 6, and 7) were asked to describe, not only their purposes for computer use, but also any impacts of computer use on their routines and vice-versa. Participants had no difficulty understanding the interview questions or giving examples of both routines and unanticipated impacts (positive and negative), although most reported routines were related to accessing the computer. The interviewer probed for examples of other routines as they related to unanticipated impacts;
This was done by suggesting examples in order to help interviewees articulate their perceptions of impacts on routines.

From this pilot study it was found that teachers do indeed experience unanticipated impacts on routines and purposes, and that they were able to describe and give examples of these. Appendix C lists examples of impacts on instructional and management routines collected from interviewees during the pilot study; this provided the researcher with examples to be used as the basis for probing during subsequent interviews in the study. An important finding of the questionnaire was that participants described routines and impacts on routines (including unexpected impacts) without referring to specific software; the Trojan Horse was recognized despite the use of various titles.

As a result of the pilot study the following changes were made to the survey and to the interview schedule:

1. Survey questions about perceived difficulties and benefits of having a computer in the classroom were deleted because teachers described general impacts rather than impacts on routines; these questions were better dealt with through in-depth discussion in an interview format. However, the questionnaire was an efficient means for identifying teachers' instructional purposes for the computer (as suggested by Werner and Case, 1991, p. 34).
2. Rather than a single interview, it was decided that a series of discussions would provide a deeper understanding of each teacher's perceptions and a sense of how the implementation developed over time. It was decided that the interview schedule would be conducted during the first four months (September to December) of the implementation.

3. Because teachers commented upon impacts of computer use on their instructional purposes, this topic was included in the interviews.

Selection of the School

Three criteria were used in selecting an elementary school for the study proper:

1. A computer was to be placed in each classroom at the beginning of the school year, September 1991. (This criterion is obvious because the purpose of the study is to examine perceptions about unexpected impacts from the introduction of a single computer to primary classrooms.)

2. The staff and administration had developed a policy for computer use. This implies that school-wide expectations and support for computer use across classrooms would be relatively consistent during the time of the study.

3. The teachers and administrators were willing to take part in the study. When the proposed research was presented at a
staff meeting by the computer helping teacher, they agreed to be a part of the study.

The selected elementary school had a population of 250 students, in 10 divisions taught by 12 teachers, six of which are primary. The students represent a range of ethnocultural and socioeconomic backgrounds.

The school had a bank of 15 computers centralized in one location together with sets of software for each machine. Teachers were encouraged to book their classes into this laboratory on a regular weekly basis, although there were allowances on the schedule to book extra times on an ad hoc basis. The vice-principal administered the lab and maintained the hardware and software.

The Innovation
Three years previous to the study, the staff decided to focus on computers as a topic for professional development. They designated one full day to explore the ways in which they might use computers to enhance cooperative learning. They planned the day with the district computer helping teacher, who returned on several occasions to present follow-up demonstration lessons. In the following years, no more professional development days were designated for computer inservice. However, a series of informal computer support sessions, mainly to introduce new software and how to use a word processor, were provided for interested staff after class by the school computer helping teacher. A district teacher consultant also
presented inservice to some of the intermediate teachers who were interested in using Cooperative Learning to teach keyboarding skills. This method was adopted by the intermediate teachers.

Four years previous to the study, the vice-principal was in charge of computer support for the school. Two years later, staff voted to have a computer specialist; a teacher was hired part time (60%) to take students in Kindergarten through grade 5 to the computer lab. This teacher took charge of all computer support for two years until she transferred. In the year of the study, it fell back upon the vice-principal, who had previous experience as a computer helping teacher in the school, to provide support for the staff. He taught 90% of the time, with 10% to include all of his administrative duties, including computer-related activities; he initiated and maintained all school-wide policies for computer use in conjunction with the principal and teachers.

After district distribution of new computers in June, 1991, the teachers voted at a staff meeting to house them in individual classrooms, rather than add them to the laboratory. Each teacher was then given a computer for use in his/her classroom in September, 1991. It was also mutually agreed by the staff and administration that a portion of the software supplied by the district would be designated for use in each classroom. Using a district-produced document that showed the recommended grades for each title, the vice-principal grouped disks and distributed them to each teacher, although he still maintained a central holding in order to
accommodate use of a variety of titles. This document became the agreed-upon policy for computer use for the school. Because he felt that students would benefit from word processing, he promoted keyboarding and word processing as a central focus for computer use, particularly in the intermediate grades. Staff supported his recommendations.

Data Collection and Analysis

Data were collected during the first four months of the school year when computers were being implemented by the teachers (September - December). This was also the time when routines were being negotiated by teachers and students. Doyle (1986) points out the importance of establishing routines at the beginning of the year:

Research on effective management at the beginning of the year suggests that classroom structures are successfully established when rules and procedures are announced, demonstrated, enforced, and routinized. In addition, successful managers hover over classroom activities at the beginning of the year and usher them along until students have learned the work system (p. 412).

Procedures for collecting data occurred in the following sequence:

1. In September, 1991, a questionnaire was distributed to all teachers (n=12) at a school staff meeting. It asked them to describe their purposes for computer use (see Appendix D). Appendix E summarizes the results of this survey.

2. At the same staff meeting, the vice-principal asked whether there were any teachers who were willing to be interviewed by
the researcher over the course of the next few months. Four primary teachers volunteered: Mrs. Freer (grade 2/3), Mrs. Arthur (grade 2/3), Mrs. Douglas (K/1), and Mrs. Evans (K/1) (All names used are pseudonyms). All were experienced teachers who taught combined classes. What differentiated them was their computer experience.

3. The four volunteers were interviewed individually before they began to implement their computer plans. These audiotaped, one hour discussions solicited the teachers' educational purposes and plans for the computer, background experiences with computer use, and acquaintance with available software (Appendix F).

4. These teachers were further interviewed individually at the school on a regular basis in order to obtain their ongoing perceptions of what unexpected impacts arose as they were setting up their classroom routines for the year (Appendix G). In the light of Yinger's model of types of routines, interviewees were asked to reflect on impacts (including unexpected impacts) upon instructional and management routines during implementation of a computer. The timing and number of audiotaped interviews was scheduled in consultation with each teacher. Before the next interview was scheduled, each teacher was asked by telephone whether any new impacts had occurred. This schedule continued until each teacher no longer reported unexpected impacts of computer use upon her
instructional purposes and classroom routines. Five interviews were required with each teacher until mid-December. Twenty interviews in total were conducted.

5. The school's policy and plans for computer use were examined in order to identify the stated school-wide purposes and support for the innovation. Clarification of this policy was further accomplished by interviewing the vice-principal, five times over the course of the study (Appendix H). He administered the computers and software in both the laboratory and the classrooms. (This information on the school context is discussed in the previous section.)

6. Interview data were analyzed and are reported in two ways. First, each of the four teachers is presented in Chapter Four as a separate case. Included are descriptions of the background of each teacher as well as the routines she established, and her instructional purposes for the computer; each summary also contains a description of unexpected impacts on instructional and management routines and on instructional purposes. Second, commonalties and differences are reported across the four teachers in Chapter Five.

7. At the conclusion of the data analysis, the vice-principal, who was in charge of the computers for the school, was interviewed (audiotaped) to get his perspective on the findings of the study. To gain a school-wide perspective on the accuracy of the
findings, he was given Tables 1 and 2 (see Chapter 5). These were explained in a discussion of about half an hour. It was his opinion that the impacts on routines and instructional purposes reported in Table 1 were reasonable and accurate. He also thought they were typical of the types of impacts he had encountered in his own classroom. He had no trouble understanding Table 2 and agreed that it represented key factors that influenced implementation of classroom computers in his school. He was unable to think of any other factors that were not on Table One (p. 123).

In summary, these procedures allowed for a comprehensive description from the point of view of the principal actors, and are related to the major questions of the study in the following way:

1. What are the instructional purposes that primary teachers try to achieve with one computer in the classroom? (Data gathered through the questionnaire, ongoing interviews with the teachers, and the policy analysis.)

2. How did unanticipated impacts affect instructional purposes and classroom routines? (Data gathered through the interviews.)

Limitations

It is assumed that information about computer use and its impacts can be gained from the perspective of teachers through the use of
interviews. However, there are three limitations to such data:

1. No claims are made about the nature or extent of computer implementation in the school or in the district because the researcher did not observe the actual use of the computer in each classroom. Computer use was defined narrowly in this study in terms of the instructional purposes and activities that teachers reported for the hardware and software in their classrooms. The survey and interviews gathered only self-report data, as teachers were asked to reflect on unexpected impacts. What teachers and students actually did with the computer may differ from the planned purposes or reported activities.

2. External validity refers to the generalizability of this study. Because the school was not randomly selected from a given population, nor purposefully selected to represent certain features of the population, there needs to be caution about broader claims beyond the case. The use of one school site limits the generalizability of results because school cultures vary across sites, and this variability may effect the nature of unexpected impacts. No claims are made about teachers, with or without similar computer experience, in other schools. However, it is assumed that if a reader understands the conditions under which unanticipated impacts were experienced, he or she will be able to judge how similar or applicable the case is to his/her own situation.
3. Reliability of case studies is usually weak in the sense that findings are not easily replicated. A case is constructed for certain purposes (e.g., to show teachers' perceptions about the unanticipated impacts of computer use) and situated in a given time and place (e.g., a specific elementary school). To help the reader locate the case in its context, the study outlines its purposes, the details of data collection, and the reasons why specific choices were made in defining the case and the method (Stake, 1978).

On the other hand, one of the strengths of case studies is internal validity. They portray some aspect of human activity in its natural context apart from a researcher's manipulation. Internal validity of this case study refers to the need to demonstrate to readers that the findings and interpretations are credible reconstructions of the respondents' perceptions and experiences (LeCompte and Goetz, 1982). This involved a number of tasks:

1. Instruments were piloted in order to enhance their face validity. Teachers not a part of the school under study were asked to respond to questions included on instruments. This helped to clarify the questions and show whether they were understood similarly by respondents and researcher.

2. By interviewing the same individuals several times over a period of four months, each respondent's perceptions and any apparent inconsistencies could be probed and clarified. With
ongoing interviews, there was less likelihood of misunderstanding a respondent's perceptions.

3. Multiple data sources allowed for corroboration and extension of perceptions. For example, in the interviews with teachers and administrator, reasons for conflicting perceptions were checked.

4. Individuals were given a summary of their own interviews, and asked to comment on the clarity and accuracy of how their perceptions were portrayed, and the plausibility of the interpretations. Any difficulties or inconsistencies perceived by the interviewees were discussed with them and clarified accordingly. Also, although respondents agreed to be re-interviewed as needed if the researcher had difficulty interpreting the data, no such problems arose and further interviews were not necessary.

5. The research agenda was made clear to all respondents. They understood that the study was focussed on their perceptions rather than classroom observations, that the findings were not, in any sense, evaluative of individual teachers or of the school's computer program, and that the school, school district, and respondents would be anonymous.
Summary

This chapter described the study's methodology, including the pilot study, selection of the school, data collection, and limitations. Chapter Four presents the case of each teacher.
CHAPTER FOUR

THE CASES

This chapter gives separate accounts of how computer implementation evolved over four months in the classrooms of the four interviewees. The pseudonyms used are Mrs. Freer, Mrs. Arthur, Mrs. Douglas, and Mrs. Evans. These cases are sequenced from the least to the greatest levels of implementation. Provided are descriptions of each teacher's background, the classroom contexts in which the implementation took place, and the unexpected impacts of computer use on classroom routines and instructional purposes. Following the description for each teacher is a brief interpretive summary in which the researcher makes a judgement about the level of implementation reported.

Interview quotes are referenced to indicate when they occurred. For example, (2O) refers to the second interview which happened to occur in the month of October, and (5D) refers to the fifth interview, which occurred in December. Because the descriptions of background, purposes, classroom context and routines were collected during the first interview in September, this coding system is used only in the descriptions of unexpected impacts on routines and on instructional purposes, which were collected over time (e.g., during interviews two through five).
MRS. FREER

This account describes the least complex level of implementation in the study. The teacher had almost no previous computer experience and, although she felt that she should try to make good use of the computer, was vague about her instructional purposes. Of all the interviewees, therefore, she found that the computer caused her the fewest problems or frustrations and reported the fewest unanticipated impacts. This was because she used it in a very simple way (drill and practice) and did not attempt a more complex level of implementation (word processing, simulation, problem solving).

Interviews were scheduled as follows:
1. September 16 (1S)
2. September 27 (2S)
3. November 6 (3N)
4. November 20 (4N)
5. December 17 (5D)

Background

Mrs. Freer started teaching in a rural school district at sixteen years of age. After three years, she moved to an urban district where she continued to teach primary grades for another three years. She then took 12 years off to raise her family, waiting until all of her children were in school before returning to the profession. Upon returning to teaching, she began as a substitute and was consequently offered a permanent position by a past principal of the study school, and has worked there ever since. In all, she has taught for twenty years, fourteen of these at the study school, where she currently enrolls a
grade two-three primary class. She intends to retire at the end of the school year.

Computer Experience
Mrs. Freer has no formal training with computers and, before the study, never had one in her room. Previously she had depended upon parent volunteers trained by another teacher, or the computer helping teachers to work with her students in the computer laboratory. This relief schedule provided her with preparation periods. Although she does not own a home computer she said that, this being her last year, she now feels obliged to gain some basic skills with the computer.

She claims that computers are "an excellent resource" for students and said that if she were younger, she would spend more time and energy learning to use them. She also opined that students are highly motivated to learn to use computers and that they know "a hundred times more" than she ever will.

Instructional Purposes
Mrs. Freer was given an Apple IIe with a single disk drive and a colour monitor in September, 1991 to use full time in her classroom. Although she did not have well articulated purposes for the computer, she described several general purposes in the first month of the study. One purpose was to help students become more "computer literate" - to become familiar with the hardware and be
able use a variety of software programs. She also wanted them to get used to using the keyboard, inserting disks and loading programs.

Another purpose was to help students build their skills in language and math. Again, she was unsure as to how to do this, but intended to supply them with an assortment of titles that might help accommodate this purpose. She hoped to match the software with the math concepts being covered in class. Unknowledgeable about the relevant and available titles in the school, she depended on the computer helping teacher to supply an initial box of assorted disks appropriate to her students. At the start of the year, the children were free to pick the programs they wanted from that selection when their turn on the computer came around. Because they had used many of the titles in the previous year, they knew what software they preferred and were able to choose accordingly. She planned to work together with the computer helping teacher to change the titles sometime in January.

A third purpose was to give the children opportunities to use software that would help them improve their "thinking skills." At the time of the interview, she was unsure as to what software was available for this purpose or how the computer might be used to accomplish this, but intended to ask the computer helping teacher to assist in finding some appropriate programs.
She did not report an intention to use the computer to help the children with writing or any other kind of application software. In this case, because her purposes for the computer were vague, its use was kept relatively simple.

Classroom Context
The class consisted of ten boys and thirteen girls. Three of the boys were in grade two and seven were in grade three, while four of the girls were in grade two and nine in grade three. One of her grade three boys was identified Learning Disabled and there were no identified gifted students.

She described her class as challenging to work with, particularly where two boys were concerned. Both demonstrated social and emotional problems, which affected their behaviour and that of the class in a negative way. Students were difficult to manage at times, and she spent an inordinate amount of time specifically establishing and modelling routines for the year: "Everyone in the school says that this has got to be one of the worst years in terms of needy children." By the first interview most of the children had incorporated the major routines into their daily activities: "I've got the two's sitting with the threes, and constantly reminded them to check with their partner and help them with routines."

Management Routines
When asked to prioritize and describe the most important classroom routines, she started with management of materials. Students were
arranged in six working groups with a leader for each team. This leader helped members who required assistance when completing their seatwork, and looked after distribution of materials for their group whenever necessary.

When calling the class to attention, she would say, "Class, sit up" or "Claaaass...", and all students were expected to sit and pay attention. She then waited until all eyes were on her; even if students were moving around in the room, they were expected to stop and give her their attention. At the beginning of the year when this routine was being established, she would have them purposely go back to what they were doing and repeat the direction for practice. When there was a great deal of activity, she raised her hand to gain attention; each child stopped whatever they were doing and raised their hand, encouraging those around them to do the same.

Students worked at learning centres, including listening, art and painting, building blocks, Lego™, and computer at specific times of each day. Although these centres were accessed on demand, each student was expected to try all of them at some point during the term. No formal management routine was yet worked out to give the students fair access.

At the start up of each day, students were allowed to use the centres. At the bell, they gathered at the discussion carpet in order to go through calendar activities together, review the day of the month,
month of the year, special days, seasons, and share ideas and items they brought from home.

Her management routine for clean up included assigning twelve volunteer monitors to help at the end of each day, from dusting to watering the plants. The routine for choosing these monitors was informal: "The next time around if your name wasn't on the board, you would get to pick the jobs you wanted to do." Names were usually changed once every two or three weeks so that others could take turns helping tidy the classroom and looking after the materials. "Sometimes the children will say, 'When are we going to change the monitors?' and I just say, 'When we have time,' because it takes ten or fifteen minutes to do. You almost have to put it in your daybook, otherwise it's five to three and you're rushing them." At clean-up time she counted to five, either verbally or by showing her fingers, and then said "The magic number is..". This focused the children on the task at hand and signalled them to move quickly.

Instructional Routines
To provide activities for students who finished their assigned work early, Mrs. Freer established a routine where the students could select from a number of activities without having to ask her. She had a changing list on the chalkboard called "Extra Work" which students could refer to at any time during the day. Some of these included working in centres for reviewing language and math skills, writing theme books, and doing puzzles and math games. One centre changed according to seasons or special holidays; "I call it the
centre for speedy people and they get prizes for completing it - a little bribery, but I don't mind... They have what I call a 'Fun Booklet,' which includes activities such as dot-to-dot, colouring sheets, fun math sheets, fun language skills sheets - so even though we call it our fun book, it's not just straight fun activities." They also worked in half lined, half plain exercise books where they could draw pictures on the top and write about them on the bottom.

She decided not to establish the routine of having the children write in daily journals, "because I found last year it started out all right, but unless I gave them a topic, half the class wasn't interested. It got to be a real drag. I found it was absolutely full of mistakes in grammar and spelling, which they (current researchers on writing) say is fine, I mean, that is their control of the language, right? ...[But] I spent all this time trying to teach them how to use the dictionary to look up words and use correct grammar. I could be wrong there, but I thought I'd leave it this year."

As part of assessment and evaluation routines, she monitored the centres by moving from one to another and observing the children. Often they were excited by what they were doing and wanted to tell her and the other children about their experiences. Some centres were more conducive to this than others, and she intended to establish a routine where telling about their work could be a regular part of completing certain centres. She increased her understanding of their capabilities by sitting with them at the centres and listening as they explained what they were doing. She endeavored to check
students' work frequently at the beginning of the year: "Sometimes I will just sit at a table and when they are finished, if it's math or something, they can bring it up to me before they start something else. I do that more at the beginning of the year because that way I get the routines down... If I let them get too far ahead, it doesn't matter what it is, there are always a number of them that will begin making mistakes in setting up the page and so on."

She kept on-going anecdotal comments on the students and stored these, along with samples of their work, in portfolios. "All of their story and poetry writing," she said, "is kept organized and all drafts are kept so that I can see their growth and show both the students and parents the progression throughout the year."

As part of on-going assessment, she developed a routine for students who need extra help with some concepts. Whenever she came across a concept that anyone, particularly in grade three, had not mastered, she assigned specific homework. These students kept homework books which were written in regularly to help them keep track of extra work.

Establishing routines for having students set up their exercises each September was important: "That's another thing we spend a couple of weeks on at the beginning - how to put your date and name on the page, how to number, how many spaces to leave, things like that." In this way students learned how to follow a standard format for their exercise books.
Another instructional routine pertained to *story writing*. Every Thursday was story writing day and this was linked to the theme story of the week covered on Tuesday and Wednesday. For instance, students were encouraged to write as if they were one of the characters from the story, or the subject was left up to them. They kept their draft books so that she could compare early drafts of their work to more finished products, thereby monitoring progress throughout the year. Each student also compiled a book which was hung on display in the classroom and supplemented as the year progressed.

**Unanticipated Impacts on Management Routines**

Mrs. Freer was asked to detail the specific unanticipated impacts of computer use on her management and instructional routines, as well as on her instructional purposes for the computer. She reported a variety of effects on management routines including: a) access; b) calling students to attention; c) managing materials; and d) seeking assistance.

Many unanticipated impacts occurred around the category of *access*. Students were allowed to use the computer during the day, provided they asked permission. "I would only say yes if it was their spare time and if they'd finished their work, although sometimes they're quite happy to go and work at the other centres." She also assigned a specific time, during silent reading at the beginning of each afternoon, when the students were able to use any disk they wanted
from the titles available. But this caused some specific problems, such as occasional high noise levels and distraction of the other students. (2S)

By the second interview, she was not satisfied with the way students were accessing the computer, and expressed a desire to start a routine where she would teach a math or language concept to the group, followed by pairs of students getting a turn on the computer to practice. She envisioned the pairs taking their turns automatically: "where we just have a list, and they just go up and touch the next person to let them know it's their turn, and go back without saying a word - hopefully someday!" (2S)

By the third month she was still unhappy with the accessing routine because students were rushing their work in order to get a turn on the computer. Competition for computer use developed because of limited access time. "What I'm finding now is that quite often two or three children will finish their work very quickly, and I know they're rushing; they'll even run up to my desk to bring their work saying, 'Can I please go to the computer? Can I go to the computer?'...they hurry through their work to get to the computer." She decided that students would benefit from having more times when they could access the computer during the day and thought that this may curtail the competition. She heard that another teacher had a good plan for access, and intended to ask her how to set it up. (3N)
Student behaviour at the computer during the regular silent reading time was still a problem by the third month. The noise level disturbed others and prevented them from concentrating on their reading. "The kids will get so excited and they'll start laughing, and I look at them and they're even jumping up and down. Well then, half the class stops and watches them. That's bothering me and I think it's bothering the class." She partly attributed this to having more than one student at a time at the computer, and thought she might change the routine to allow only one student access during silent reading. She had paired the students so that they could help each other, but felt that later on when they all knew the programs, the students would be more successful on their own. She thought about adding a routine for access before school, at recess, and at lunch so that they would not need to use it during silent reading, but decided to continue with silent reading access for now. "They might just need to get used to it (the computer)... it's just that they get excited, I mean, I can't blame them for that". The computer would not be a disruption during other times of the day because there was normally a lot of activity at any given time. (3N)

By the fourth interview, she reported an improvement on the access routine. In order to minimize disruptions during silent reading, only one student could use the computer at a time, although, on occasion, she still allowed two students access; a posted list of names meant that students always knew when their turn was imminent. Further, on the advice of another primary teacher, she divided the class into five groups, one for each day of the week. Each group was allowed
access on their day before school, during recess, during lunch, and any time during class when they finished their other work. This increased access substantially, and allowed the children to make better use of the computer. (4N) By the fifth interview she said, "I've stuck with that because it hasn't caused any problems." (5D)

The routine for *calling students to attention* was also impacted in an unanticipated way. "It's harder to get their attention when they're at the computer because they don't want to shut it down when they're in the middle of something." Raising her hand and waiting for them to do the same didn't work well because their attention was focused on the computer, and students could not easily see her because of the positioning of the computer centre. While the rest of the class was focusing their attention, she would talk specifically to those working on the computer, sometimes allowing them to continue their work, while at other times having them shut down completely, especially if someone else was waiting for a turn. (5D)

Although asked only to describe unanticipated impacts of computer use on routines, she also reported on impacts of routines on computer use. In terms of *managing materials*, for instance, she was surprised at how well the computer worked within her routine of having the children sit in six groups, each with a monitor to distribute materials. There were no problems with distribution where the computer was concerned. Even when she adapted the routine so that the students were sitting in three groups, this had little effect on computer use. (5D)
In the category of seeking assistance, she reported two unanticipated impacts. (Although both were reported when asked about impacts of computer use on routines, they also reflect the positive impact of routines on computer use.) The first was the addition of a new routine. In order to prevent students from interrupting her, she assigned two student "experts" to help others with many of the problems they might encounter. Whenever someone had a computer difficulty, he or she went to one of these monitors for assistance. She chose these helpers by asking for volunteers who felt they had enough expertise to do the job. The first two had been computer monitors in the previous year with their last teacher. (2S)

Routines for seeking assistance worked well because students could also ask their buddies for help. An unexpected impact, she said, was that so far, she never had to drop what she was doing in order to help a student at the computer. The two monitors had a good grasp of the available software: "in fact one of them came up to me yesterday and said, 'I think the disk those two girls chose is going to be too hard for them. I said, 'You let them try it and see', and it turned out that they did just fine." Because of this unanticipated success, she decided not to change these monitors until later on in the year when other students gained expertise and were more capable of doing the job. (3N)
Unanticipated Impacts on Instructional Routines

Impacts on instructional routines included: a) finishing early; and b) evaluation. The computer had an effect on her routine for students who finished assigned tasks early. It was a popular activity for those who completed other work. They were motivated, often chose that activity above others, and had little trouble getting started independently. The popularity of the computer waned during the Christmas season, however, since many students preferred to do the related art activities. (5D)

Other impacts on instructional routines came under the category of evaluation. On-going observation of students worked well where the computer was concerned. "Two people will be working at the computer and I'll slide in a chair behind them and sometimes I talk to them and sometimes I don't. I just watch them to see what they're doing. They get so enthused I don't say anything because they're enjoying it and they certainly know what they're doing - they may turn around and make a comment to me about what they're doing." She also noted that social development was encouraged: "I've seen a great improvement in some of the kids going to the computer and helping each other." Although in the beginning of the year there were arguments as to whose turn it was, over time the students' motivation to access the computer meant that they had to learn to work together. (5D)

Routines unaffected by computer use included journal writing (because she rarely practiced this routine), story writing (she did not
use the computer for writing), and setting up exercise books (because this didn't apply to computer use).

**Unanticipated Impacts on Instructional Purposes**

When asked to describe the unanticipated impacts of computer use on her instructional purposes, she alluded to three: a) skill development; b) motivation; and c) literacy (learning about computers). However, because initial purposes for the computer were vague, so were the impacts on those purposes.

By the second interview, she had not pursued her purposes related to *skill development*, although she still intended to do so. She was not satisfied with having students only play with the computer, and wanted a better match with the math program. This took longer than she expected because of diverse student needs. "I find the math program so hard to know what's ahead of us, with the three's doing one thing and the two's doing their own math. Sometimes I can combine them, but very, very little. So math period is going, going, going the whole time, and I haven't got it worked in so I can send a group to the computer, but I hope that will happen." She and her planning partner had trouble developing the math program to meet the needs of a range of student abilities. She hadn't had time to integrate the computer, but hoped to do so soon with math and language arts. (2S)
By the third interview (3N), she still had not aligned the computer with her math and language programs as expected, although she still intended to do so. "I'm not happy with what's going on in the classroom with the computer so far and it's mainly my fault because I haven't organized everything. The whole class is taking too long to get organized. Up until last week we didn't know if we were going to reshuffle the whole school (because of increased enrollment) ...As far as the work load goes, we've been doing that, but not any of the extra things." (3N)

To choose software to enhance what students were studying in math, Mrs. Freer needed assistance from the computer helping teacher. She knew that software existed for building number facts and related skills: "I need to go through the software with someone else. The disks I want may be right in my room for all I know. I'll have to figure out to work those." She felt, however, that children may not want to work on this type of program for an extended length of time, and felt she would have to offer other kinds of software in order to keep them interested. (3N) She finally went through all of the software in the computer lab with a student monitor, but was unable to find a program that drilled basic math skills in a game format. "I could have thrown that computer out the window, because we just couldn't find it." (4N) At the end of the study, she still felt that she would like to introduce new programs, although she was unsure as to what programs were available and didn't have a plan as to how she might do this. (4N)
Two unanticipated impacts were related to her purpose of motivating students. In the second interview, she commented that most children were eager to use the computer, and that she was surprised at the high level of motivation that it provided. (Neither had she expected to find that the computer would become a source of such positive input from parent visitors.) (2S) The three or four children who were not as enthusiastic were each paired with a student with more interest and expertise. "I'll just say, 'How would you like to go to the computer and work with so and so... even if they just sit there, they're learning something." (4N)

Due to previous experiences, student expertise was high enough that they were able to solve many problems without intervention. She thought many of the children's families owned computers and that this contributed to their computer literacy. "Yesterday the computer wasn't working right, so I sent the two boys (monitors) back and said, 'See what you can find out.' They started moving things and plugging in this and this and this, and the next thing you know it was working." Children, she said, will always be the experts because they spend more hours at the computer than most teachers will ever have. Because the children were familiar with the software and used the computer in a simple way as a learning centre, she did not have to intervene, and the student monitors were enough to keep the others out of trouble. (4N)

She did not attempt to adapt computer use to suit her purposes, although she expressed an interest in doing so. In all, these vague
purposes were not clarified or made more specific over the course of the study - they remained virtually unchanged.

Seeking Assistance
Once the computer was set up and the software compiled by the computer helping teacher, Mrs. Freer had little need to seek assistance. The software was not changed and she did not attempt to use the computer for complex purposes. The hardware was fairly reliable and she did not use a printer with moving parts. She occasionally consulted with a colleague, but did not do any planning for computer use on a regular basis.

Interpretive Summary
Although the computer impacted management routines (access, distribution of materials, transitions, start up, and clean up routines) and instructional routines (seeking assistance, finishing early, and evaluation), the researcher concludes that the effects were minimal due to Mrs. Freer's vague and general purposes. In fact, because she did not attempt to use the computer in a more complex, integrated way, unanticipated impacts on her instructional purposes were also minimal. When asked to summarize key concerns about the implementation, she acknowledged some anxiety about not using the computer to its potential, and attributed this to her inexperience with software and to adaptations she had to make to classroom routines. (5D)
She had not anticipated that it would take as long as it did to get the computer routines running smoothly. She attributed this to a number of competing activities in planning her program and to initial uncertainty about implementing the computer. She had expected that it would be a disruptive influence in the class, but this only occurred early in the year. The routines she established eased the problem and made the computer "absolutely no problem" in the classroom. "It's positive because I've got a real routine working now and the children know it. We've been doing it for some time now, so there's no hassle... The children know what to do." Because the use of the computer was simple and she had low expectations, there proved to be few problems with implementation. (4N)

Mrs. Freer had not asked to have the computer in her classroom, but received one because of a staff decision. As a result, she was not strongly committed to the innovation, and did not use the computer for anything more than an independent centre, where students could freely explore the software. There was little interest in spending the time and energy necessary to use the computer in complex ways in her classroom. Because her commitment was low, purposes were not clarified or made more specific over time. They remained vague and little was attempted or accomplished in terms of implementation.

By defining the computer as a "centre" in the classroom, she could claim some implementation without actually changing much of her teaching or adapting her role. Under this "false front", she gave an appearance to colleagues, parents and students that she was
complying with the decision to use computers in the classroom, but without having to change much of her practice.

Olson's Trojan Horse thesis, although detectable, was not particularly influential in this case because the instructional purposes for the computer were unclear over the course of the study. Unanticipated impacts of vague computer use had little effect on routines or purposes. In the cases to follow, where the level of computer use is more complex, unanticipated impacts are more apparent and have a greater impact on both routines and instructional purposes.

**MRS. ARTHUR**

This account documents the case of Mrs. Arthur, a grade two/three teacher who had some previous computer experience but, like Mrs Freer, was vague about her instructional purposes. Although also a very experienced teacher and late in her career, she did not attempt to implement the computer in a complex way. While she felt that it was important to use the computer in the classroom, it presented her with some unanticipated problems, and so she did not accomplish as much with the computer as she originally intended. She was interviewed as follows:

1. September 19 (1S)
2. October 2 (2O)
3. October 22 (3O)
4. November 6 (4N)
5. December 17 (5D)
Background

At the beginning of her career, Mrs. Arthur taught for three years in a large metropolitan school district, but decided to stop teaching for thirteen years while she raised her children. She has taught in the study school for the last fifteen years and would have retired by now, except that "things didn't work out financially"; she still enjoys teaching as it "keeps her young." She described herself as a "rather structured" teacher, open to using some new teaching strategies, as long as they work well: "I don't mind trying something new and working it into my program, but if it doesn't work for me, I don't use it."

Mrs. Arthur is not enthusiastic about current curricular change: "It's not necessary to agree with the changes brought about by the Year 2000 Document [curricular integration, individualized learning, continuous student progress] completely. Every new program has its pitfalls and I'm not so insecure in the way I do things that I'm going to say my way doesn't work." She is traditional in her outlook and believes in "covering the basics." She is not supportive of the current trend to individualization of the curricular program, and prefers to use whole group instruction: "I don't believe in individualizing the program, that's just not my way. But when you do have individuals in the classroom that really need it (an individualized program), I guess that's the way I'll have to go." In short, she feels most comfortable with a teacher-centered classroom.
Computer Experience
When asked about her computer experience, Mrs. Arthur said her skills were "at one time, very, very good", as her husband had owned a computer retail store. She was a participant in the first provincial computer implementation pilot program in the early 1980's, where a number of schools in the province were given a computer to explore its educational uses. In subsequent years her interest waned, however, and other staff members took an interest and became more skilled with using the technology: "If you have a family, teaching is part of your life, but for some single people, it's their whole life and some of the people that were on staff became totally dedicated to computers. Their's was much superior to my knowledge, so I just kind of let them go to it, and they did a fantastic job. There is no way that I wanted to put in that much time, so my interest kind of lagged." She always had a computer at home, but never had much reason to use it. When the school instituted a computer helping teacher three years ago, she depended on this person to do all of the computer teaching in the lab until this year. "We had a person who was very talented, she took the class for a double period, while I had a spare. I loved it and she was very good for the kids."

Instructional Purposes
Mrs. Arthur was given an Apple IIe with a single disk drive, a colour monitor, and a printer for her classroom, but she had little interest in the innovation. As a result, her instructional purposes were vague and she was not specific about how she intended to use the computer, except for word processing so that students could publish
their assignments, for simulation games to help with problem solving, and for drill and practice to build skills in language and math. Although she was able to outline these general goals, she had little idea of what she had to specifically do to achieve them.

Because most of the class were "below average achievers," she wanted to employ software that was easy to use. She felt that it was important for the children to have success: "The computer has to be easy for them, so that they feel successful when they use it. I want to make them want to feel they can do it because, if you're like me, machines kind of scare you, and I don't want them to have that feeling."

She had a printer mainly because of a student with a learning disability for whom handwriting was a problem. It was hoped that by using a keyboard, this student could record her ideas more easily, and print out her assignments rather than hand write them. Mrs. Arthur felt that it was important to get this student familiar with keyboarding, so that she would be able to use the computer more fluently in later school years. Also in the classroom was an identified gifted student who enjoyed using the computer, and she intended to use it to help keep him motivated and challenged. She hoped he would help the learning disabled student to learn how to use the word processor and to become more adept with the hardware and software in general.
Classroom Context

The grade two/three class of twenty-four children had equal numbers of boys and girls. Five of the boys were in grade three and seven in grade two, while nine of the girls were in grade three and three in grade two. The fine motor control of one student was underdeveloped, causing her problems with handwriting; "By the time she works through the mechanics of printing an answer, she gives up." There was also a gifted child, described as "my first truly gifted child in all my years of teaching. He has a grade twelve mind but he is a seven year old, socially and emotionally." Having a "split class" was difficult for her because these special needs kids demanded a great deal of her time.

The children as a group were at a lower level of academic development than average; "looking at my class list, most of my students are low." Some were developmentally delayed, both emotionally and intellectually, and this contributed to behaviour problems in class; the well behaved students were also the "quietest ones," so they were not role models. Somewhat frustrated, she said: "It's very difficult for me to teach so many needy children - discipline is so different today, kids have much more freedom, and I agree with that, but it makes for some interesting challenges. If you don't have control, how effective is your teaching?"

This theme of control underlay many of her concerns and apprehensions. However, when asked to describe the important
classroom routines that she was establishing in September, Mrs. Arthur chose to mention five. (1S)

Management Routines
The establishment and maintenance of classroom routines was important to the smooth and orderly functioning of her class. She was initially frustrated because many usual routines had been difficult to activate, and she needed to spend an inordinate amount of time getting them established. She attributed this to students with special needs and behaviour problems.

For the start up routine each day, the children gathered in a circle to discuss calendar concepts and share their thinking about items they brought from home. This allowed them to practice oral skills in front of an audience: "I don't care if they bring something or not, everybody gets up and shares." Directly after this routine, they moved to language arts activities.

To get students' attention she called for order and waited until all were focused on her. This was not working as well as it had in the past because of the makeup of this particular group of students, and she intended to reevaluate and adjust the routine so that it would be more effective. By reteaching and repeating the routine, and by reinforcing a call for order through different words and voice tones, she hoped to increase student compliance.
She grouped students heterogeneously, and picked a leader for each group to distribute materials and to help members of the group with questions they may have about an assignment. Also, one student each day was assigned to be a special helper, both to aid in management tasks and to make each student feel as though they were a responsible member of the class. Every student got a turn on a rotating basis and was expected to help around the class and take some responsibility in helping peers: "they become the leader in charge."

Whenever there was movement as a group (for example, when the whole class came to the carpet for a story), students were encouraged to count by two's, or recite the alphabet, or months of the year until the last person was seated. "I find that this cuts down on mumbling and talking as they walk to wherever they are going." This routine was used to gather them together on the discussion carpet at any time during the day, or to call them to the chalkboard for instructions.

Instructional Routines
To encourage the children to cooperate and help one another on a continuing basis, she had a routine whereby older or brighter students helped the younger or slower ones. Also, they were encouraged to consult with peers before bringing their questions to the teacher.
The focus of instruction varied from day to day, and integrated themes were used to organize curricular content. On Mondays she introduced new concepts and worked on language and math skills, whereas on Tuesdays, Wednesdays and Thursdays she concentrated on the theme for the week, organizing activities from several content areas around a specific story or concept. Fridays were reserved for oral presentations and finishing activities that students had been working on during the week.

Unanticipated Impacts on Management Routines

Impacts were reported on a) access; b) seeking assistance; c) movement; and d) start up routines. Most impacted were routines related to access. Initially, there was little trouble with organizing access to the computer. Students could use it whenever they finished their other work, and during silent reading (the first period each afternoon). For centre times (two to three times per week), the first two students to sign up were allowed to use the computer for that period. Students usually rotated through the centres, and initially she did not find it necessary to discipline anyone for monopolizing the equipment. "I try to be as fair as possible because they seem to think that it's a real treat to have the computer in the classroom." (1S)

Students had a strong sense of fairness about equal access to the computer. This raised a potential problem, however, in that she wanted both the gifted and the learning disabled student to access the computer on demand. By the second interview, the learning
disabled student was using the computer a great deal, and Mrs. Arthur was concerned about her monopolizing it. She tried to remedy this by allowing this student to use the computer only when the rest were engaged in the language arts period each day. She also decided to move from informal access routines to more structured ones: "I'm finding now... Last year's class could do this without a lot of regimentation, but I think I am going to have to be the 'old general' with these ones." (20)

By the third interview, she was still frustrated with the competing demands on the computer, and so decided to seek assistance from a colleague who had previous experience. Through co-planning with this teacher, she divided her class into five groups corresponding to the five days of the week. The Monday group, for example, would have exclusive access to the computer on that day. This allowed an average of five students per day to use it, provided they had finished their other seat work. This provided more equitable utilization of the equipment, while maintaining some flexibility of access. (30)

By the fourth interview, earlier frustrations were somewhat resolved as access routines began to work well and competition for use became minimal. "The kids come in early on their days (days when they were scheduled to use the computer); you'll see them at 8:30 in the morning working quietly at the computer," although they were still a "little leery" about beginning without permission. She found this intriguing and was surprised at the extent to which they respected and cared for the hardware and software. They enjoyed
using it and the teacher said that it was "highly educational and an asset to the classroom." (4N)

Two different impacts were reported when students needed to seek assistance with computer problems. Although she normally picked at random a helper for the day, this did not work well where the computer was concerned because not all students were capable or confident enough on the computer to be able to help others; "I have a lot of low kids who are not computer literate enough to help somebody else." She adapted this routine by making it clear that the daily helper was not responsible for aiding others with computer problems. Second, the routine for having one competent student in each of the learning groups help the others was strengthened. These "group experts" were chosen on the basis of maturity and academic competence - a student who ran into problems on the computer could always ask this person for help, even when the teacher was busy with someone else. (5D)

She also noted that the customary method of dealing with movement around the classroom - having students chant months of the year or times tables as they moved from one activity to another - worked well for those at the computer; they seemed to have no problem taking part in the routine with the rest of the class, and were able to move without incident to the gathering area. (5D)

Because the learning disabled student needed to use the computer more than the others, Mrs. Arthur felt it necessary to adapt the daily
start up routine to accommodate her. While the rest of the class discussed the calendar, she could work on improving her written skills at the computer. This provided her with a consistent block of time each day when it was not available for other students. "It was getting to a point where everyone feels that if she is on it too long, in spare time or before school, it's unfair that she's getting the majority of the time, so I thought I might utilize that time because her oral skills are really good." At times during language arts, the gifted student would help the learning disabled student to transpose her thoughts onto the keyboard; this only worked depending on the mood of both students. (5D)

Unanticipated Impacts on Instructional Routines
Impacts on instructional routines included a) integrated themes; b) evaluation; and c) student cooperation. Mrs. Arthur did not relate the computer to the math program or to the integrated themes she designed each week, and so it remained a separate centre, unrelated to much of the activity in the classroom. Part of the problem was her unfamiliarity with the software available in the school. "I don't have software that I can use well enough. I probably would use it with my brighter kids, which maybe is right or wrong, I don't know. It might just be my inadequacy, but I'm such a stickler for the old skills and basically that's why I haven't got there yet. I thought if I could get some of those disks that have some of the language arts skills on them or even some reading skills for some of the other kids, then I could link it better to the other things we are doing." (5D) Although there were many software titles in the school that would help her
achieve these purposes, she did not take the time to learn what they were or how to use them.

Student *evaluation* routines did not work well with the computer because her "normal kinds of evaluation involve a lot of printing and writing skills." Although she looked informally for "improvement" in their computer use, no comments were made on the first report card. (5D) Evaluation was difficult simply because implementation purposes were not clarified.

The computer had a positive effect on students *cooperating* with each other, and encouraged those who were more capable to help the younger ones. This was the case, for example, when the gifted student finished his other work early and enjoyed helping other students on the computer. This worked because her students were "the kind of children who liked helping each other." (5D)

There was also a more serendipitous impact on student cooperation. When some of the "average students" were motivated to get their work done quickly, they often encouraged their partners to finish quickly as well, so that they could both take a turn on the computer. (30)

These impacts upon management and instructional routines were minimal, largely because the computer was not significantly integrated into the classroom. As a special interest centre, it remained peripheral to the program.
Unanticipated Impacts on Instructional Purposes

Mrs. Arthur talked about impacts on purposes, including: a) motivation; b) development of skills; c) managing student needs; and d) curricular integration.

By the second interview, motivation continued to be an important purpose for implementing the computer. Students enjoyed using it and unexpectedly wanted to get their work finished to use it more often. In particular, several boys who were difficult to motivate, worked at a higher level because they wanted to finish their work quickly and well in order to use the computer.

By the third interview, children were still eager to get to the computer and continued to help their partners finish work so that they could both get to it sooner: "I don't allow them to give each other the answers per se, but they are definitely using cooperative learning to teach each other." (30) This motivating aspect was turned into a vague sense of purpose: "I want them all to feel successful and not to be intimidated as the adults are; I find that because they're having fun, they think its a treat." (5D)

She described how the computer was particularly useful in motivating her gifted child: "With my philosophy and with my work load, and particularly my gifted child plus my low students, the computer has helped me a lot. Without it, I think I would be in trouble at this point with my gifted child, because he really doesn't
want to do extensions of what the others are doing all the time. He loves using the computer." (20) He had little patience for anything that seemed tedious, and it was the computer that kept him challenged: "I shouldn't use the computer as a carrot, but right now its my sanity." By the third interview he was not monopolizing it as he had done earlier; " The one thing that it's done for him is that it's taught him to deal with his frustration level. He's making a concerted effort to finish his work immediately so that he can get at the computer; even though it's so and so's turn, they still have things to do. So if he gets in there first, he'll get ten or fifteen minutes to do something that he wants to do." (30) Other children viewed him as a role model and wanted to use the computer because they saw some of the things he was able to do with it. She hoped that their watching him publish work on the printer would encourage them to use the word processing software as well, and to write more prolifically. (20)

On the other hand, the learning disabled student lost interest in word processing. "It worked really well for about the first month for me to motivate her to finish some of her work, so that she could type it in - to see the typewritten product. But she's lost interest, and it's slowed right down." The reason was that her printing had improved with practice, and it was now easier to write assignments by hand than to use the keyboard. "Her printing has improved, so she doesn't mind the appearance of her work now. Whereas, before she was ashamed of her printing and so she would hide it." This student still used the computer for drill and practice games. (30)
In the fourth interview, Mrs. Arthur related a "major unexpected impact." The computer broke down and no one in the school was able to fix it immediately. While it was not working, she realized how much she depended on it for dealing with her two special students. The lack of access to a computer adversely affected the behaviour of her gifted child. He increasingly required her undivided attention and became upset when she couldn't or wouldn't give it to him: "I no longer have that big carrot, so he is restless... I notice that he's encroaching on my time too much - he wants me one hundred percent now, whereas before he could go to the computer. I'm getting more frustration from him... It's not even so much the motivation that the computer provides - the child is motivated - his emotional stability is most important and dealing with frustration is a big component of his education at this point. So I do have to have certain things like the computer that are appealing to him because anything else is boring." Similarly, when the learning disabled student was unable to use the computer for drill and practice, she reacted negatively to having to do things with paper and pencil, and demanded more teacher attention.

Another impact on purpose was in the area of skills development. She wanted to use the computer to reinforce the math program; "as far as using it as a tool for math in the classroom, I haven't been able to do that yet, but I would like to spend more time on this." To this end, she wanted to better match the software with the concepts she covered in math. She had not expected to take so long to arrange for
this, and attributed this lack to the extra time it was taking to plan for two grade levels in math; "my problem is that the math program needs to be so individualized and I have such a spread of abilities in my class." Although math was one of her strengths, she was frustrated that students were not getting the skills they needed. She knew that the computer could help alleviate some of the pressure, but wasn't sure how to go about this. She thought that perhaps there was some software that could help teach problem-solving, but was unaware of its availability in the school. (20) Because her commitment to the innovation was weak, her purposes remained vague over time.

At the third interview, she still had not related the software to her math program because, she said, the disks were unavailable. She also felt that she needed more time to build her own skills on the computer. Although it could be a "marvelous tool," she had difficulty in changing her "old philosophy of teaching." "With the split class, I find I don't have as much time to use the computer advantageously as a teaching tool because I'm flying all day. It may be me, with my old, structured style of teaching, trying to still give too much instruction of skills while incorporating the new program. So I don't have time to get to the computer as well. I think it could be a marvelous teaching tool if I could just get past my old ideas of teaching, which I can't. I can't allow these children not to have the skills that I think have to be drummed into them." (30) By the fourth interview, the computer was still not being used for reinforcement of skills. Once again, she claimed that she had not
expected it to take so long to align the software to her math program; she had not had a chance to do so to date. (4N) Resistance to change prevented her from integrating the computer into daily classroom life.

She did say that the computer helped her to manage student needs. She likened it to a classroom assistant, on which she had come to rely, and suggested that money would be more effectively spent on purchasing software rather than providing more classroom assistants to help with special needs kids; "I really rely on the computer for helping keep my special needs kids occupied. These are possibly the wrong reasons, but they work for me." She was willing to give up classroom assistance time in exchange for more software. (4N)

Slow curricular integration was blamed on a lack of a wide variety of software. More kinds of math games and drills, for instance, would help her to use the computer more effectively. "I'd love to have 'Rosie Rabbit' now. I've got the printer and the kids could write stories and print them out." When she was told that the software was available in her school, she replied, "Okay, a lot of those things [software] I should get a list of so I'll know what's here." (4N) Although she expressed a desire to use a wider range of software, she did not take the initiative to find out what was available in the school. This ongoing contradiction demonstrated her lack of interest in anything beyond minimal implementation.
Seeking Assistance

Although Mrs. Arthur had a variety of ways available for assistance, she did not use them on a regular basis. Occasionally she went to the computer helping teacher with a problem; "the vice-principal is probably the most helpful in the school, since we lost last year's computer helping teacher." (20)

She did not observe other classrooms as originally intended because of her "troublesome" class and busy schedule. By the second interview she no longer had any intention of observing others because she felt that "what works for some may not work for others." (20)

She expressed a desire, however, to talk with one particular teacher who had previous experience with a computer in her classroom, and did so by the third interview. From this colleague she learned some valuable pointers about the hardware and software, and how to begin integrating the computer into daily classroom life; in particular, she learned to group the children for better access, using the days of the week as a guide. Although this brief collaboration was helpful, she did not pursue regular or further planning.

Interpretive Summary

The researcher concludes that in Mrs. Arthur's class implementation was shaped by three factors. First, classroom control was of primary importance to her; "If you don't have control, how effective is your teaching?" She was apprehensive about any shift in the locus of
control that could threaten her authority, as evidenced by inflexible routines designed to keep students in check and by her treatment of the two special needs students. Because they didn't fit the normal routines, she was unsure about what to do with them, except to keep them happy and occupied so that she could continue working with the whole group. She used the computer to keep them busy without also exploiting its potential for a rich, individualized learning experience.

Second, her purposes were vague to a point that they demonstrated no real intention to integrate the computer into her overall curricular plan. She made comments such as "It's highly educational" and "Children enjoy it," but did not discuss the specifics of what this meant, nor did she attempt any plan for achieving her purposes. While claiming that the computer could provide opportunities to enhance math and language skills, she did not pursue these purposes in a specific way. She remained consistent in her unfocused and minimal use of the computer; when the computer broke down and there was little attempt at getting it fixed for about three weeks.

Third, although her purposes for the computer were vague, they were still more complex than Mrs. Freer's, and so the Trojan Horse thesis became a more important factor - unanticipated impacts were a minor deterrent to implementation, and caused her feelings of frustration and inadequacy. Partially because of these impacts, she did not try to achieve her purposes within the expected time; she did not integrate the computer into the daily math program or language
arts themes and no attempt was made to use the computer specifically for problem solving as originally intended. She felt that factors like a challenging class, a learning disabled student, a gifted student, and concurrent school-wide curricular changes hindered further implementation. In reality, though, her low threshold for change prevented her from becoming committed to the innovation.

**MRS. DOUGLAS**

As a Kindergarten/grade one teacher, Mrs. Douglas' experience with computers was more extensive and her instructional purposes more complex than those of Mrs. Freer or Mrs. Arthur. Consequently, the Trojan Horse was more evident than in the previous cases, and it took her longer than anticipated to integrate the computer into her classroom. The interview schedule was as follows:

1. September 18 (1S)
2. October 2 (2O)
3. October 30 (3O)
4. November 8 (4N)
5. December 17 (5D)

**Background**

Mrs. Douglas is an experienced teacher who started in the profession twenty-six years ago. She took a leave from teaching while raising her children and worked as a substitute teacher for four years upon her return. Previous to the current school, she taught at one other
school in the district and in two other large metropolitan districts in British Columbia. Before that, she taught in a school district in Oregon. She taught Kindergarten at the study school for the past three years and currently enrolls a combined class of Kindergarten and grade one students, sixteen of which had been in her Kindergarten class during the previous year. This is the second time in twenty-six years she has taught students in grade one.

At the time of the study, Mrs. Douglas sponsored a student teacher on a thirteen week practicum from the University of British Columbia. This student attended the first interview in order to gain an understanding of the study. Throughout the implementation, Mrs. Douglas reported that the presence of the student teacher had significant impacts on the use of the computer and the classroom routines.

Computer Experience
An IBM-compatible computer was used mainly for word processing at home. Further, she had developed a program for aiding primary teachers to write anecdotal report cards as part of a course while working on her teaching diploma at the University of British Columbia. She organized and completed a presentation on this program at the university's Language Department Conference in the summer of 1991. Although designed for Kindergarten teachers, she planned to adapt the program to be used by teachers of grade one children.
She was only now becoming comfortable with Apple II computers and software. In the past, she had parent aids take students to the school computer lab, and depended on the computer helping teacher to work with her class. In January of last year, however, she decided to introduce students to computers, and took them to the computer lab herself rather than utilizing the computer helping teacher.

Instructional Purposes

In September, 1991, Mrs. Douglas was given an Apple IIe, with a single disk drive and a colour monitor. She hoped that it would motivate students to achieve better through using the software regularly. To this end, she organized the classroom around learning centres and set the computer up as one of them. At the time of the first interview, the computer was the most popular centre. Often a group gathered to watch someone use it. She intended to establish a routine where the student of the day (or "special person") would use it first, and only after this person had finished, would others be allowed to sign up for a turn.

Mrs. Douglas intended to use the computer in three stages. The first was to reinforce math and language skills through drill and practice and games. The focus would be on number and letter recognition, and she intended to align each program with the number or letter concepts she was covering at the time. By changing each game about once a week, all students would get a chance to various programs without becoming bored. She was unsure whether this would be possible, however, because of a lack of appropriate software. She
used math games as an alternate method of drill and practice, and planned to

In the second stage, she intended to teach students how to use the school's automated library system for finding and checking out books. This would familiarize them with entering series of numbers on the keyboard while someone called them out orally, help build the skills necessary to use the library computer, and aid with number recognition.

The third stage would be simple word processing in order to enter and print stories and journals. This was a long term goal for the year, and because her students were young, she was unsure as to how successful it might be. She felt that it would not be possible to do this solely with the classroom computer, and so planned to take the students to the school lab when ready to begin word processing. New concepts would be introduced in the lab, whereas the classroom computer would be used for follow-up and on-going writing activities. Although she was not yet conversant with the program entitled, "The Children's Writing and Publishing Centre," she felt its large fonts (letter shapes) and graphics capability would be appropriate for primary students.

Classroom Context
In a class of 24 students, 19 are in grade one and five are in Kindergarten, including 13 boys and 11 girls; the ages ranged from five to six years. The grade one students attend full time and the
Kindergartners on Monday, Tuesday, Wednesday, and Thursday afternoons and all day Friday. All of the Kindergarten students were January entrants, and experienced their first six months of school on a half-day schedule. The seven new grade one students were working on routines that the others had established in the previous year. She felt, however, that routines changed for all students since there were new curriculum expectations and differences in the classroom environment such as sitting in desks and working in exercise books.

The students constituted what Mrs. Douglas called a "very active group." At the time of the first interview, she took them outside twice a day, because the group became restless if they remained inside too long. She felt that they were still "getting over the summer," but added that some of them had never really settled down from the previous year. "In that respect," she said, "we are slow in getting concepts across to some of them, so we're still working on establishing routines and this is a big part of their day."

Mrs. Douglas also described her class as a "fairly challenging group". Although there were no identified gifted or learning disabled students, there were some "very needy kids," most of whom were described as "immature." Four received learning assistance and needed constant reinforcement of routines and rules, and five others had unusually short attention spans. "It may take several years for them to learn some of the routines and behaviour expectations," she said. This was the second consecutive year she taught some
students; she requested to have them enrolled in her class again because what they had learned in the previous year could have a positive effect, particularly for those with special requirements. "One little girl," she said, "has to be constantly monitored and needs to be brought back on task three or four times during one activity." About one third of the class were ESL (English as a Second Language).

Experience had taught her that it was essential, particularly for young students, to establish routines early in the year and then to modify them as the year progressed. She reiterated that since the children constituted a very active and immature group, many of the classroom routines were still being established and reinforced at the time of the first interview.

Management Routines
Mrs. Douglas reported several key management routines. In order to gain the group's attention, for instance, she sounded a clapping pattern, which the children repeated, forcing them to stop what they were doing. For a "more formal" lesson, where the children were completing seatwork, she rang a bell to get their focus. Since the children were still learning the routine of raising their hands to speak or answer a question at the time of the first interview, they needed frequent reminders to comply.

For the daily start up routine, students read silently for ten minutes and then met together for circle and calendar activities. At this time they usually worked on number concepts related to the date.
When *distributing materials* to a large group, she used a routine whereby those behaving as expected (e.g., by sitting quietly and paying attention) would receive materials first. She did most of the distribution herself because she felt that it was too early in the year and the students were still too young to take on the responsibility of acting as monitors.

Upon completion of certain activities and at the end of each day, the children followed a routine for *leaving the group*, including dismissal by colour of clothing, alphabetically by first initial, or sequentially by age. This helped to reinforce skills and prevented rushing through the classroom or crowding in the cloakroom. At the time of the interview, they often needed to be reminded by coming back and starting again when they forgot to comply.

To establish and *reinforce* management routines, she often modeled correct procedures for the class. If students forgot to put away the scissors, for example, she engaged them in a lesson on correct care of scissors. Once she had demonstrated where to put materials, she expected students to comply with the routine.

**Instructional Routines**

When asked to describe her most important instructional routines, Mrs. Douglas gave a variety of examples. *Delivering instructions*, for instance, included two routines. First, the entire group to came to the circle area (a carpeted corner of the classroom), where they were
expected to sit quietly and attend to instructions. Second, when introducing something new such as an art project, she demonstrated and then charted each step; in some cases, she used students to demonstrate instructions, in order to involve them and increase motivation. Oral and visual instructions accommodated different learning styles; the time and effort involved was worthwhile, she claimed, because the children were just beginning in the school system and it was important to teach them to how to attend to what was being said. Demonstrations were also used to reinforce instructions because of the ESL students.

An *assessment* routine occurred when students finished writing and illustrating their daily journal entries. After taking them to her for checking, students received a sticker. In this way, she was able to give immediate feedback on their ideas and provide an audience for their writing. Further, at times during the day when they were working independently or in groups, she circulated amongst the students to assist them while monitoring their progress.

When students *finished* activities *early*, they worked at one of the learning centres, which included the computer. Because the room had originally been designed for Kindergarten, it was furnished with appropriate equipment and materials for centres (such as the house, puppet theatre, and water table); with the addition of grade one materials, there was always a wide variety of independent activities available. Students understood that limited numbers were allowed at each centre of choice. This minimized problems and allowed them
to get the most benefit from each learning station. Those who misbehaved were moved from that centre and, in some cases, not allowed to use it for a set amount of time. Because the computer provided incentive to pursue interesting, independent activities on a daily basis, students quickly learned to demonstrate acceptable behaviour while using it. (4N)

**Unanticipated Impacts on Management Routines**

A variety of effects were reported for management routines, including: a) gaining attention; b) managing materials; c) access; and d) transitions.

The routine for *gaining* students' *attention* by having them repeat a clapping pattern was modified by repeating the clapping pattern. Those using the computer often needed this further reminder because they were interested in what they were doing and did not stop and pay attention immediately. (2O)

The routine for *distributing and organizing classroom materials* did not work for managing software. Although some students knew how to handle the disks and turn the computer off, she took personal responsibility to make sure it was powered down and the disks were put away each day, because the children were very young: "the last one turned six today, so they're still pretty little." She expected that they would care for the software in the second term, and intended to establish a routine to accommodate this. Except for one child, all cared for the equipment properly because they didn't want to risk
losing their turn on the computer: "I think it's because they're interested and because it's a new centre and they know that they're only on it for a certain amount of time." (4N)

By the third month, difficulty with the management of materials was related to the complexity of a particular word processing program. She needed to supervise it closely, since it required two separate floppy disks and students were not yet ready to switch disks on their own; their immaturity and inexperience could lead to damaged disks. The children only used the word processing program when she was available to help them. (She felt that she wouldn't be able to use the program extensively until the student teacher finished her practicum.) (4N)

Computer use also resulted in the creation of new access routines. She allowed access at all times during the day provided that the students' other work was done, except during times of whole group or small group instruction. Some occasionally attempted to bypass this rule by asking to begin or continue using the computer during these times. (2O) Extending access before class and during lunch hour also became problematic when some students insisted on consuming food and drink at the computer when unsupervised, and so she disallowed access during the lunch period. (2O)

After two months, the computer was still the most popular centre in the classroom. In September, those who had finished their work first were allowed to use the computer. However, this led to a few
students monopolizing it, and so all were required to sign up for access. This new routine worked well and the children were getting better about letting each other have their rightful turn: "They just go up and if they've used it that week, then they know that they go to a different centre and leave it for someone else to do. If no one else is free, I let them use it even if they've had a turn that week, because I don't like to leave the computer sitting there just because a person has already used it." This was the only centre that needed a sign-up routine to ensure equitable access. (30) By the third month, Mrs. Douglas adapted the routine so that students could bypass the sign-up list if the next person on the list was not ready.

A routine was needed to let students know how long their turn should be. Each student was to play a single game and then turn the computer over to the person who was looking on. Sometimes the person watching would coach the one playing and, although all of the students knew which keys to press to make the games work, some of them needed help from their classmates to successfully use software that required number recognition. (20) If no one was waiting, an extra turn could be had after checking with her. (4N)

Another access routine limited the number of students at each centre, because she felt that if the numbers were too high, students wouldn't get as much benefit. Although she began by allowing two students at the computer (one watched while the other used the keyboard), one would begin doing something else rather than watch. "It's pretty well down to one at a time and they go and do something
else and wait for their turn, and not waste their time." Those watching became bored because they were familiar with most of the programs. The grade one students had begun experimenting with the writing program and they weren't interested in watching each other write. The routine had evolved to work more efficiently. (4N) During the fifth interview, she expressed surprise that, once access routines were in place, no one fought over whose turn it was next. Students had become generally responsible in their use of the computer and respected the equipment. Except for the sign-up list, the routines for access had become essentially the same as those for any other centre. (5D)

The routine for accommodating movement worked well with the computer. When children were summoned for circle (discussion or story) time, for example, she gave them five minutes advance notice so that they could finish what they were doing and clean up. They were not allowed to start new activities during this transition time. This worked well for ending a student's turn by affording them enough time to complete their game and shut down. (5D)

Unanticipated Impacts on Instructional Routines
Impacts on instructional routines fell into four categories, including: a) reinforcing routines; b) giving instructions; c) questioning; and d) evaluation.
Occasionally students became negligent in following computer routines. When reinforcement of these routines was necessary, it was done with individual students rather than reteaching the whole class. (4N)

When introducing a more complex word processing program, she adapted her routine for giving instructions and worked with individual students instead of several at once, while the student teacher took the rest of the class. Concerned about distracting others, however, she then decided to model the use of new programs in front of small groups in the computer lab, so that they would be able to try the programs immediately after instruction. She felt that she needed to wait until the student teacher was finished her practicum before attempting this. (30)

The routine for having children raise their hands to answer questions had been unaffected by the computer, since she did not allow students to use it while she was questioning the whole group. They only accessed the computer during centre time or when they finished their work early. (5D)

Mrs. Douglas had a variety of routines for evaluating students, including observations, interviews, marking products, and testing. With the computer, though, she kept these informal because students were not as far along in their learning as expected; they were still at a beginning level. When they would begin using the computer in a more integrated way (for completing writing assignments, for
example), she intended to utilize more formalized routines to assess progress. In the meanwhile, she observed them to find which ones were able to handle the programs and were ready to move on to new ones. Also, by reviewing the sign-up sheet, she had a record of precisely which programs the students used. From this record she could determine which programs they preferred and in which ones they had gained expertise: "I'll also go through (the lists) and see which ones are having success with the programs and I'll know that they are ready to move on to harder ones. The children know that they'll get to the point to where they know that they've done this disk and they're ready for that one." Once they would start a program that was capable of printing out their stories, they would then become even more accountable because she would have hard copies of the writing. These could be used to share with other students in the class and with parents during conferences. (5D) She didn't comment on the students' computer use on the first term report cards, but intended to do so in the second term, once all were using it for writing. This delay was partially because of the student teacher: "I was waiting until I had control of the class, really. Because my student teacher wrote part of the report cards, there just wasn't a computer comment this time." (5D)

Many of these minimal impacts on management and instructional routines were unanticipated. Some existing routines had to be modified and new ones added. This made implementation slower than expected and she felt frustrated that she was not using the computer for writing as originally planned. Because her purposes
were more complex than those of Mrs. Freer or Mrs. Arthur, it had indeed been a Trojan Horse that, to some extent, impeded implementation.

**Unanticipated Impacts on Instructional Purposes**

Mrs. Douglas detailed changes on her instructional purposes for the computer related to: a) accountability; b) word processing; c) student cooperation; and d) development of skills.

In September her purpose was to let students freely explore the software. As they began to use the computer, however, she felt a need to make students more *accountable*, so that she could keep better track of their progress and so they would take more responsibility for their work. This could be done once they started using the computer for writing, providing her with a hard copy to be edited and evaluated, thus making students more answerable for their efforts. (4N)

Although she believed they were not quite ready to start *word processing*, Mrs. Douglas began planning for journal and story writing. Spelling and letter recognition skills were still low, except for two or three children. These more capable students would first try writing and spelling on the computer, while the others continued working on letter recognition games in order to increase their reading skills. Once she became more familiar with the word processing program, she intended to set up an instructional routine to introduce it to the whole class. (5D)
She planned to have them write on the classroom computer and then print in the lab. (She would first have to learn how to use the school printers herself.) It would be motivating for students to see their work in typed print, particularly for those who were not yet able to print neatly and efficiently. In the second month, she anticipated that it would take time and organization to accomplish this goal, but felt that the student teacher would provide the time she needed. (30)

When she began teaching the children to use a simple graphics and word processing program, she encountered unexpected problems with the start-up disk and couldn't get it to work satisfactorily; not all of the features of the program were working. "I will continue to use it," she said, "once I figure out how it works. I just put it out for one day and the children went as far as they could go on it and I put it away so that they wouldn't become frustrated like I was.... I don't know whether it's a faulty disk or whether it's the computer, or whether it's just that I'm using the software incorrectly." (20) Later she reported still having problems: "I am still having trouble learning how to use the program...Even though I have been shown how to get in to it, I haven't been able to do it on my own." The problem turned out to be a faulty disk, and this affected the timing of her instructional purposes. (30)

By the fourth month she had still not begun to tutor individual students in word processing as planned, because she felt it would be a distraction while the student teacher was in charge. The dynamics
of the class also changed because a new student had arrived and one had left, giving the student teacher further problems with planning and management. "It's enough for her to do the lesson plans and to teach the lessons because she is progressively teaching a larger percentage of the day, and to ask her to do the computer on top of this is really asking too much at this point. So it's going to be slower implementing the program." To give students individual time on the computer, she planned to take them out of the class: "I just felt that that was too much distraction in the class, so I will probably have to take them out of the class and do it in the computer room because she [the student teacher] is still working on her management and any distraction in the class can make things more difficult." (5D)

To enhance student cooperation, she intended to pair a younger or less able student with an older or more able one to help with the word processing once they began writing, saving and printing. Some could also do their individual stories while other, younger students worked together in pairs on a single story. Because this may be complex to attempt, she decided to "wait until they really know the program and know what they're doing." She would see how this unfolded once they actually began using the computer for writing, but decided not to initiate student pairs until they moved into the lab and began working on their stories. She also hoped to established a routine whereby grade seven students would help them save print their stories in the lab. (4N)
Mrs. Douglas planned to take a few of the less capable students and work with them on the computer in order to help them increase their basic number and vocabulary skills while the student teacher was instructing the rest of the group. (She explained that she would have to increase her own skill with the programs before trying this.) She attempted to align the computer programs to the materials they were covering in class so that there was a "natural fit," although this was not always possible due to the lack of appropriate software. (2O)

Many impacts on instructional purposes were positive. The computer, for instance, provided students with an additional avenue to build basic skills in reading and mathematics; the drill and practice programs and games were useful in motivating them to increase their competency, particularly in math. Students also gained on-going experience with manipulation and exploration of hardware and software. (5D) Although only a few began to write stories, those older grade one students who did seemed to be highly motivated, and she intended to continue until all of the students had done so. (4N) By the end of the interviews, all were writing journals, as originally intended, although there occasionally were minor problems with some of the disks, as they seemed to be working improperly. Once she had full charge after the student teacher completed the practicum, she was able to do more in her class and the lab. She took the students to the lab in order to use the word processor and print their stories and journals, while using the classroom computer to supplement this process. (5D)
Seeking Assistance

Mrs. Douglas sought assistance from two sources: a) the computer helping teacher; and b) another classroom teacher.

She usually requested help from the computer helping teacher, who had set up the computer and software in her room; this kind of help related to solving hardware and software problems and to selecting appropriate software. By the second month, she requested help from another classroom teacher of the same grade who had previously implemented a classroom computer at another school. This colleague gave ideas on how to integrate the computer more effectively. Most of the time, however, Mrs. Douglas said she depended on her own resourcefulness to help her through difficulties. By trying software herself, for example, she was able to judge its appropriateness for students and how to best work towards her purposes.

Interpretive Summary

As an experimental computer user, Mrs. Douglas was enthusiastic about implementation and attempted to use it in a variety of more complex ways. Instructional purposes were more precise than those of Mrs. Freer and Mrs. Arthur, although she was not able to achieve some of them in the time allotted; it was not until January that word processing was done on a regular basis with the whole class. Two factors negatively influenced the implementation. First, the presence of a student teacher who had difficulty managing the high energy and low maturity of the students took some of the focus away from
implementation. Second, there was some difficulty in getting the software and hardware working because of faulty disks and equipment. However, her purposes were better articulated to start with and she was motivated to adapt them as things progressed. Since she was committed to the innovation, her threshold for change was higher and unanticipated impacts did not discourage her. The Trojan Horse, however, did slow the implementation as unanticipated impacts were brought on by both the computer and by the student teacher. She adapted her purposes as she became more aware of the computer's potential as a learning tool.

MRS. EVANS

The case of Mrs. Evans was unique because, compared to the other three teachers, her experience at integrating the computer into daily classroom life was considerable. Although this was her first year in the study school, computers had been used extensively in previous years, and she had implemented a classroom computer for one year at her preceding school. Her case contrasts to the others because the implementation proceeded successfully, even though complex purposes were attempted and unanticipated impacts were encountered. Interviews were scheduled as follows:

1. September 18 (1S)
2. October 4 (2O)
3. October 16 (3O)
4. November 8 (4N)
5. December 17 (5D)
Background

Mrs. Evans has taught for seventeen years, mostly at the primary level. She began her career in Winnipeg, teaching grades four, five and six language classes for one year before transferring to primary. She taught primary for two more years in Winnipeg and then moved to the study district where she has continued in the primary grades ever since. Grade levels taught include Kindergarten, one, two and three. She worked at three other schools in the district before attaining her current position at the study school, where she teaches a 1/2 combined class.

Mrs. Evans' class consisted of thirteen boys and ten girls. Three of the girls and eight of the boys were in grade two and seven of the girls and five of the boys in grade one. Two of the grade two boys were identified Learning Disabled and five students were ESL (English as a Second Language). Although this particular combination constituted a challenging group whose needs were varied, she described them as "very pleasant to work with - both easy-going and cooperative."

She described her teaching style as "laid back" and that she was one to "go with the flow." She had not always been this way, but experience taught her that in order to do her job well, she would have to develop a "relaxed attitude." With the increasing amount of change in the educational environment, she felt it was critical to be able to adapt to change. Along with this ability to relax, she was able
to adjust to large scale changes more easily and had begun to seek out opportunities for innovation.

Computer Experience
At her previous school, the enthusiasm of the computer helping teacher motivated her to understand the potential benefits of computer use. On her request, he helped her learn how to use the hardware and software to enhance her instructional program over two years. In the year previous to transferring to the study school, she was given a computer for her classroom, which she used as centre to reinforce math and language skills, to explore a variety of simulation software to improve student thinking and, for journal and story writing.

Besides the classroom computer, she also made use of the computer lab for word processing by having students write and publish "books." Dealing with primary students in the lab was difficult because of problems they had with the hardware and software. In response, she adapted her management and instructional routines and requested assistance from parent helpers, thereby improving the success of implementation.

Instructional Purposes
An Apple Ile with a single disk drive and a colour monitor was used full time with her students during the 1991/1992 school year. Because she had implemented a classroom computer previously, she was clear about instructional purposes and how she might attain
them. At the first interview, she planned to use it in four ways: to teach independence and familiarity with the computer, to use a word processing and graphics program, to reinforce arithmetic and language skills, and as "a tool to support thinking and reading."

To enable children to become more familiar with the computer, she intended to provide them with a variety of software to explore freely for the first part of the term. This would then allow her to plan further activities based on their demonstrated interest. All children could have equal access to the computer if grouped according to the days of the week, so that each day about five students had their turn. In previous years she found that this method increased student independence - they quickly learned that if they didn't take responsibility for their turn on their given day, they would have to wait until the following week, unless there was a time when no one else was using the machine.

To reinforce skills, she planned to concentrate initially on math and reading, and named several MECC Software titles that would help accomplish this, including: Phonics Prime Time, Contraction Action, Word Muncher, Compound It for Language, Addition Logician, Path Tactics, and Circus Math. She intended to continue her past practice of selecting software to enhance instruction; programs would be related to those concepts introduced or reviewed in class.

For word processing and graphics, she planned to employ the program Explore-a-Story as in previous years. Students would be
motivated, she said, to write more frequently and with better quality as they saw their work published. The program would also help them become familiar with manipulating text and graphics on the screen and increase their confidence with the computer, while enabling them to see its potential for desk-top publishing. She intended to begin by training them to load the program, become familiar with the commands. Learning to add text would accommodate their emergent writing. Next, they would learn how to save their work on data disks so that they could print them out in the lab. She planned to pair emergent readers and writers with "buddies" who already knew their numbers and letters, as she had tried this before and found it to be a successful method of motivating beginning writers.

As the computer lab would allow students more access time to become familiar and independent with the equipment, she intended to use it in conjunction with the classroom computer. Five students would be trained as peer tutors for their classmates, and parent helpers would be incorporated to help children save and print their stories and pictures.

To help assess the achievement of her purposes, a record of student's printouts would be kept in their folders, allowing her to encourage those who were behind and ensure they got their turn. In the past she noticed that, while some students wrote prolifically, others continually started passages without saving them. If their files were
kept current, students were not likely to find themselves at the end of a term with little or nothing printed out.

Management Routines

When asked to describe management routines key to the functioning of her class, she identified a) start up; b) seeking assistance; c) calling attention; and d) managing materials as important.

To start up each day, students were expected to read independently, or with a buddy or with her. Once the morning attendance was taken, she called them together on the carpet to go over the calendar, discuss news stories, and then write in their journals before going to the centres. Free writing in journals was encouraged, although she provided suggestions on a regular basis for those children who needed them.

When students needed to seek assistance with a particular problem, they checked with two other classmates before coming to her. This helped them become more independent, while seeing the value of peer resources.

To call the class to attention, she said "Freeze" and expected them, no matter what they were doing, to stop and listen. Sometimes she clapped a pattern, which the children repeated, to focus them on subsequent directions.
Routines for managing materials were established early in the year. She overtly taught where to put materials and how to look after them; to aid this process, she labelled places for putting things away. If a student did not care for materials properly, she asked a peer to model the correct procedures; if someone abused the materials, they lost their privilege for a short time.

Instructional Routines
In describing her instructional routines, Mrs. Evans included: a) questioning; b) monitoring; c) giving instructions; d) assessment and evaluation; e) expectations for behaviour; and f) finishing early.

When questioning students, Mrs. Evans used a ten second wait time to allow them to think about an answer. If anyone had trouble answering, she allowed that student to discuss the question with a neighbour and came back to him/her after other students shared their thinking.

To monitor seat work, Mrs. Evans circulated in order to answer questions, offer assistance, and reinforce behaviour expectations. While students were completing their journals, for instance, she helped them with vocabulary and spelling on request.

After giving instructions she made a game of having students repeat in their own words or model the instructions in order to make sure they understood what was expected. Sometimes she placed the instructions on the board or a chart. A child who had difficulty
focusing would be separated in order to lessen distractions for him/her and those close by. Younger students had older "buddies" to help with repeating directions.

To aid in assessment and evaluation, she recorded observations and on-going anecdotal comments on index cards, kept file folder portfolios for samples of each child's work, and dated the journals each day to monitor progress. Her intent was to build a range of evidences which demonstrated to parents what the children were capable of doing.

Expectations for behaviour were set through student input (group brainstorming and discussion) and were defined in positive terms. (i.e. "Walk for safety" rather than "Do not run.")

Students who finished assigned activities early were free to go to the class centres, unless there was a quiet activity going on. In this case they read or did other quiet activities provided for them.

In all, she described a dynamic classroom, where routines were used to help cut down the amount of time spent on teaching repetitive tasks so that more time could be given to a flexible, child-centred program of instruction. The structure imposed through this framework of routines was intended to allow students to gain independence by making clear choices while working within specific limits.
Unanticipated Impacts on Management Routines
Although impacts were minimal because of previous experience she reported some effects on management routines, including a) access; b) managing materials; c) seeking assistance; and d) calling attention.

In the second interview, she stated that students were eager to access the computer and that they were enthusiastic about the software. To organize access more equitably, she established several routines. For example, during whole group instruction, they weren't allowed to go to the computer on their own, but when they finished their other work, they were free to use it; a sign-up sheet allowed them to check their names each time they had a turn. Although the routine was clear, students sometimes forgot, and so she checked the list whenever a new student began to see whether he/she had signed the list. Because she wanted students to explore the software freely, she did not yet wish to formalize software access. (20)

By the third interview, she adapted the routine so that students worked in groups of two's and three's. Although she originally intended to pre-arrange student pairs, she found that they finished their work at different times, and that a few weren't interested in using the computer at all. As this created a variety of access difficulties, she decided to allow students to pick their own partners when they were ready. This adaptation had not presented any problems to date. (30)
By the fourth interview, she noticed that the computer was unused for portions of the day: "I would still like to see it used more frequently. There are a lot of times during the day when the computer is not being used." She decided to adapt her access routines so that fewer students could use the computer for a longer time each day: "What I'd like to do now is look at setting up a time each day where a couple of kids can go and work on the computer and the next day a couple more kids would use it all day. Then I could try and track them while they get more familiar with what to do next. That way they'll come to me less often with, 'What do I do now?' questions." This helped her adapt computer use to individual needs. (4N)

During "buddy reading time" at the start of each morning and afternoon, students were not allowed to use the computer, although some of them occasionally tried to circumvent this routine. Once they had finished reading, however, groups of two or three often set themselves up independently at the computer. (5D)

By the third month, the students were getting better at managing materials. They were usually good about clean up and software care routines. She found, however, on returning from a two-day absence, that routines were ignored under the substitute teacher. Disks were scattered about the room and the computer had not been properly cared for. Further reinforcement of the routines was necessary so that the children would carry them through when she was not there.
Apart from that single instance, management of computer materials did not pose a problem. (4N)

When children needed help while she was busy, they could seek assistance from another member of their group. Failing this, they asked one of the two classroom "computer experts" that she had trained specifically for this purpose. If they were still unable to solve their problem, they asked her for help, although she said that the children had gained independence and this did not occur very often.

In order to gain students' attention, and they were asked to stop what they were doing and focus on her; "I just say 'Freeze' and everybody stops, looks, and listens, no matter what they are doing." The children on the computer complied as well: "That's because I reinforce it. If I have someone who doesn't stop, I say "Remember," or I reinforce it by saying, 'Boy! Those people were really fast to stop, look, and listen,' and I find that just pulls the whole group together." Frequent use of positive reinforcement helped her motivate the children to cooperate enthusiastically. (5D)

To hold student attention, she described a simple modification that was significant. She had initially set the computer up so that it was fairly central, but as a result most children could see what was happening on the screen, even when it wasn't their turn. She decided to change its location so that it would not distract them: "I think you have to situate the computer so it's not a distraction, so I
found if I just turned it and then gave the kids the security of knowing they would get to it, then it was okay and they could attend to whatever they where doing. But I think for some teachers, that can be a drawback of the computer and they may think that while they're doing this or that the computer should be definitely out of bounds, because it's too distracting of a force." (3O)

Unanticipated Impacts on Instructional Routines

Mrs. Evans also described impacts on her instructional routines, including: a) tutoring; b) accessing software; c) student cooperation; d) questioning; e) giving instructions; and f) evaluation.

During the third interview she reported an impact on her routine for tutoring individual students that was frustrating her. More complex software would require more teaching time on her part: "I'm not quite sure yet how I'm going to schedule the time in the day so that I can help with the computer, and still have the others constructively occupied as well." She planned to take the last period of each day and allow them to work on the computer while she was available to help instruct and encourage individuals. She also enlisted a parent to help the students with software problems and other computer related inquiries. (3O)

Although the implementation went smoothly, Mrs. Evans wanted to maximize the benefits for all students. "When we do journals in the morning, I'm helping them and listening to them read; they finish at different rates, [and then] go off and choose an activity. But because
I'm still helping the slower ones, I'm not available to help kids on the computer, so they pretty well have to be independent with it. Doing games works well; they are self-directed and the kids can help themselves. But what I'm trying to think of is 'What can I have everyone working on so that I can be there to help if they need it. That's one thing that I find very difficult to address - the diversity, the range. It's very hard to be there for both ends of the spectrum.' She found that by using a parent helper and enlisting the help of the librarian she was able to better meet this diversity. (30)

She also planned to set up a time in the afternoon when some students would be allowed to complete their writing assignments on the computer while the rest were working on the same assignment with pen and paper, but she suspected that it would take some time before she and the students were ready for this: "If you're going to be using the computer with the young ones, you have to be available to help them if they need it. You can't be working with a small group, you have to be working with the whole class, so that you can move over to the computer if necessary. It's that juggling act of whole group, small group, and individual instruction that makes it difficult." The age and social maturity of the students affected the way she approached tutoring: "If we do a writing and drawing activity in the afternoon, then a couple of kids can be using the computer for the same purpose and I can circulate and help them when they need it. I can't be doing a math lesson and have them interrupt me to get help. With some of the older ones, if they get stuck, they will persevere - they will try to fix things. But with some
of the younger ones, they want me right away and it makes it
difficult." A few of the younger students needed a lot of guidance at
the computer and "tended to panic" if they weren't sure what to do
next. (4N)

Once she began using the word processing software, she needed to
intervene more because the program was more complicated to use
and because there were "such a lot of steps for pre-readers." She did
some direct teaching to demonstrate how the program works, and
had the whole group at the computers in the school lab so that they
could all see at once. After whole group instruction at the beginning
stages, however, she felt it was best to move back to individualized
tutoring so the students could progress at their own pace. (3O)

*Accessing software* was also impacted. The software was kept at the
computer so that students could choose any title they wanted. She
felt comfortable enough with the computer to allow her students to
freely explore the software. She wanted them to be self-directed in
their learning and found that some of the software extended this
opportunity to them. When a student discovered something new,
he/she often showed it to others in the class. Before long, she said,
the whole class would have an understanding as well. Because of
this potential, they were encouraged to work together and share the
knowledge they gained. (4N)

Although her intention was to allow them to make as many choices
as possible, she did not do this in a random way, but kept careful
track of what they were doing in order to find opportunities to guide their learning. Many of them, she said, recognized the programs from the year before and knew which ones they wanted to use. By the fourth interview, the students were comfortable with choosing and loading their own software: "Right now I don't interfere in the classroom when they choose (software). If they get part way into a program and decide they don't like it, they can choose another one, that's okay. But in the lab I am encouraging them to get to know the word processing software." (4N) "They tend to choose the games on the computer in the classroom because they know we don't have a printer on that machine. They tend to use the math games, the matching games, and phonics and so on, but then they like to use the "Best Bubble Blower" (Explore-a-Story) disks because they know how to go and print out in the lab. They realize they can't print out in the classroom so they go for the games on the classroom computer." (5D)

Mrs. Evans also reported impacts on her routines for student cooperation. She used a buddy system so that less mature students would have the advantage of working with older, more capable students and decided to try this with the computer. She thought it would work well to demonstrate new concepts on the computer to all of the students at once and then let the whole group practice what they had seen. She felt that they would need a lot of guidance, particularly at the beginning, when the youngest students were first learning a new program. (3O) As the term passed, she continued to let them choose their own partners on the classroom computer, and found that it worked well, although some problems arose once they
started word processing: "I do notice that the child who is more proficient with recognizing the letters tends to dominate. Sometimes I get concerned that some children aren't getting their turn at writing." She felt that she would have to continue to monitor this to make sure all students got equitable access. (4N)

Techniques for questioning the group were very minimally impacted. The reason was that she did not question the class while some students were at the computer, since they needed to be working independently, and would not be so engaged during whole group instruction. (5D) On the other hand, when questioning small groups during independent study, she found that the computer sometimes distracted them from paying attention, and so she needed to repeat the question.

Having students retell instructions in their own words worked well for the computer, although it was easier for older students. She would also model step by step when introducing a new concept and then have the children repeat the steps. "When introducing a new program on the computer, I'll only pull up a group of eight to ten children, no more than that, so that they can all see the monitor." She felt it was important to check with them to make sure that some children understood the instructions well, so that they would, in turn, be able to help other students. (5D) She found that, when giving instructions, it helped to use analogies that encouraged students to make real-world connections to whatever they were doing. For instance, she used a simple metaphor to remind them how to handle
the disk drive, "We called the disk drive the garage and I told them not to forget to shut the garage door - that made perfect sense to them and they rarely forgot."

Mrs. Evans reported that her general *evaluation* routines worked well when the computer was concerned, - she kept anecdotal comments, samples of their work, and interviewed students to understand what they were able to do. Comments were placed on index cards for future reference and possible inclusion on a report card; "if someone is really interested in the computer, and some are definitely more interested than others, I make comments about that on a recipe card." She also had some specific computer-related evaluation routines, as for example: "I keep a checklist of who's written a story and who's printed a story, so I'll know if I've got some that have printed several stories, or some that have only printed one, or even if they haven't printed anything yet." (5D)

To support evaluation routines and help monitor progress, she continued to date student journals on a regular basis. Although she had not specifically assigned them to write about their experiences with the computer, some children had voluntarily written about their enjoyment of the computer in their journals. (5D)

She continued to keep portfolios of student work although children liked to take their stories home. For the older students she kept a notebook for evaluative comments before the stories went home, as for example; "Carlos printed out a story with completely invented
spelling, but he could read it back for me; he remembered it from the week before. He called it up and worked on it and printed it out—so I just took a look at the printout and recorded a comment about where he is with his spelling. If he was writing in his journal, I would get him to use a dictionary, but on the computer I just want them to write." (5D)

Unanticipated Impacts on Instructional Purposes

Because she was precise about her goals, there were no unanticipated impacts to Mrs. Evans' instructional purposes. As a result, these purposes did not change during the implementation.

By the second interview, she was using drill and practice software along with the math and language games as originally intended for development of skills. She intended to move to word processing before the next interview and did so the following week. The computer lab was used in combination with the class computer for this purpose. (She continued using the class computer as an extension of what the students did in the lab, while having a selection of math and language games, because she felt that some of the beginning readers would be more comfortable using programs other than those used for word processing.) (2O) She attributed success using the computer lab to three factors: First, previous experience with young children in a computer lab helped her anticipate potential problems. Second, because many of the students had used the lab in the previous year, they remembered what to do. Third, the classroom computer had a positive effect: "they've had the
computer in the classroom for six weeks, and so they've had a chance
to get familiar with it." (3O)

Reliability in the lab, however, was an ongoing problem. The
computers could not be counted on to work consistently. "A goal for
January is to have all of the students working on the computers in
the lab at one time, provided all of the computers are working. Now
that's your unknown factor; you can have eight working in the
morning and only six by one o'clock." (4N)

Mrs. Evans felt that she had successfully integrated the computer
into her daily classroom environment. By the fourth interview most
students were familiar with much of the available software. "When I
first started using the computer, I would not have been comfortable
having it in the room. I must say, when the computer first came in,
my first reaction was, 'I'll leave that for the older students.' So I
think that anyone who has not had a computer in their room might
be reluctant or uncomfortable with it or find it a disruption. They
are afraid that the kids will become very attracted to it while you're
trying to ...focus on a task, - that they will keep running over to the
computer to watch." Because of her well established access routines,
however, she found this did not occur in her classroom. (3O) Having
a computer in the class posed few problems for her, mainly because
of her past experience with integrating computers and because of her
students' previous experience with many of the programs. "They're
quite independent with using the computer and it's not a problem at
all, it fits right in really well." (4O)
Seeking Assistance

When she encountered problems with the computer, she depended mainly on her past experience and sometimes on the computer helping teacher. She also learned from the students, as often they found "little tricks" to solve their software problems by trial and error and through sheer persistence. Other teachers came to her for advice, not, she said, because she had new ideas, but because she had learned a lot of practical coping strategies through experience. (4N)

Interpretive Summary

Compared to the other teachers, Mrs. Evans had the most complex purposes for computer use, and displayed a more sophisticated level of use. Two main factors that influenced implementation were her previous experience and her access routines. Because she had a computer in her classroom in the year previous to transferring to the study school, along with several years of experience with using computers with young children, few problems arose over the course of implementation: "These things are no longer unanticipated simply because they are things I have learned through experience and observation." Although minor unanticipated impacts occurred, they were not seen as obstacles, but merely variations to be dealt with as they arose. Her commitment to the implementation, along with her proactive planning style made the potential effects of the Trojan Horse much less significant.
Students were given frequent access to computers, and made it a "normal part of their lives." (4N) They were free to choose their partners and to explore the software, while more formalized instruction was saved for the lab. Her role included both direct instruction, guiding groups and encouraging individuals.

Discussion

Because teachers were asked to describe those routines that were critical to the successful functioning of the class, not all routines were reported. All said that routines were essential to the successful functioning of the class, and that they established management and instructional routines through direct instruction, modelling, and reinforcement.

Most management routines were relatively simple and occurred similarly in the various classrooms. All four interviewees, for instance, reported clear routines around calling the children to attention, and for start up at the beginning of each day to introduce activities, share news and reinforce calendar concepts. Three of the teachers described routines to simplify the ongoing task of managing materials needed for "hands on" learning, whereas two highlighted clean up routines related to managing materials and giving students responsibility for maintaining a clean environment in the class.

Instructional routines were usually more complex and, as such, were described and interpreted differently by each of the interviewees. Some commonalities, however, can be specified. All four teachers, for
instance, felt responsible for establishing and maintaining practical evaluation and assessment methods for student progress. Three reported routines around students finishing early; because of the variety of open-ended activities in these classrooms, it was expected that students would finish at different times and would have to make independent choices about what to do next. Two teachers reported routines for giving instructions; students were at the beginning of their schooling, and needed help to understand and act upon directions.

Although each of the teachers approached the implementation in their own way, there were four distinct levels of computer use. Mrs. Freer held very general and vague purposes, set the computer up as an independent centre, and depended on the students to learn how to use the software themselves. Mrs. Arthur had slightly more complex purposes, but also did little more than use it as one of several independent centres in the room. With more complex purposes in mind, Mrs. Douglas was unable to achieve them because she sponsored a student teacher during the start up of the implementation. Mrs. Evans had prior experience with a classroom computer and used it in a more sophisticated, integrated way in her classroom.

Because there were four distinct levels of use, unanticipated impacts were dealt with in different ways. Mrs. Freer and Mrs. Arthur tended to ignore the implications or problems created by the Trojan Horse, and little implementation occurred. In the case of Mrs.
Douglas, one implication at a time was dealt with, therefore making the implementation run much longer than anticipated. Mrs. Evans anticipated implications, and her experience counteracted the potential effect of these impacts.

This chapter provided a depiction of each of the teachers in the study, their computer experience and classroom context and the impacts of computer use on classroom routines and instructional purposes. The next chapter provides an analysis of commonalties across the cases, and further explanation of the levels of use and their impact on the implementation.
CHAPTER FIVE

COMMONALTIES ACROSS THE CASES

This chapter has two main purposes. First, it answers the research question - In an elementary school where one computer per classroom is being implemented, what are teachers' perceptions of the nature and range of impacts on routines and instructional purposes? - from the perspective of similarities across the four cases presented in Chapter Four. Second, it relates these impacts to four levels of computer use evident among the four teachers involved in the study.

Nature and Range of Unanticipated Impacts

The teachers had little prior experience discussing classroom routines, and so had some initial difficulty explaining how these were shaped by computer use. Over the course of four months, however, they gained experience in discussing unanticipated impacts in both positive and negative terms. Table 1 (following page) is included to illustrate the range of impacts of computer use as well as their frequency. It is not intended, however, to summarize their intensity. In some instances the relationship is reciprocal - that is, computer use affects classroom routines, and these in turn have a significant effect on implementation.
TABLE 1 - UNANTICIPATED IMPACTS ON ROUTINES AND INSTRUCTIONAL PURPOSES

<table>
<thead>
<tr>
<th>Impacts on Management Routines</th>
<th>Freer</th>
<th>Arthur</th>
<th>Douglas</th>
<th>Evans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Calling Attention</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Management of Materials</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Seeking Assistance</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Start up</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Movement</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Totals</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Impacts on Instructional Routines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Student Cooperation</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Giving Instructions</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Finishing Early</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Integrated Themes</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Reinforcing Routines</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Tutoring</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Accessing Software</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Questioning</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Totals</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>
### Impacts on Instructional Purposes

<table>
<thead>
<tr>
<th></th>
<th>Freer</th>
<th>Arthur</th>
<th>Douglas</th>
<th>Evans</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of Skills</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>4</td>
</tr>
<tr>
<td>Motivation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Word Processing</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Curricular Integration</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Literacy</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Managing Student Needs</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Accountability</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Student Cooperation</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total Impacts Reported</strong></td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

### Unanticipated Impacts on Management Routines

Although the need for *access* routines did not exist before the addition of the computer, the process of establishing them was significant to the success of implementation. Access included daily times when children were allowed to use the computer, and the way in which they were expected to take their turns. Each teacher found it necessary to design and then refine routines that permitted the
group to access a single computer. Mrs. Douglas, for instance, was surprised that by the second month, no one had fought over length or frequency of turns, and that students were generally responsible in their use of the computer. This was because she organized the computer as a centre, and students were well acquainted with the access routines for the other classroom centres; there was a limit on how many were allowed to use each centre, and a routine was in place for taking turns and cleaning up. Later, however, she found that competition increased as students' interest in the computer increased, and she was forced to formalize a more structured method of taking turns.

On the advice of Mrs. Evans, who had previous experience with classroom computers, the other three teachers divided their classes into five groups, one for each day of the week. Each group was allowed access on their day before school, during recess, lunch, and when they finished their other work. This increased access time and eased competition, allowing the children to make better use of the computer. However, Mrs. Evans was still concerned with this routine because the centre remained unused for portions of the day.

Three teachers described impacts on their routines for *calling* students to *attention*. They found it difficult to get the attention of students working on the computer because it demanded their focus. Silently raising a hand and waiting for them to do the same, for instance, didn't work well, because they were absorbed in what they were doing and easily missed the signal.
Three interviewees also described impacts on their routines for managing material, especially to organize, store, and distribute the software. Two felt that, although their students participated in routines to manage other classroom materials, they were either too young or inexperienced to handle and maintain the software. Therefore, these teachers looked after the management of hardware and software themselves.

Routines for having students seek assistance when they encountered problems were impacted for three teachers. Although some impacts were negative, two of the teachers reported that their routines worked well where the computer was concerned. This was another case where there was a reciprocity between impacts on routines and computer implementation. Mrs. Arthur, for example, had a routine where one competent student in each of the learning groups helped the others; this provided a way to solve problems when she was unavailable. Mrs. Evans had a similar routine, although she also had two designated computer experts whom students could call upon if their group leader was not able to help. This eased the pressure on the teachers having to solve every computer problem as it arose, giving them freedom to attend to other children.

Two teachers reported impacts on routines for controlling movement around the classroom and in one case there was a reciprocal effect. Giving the children a five minute warning before moving on to the next activity worked well for those using the computer; they had
enough time to finish what they were doing and get ready for the subsequent activity. Because students were previously acquainted with this routine it had a beneficial effect on computer use.

As well as impacts on management routines that were common to two or more teachers, one was unique. Mrs. Arthur reported that the students using the computer first thing in the morning were sometimes so interested in what they were doing that they would not comply with the *start up* routine. Once she adapted the routine so that each group had an incentive to be ready, she never had to speak to the persons at the computer, because others would encourage them to get ready on time.

**Unanticipated Impacts on Instructional Routines**

All interviewees felt the computer had a significant impact on *evaluation* routines. Mrs. Arthur's usual kinds of evaluation, primarily focussed on printing and writing skills, were not well suited for the computer. Like the other teachers, her methods of assessing computer use were informal and she did not comment on the first report card, whereas Mrs. Douglas intended to develop more formalized routines to assess student progress in the second term.

Two teachers reported negative impacts on their routines for *student cooperation*. Mrs. Evans, for example, initially let her students choose their own partners, but found that those who were more proficient with letters and numbers tended to dominate when word processing and she had to intervene by structuring routines that
ensured equitable access. All said, however, that the computer actually helped to motivate students to work cooperatively and solve problems together.

Two teachers reported impacts on routines for giving instructions. Some of Mrs. Evans' students found it difficult to follow instructions when using the computer, because the complexity of some of the programs necessitated involved sets of instructions. Younger students had trouble comprehending such instructions and so new routines were needed to simplify the process.

Two teachers mentioned impacts on routines for finishing early. Mrs. Freer said that the computer was a popular centre and motivated some students to finish other work early, while Mrs. Evans said that she needed to adapt her routine so that early finishers would not monopolized the equipment.

Because the computer worked well with her usual methods of reinforcing routines for non-compliant students, Mrs. Douglas used it to good advantage. Mrs. Evans reported having to use specific routines to reinforce correct behaviour while using the computer.

There were also some unique impacts on instructional routines. Mrs. Arthur reported that her organization of integrated themes had an adverse effect on computer use since the computer was not seen to fit the themes presented and so was not used during these times. Mrs. Evans was frustrated that her usual method of tutoring was not
always appropriate, since it was inordinately time consuming to work with them individually at the computer. She also found that some children needed flexibility in accessing software, and changed the routine to accommodate their needs. Finally, she noticed that during questioning in small groups, she would often need to repeat a question to students focused on the computer.

Unanticipated Impacts on Instructional Purposes

Computer use not only impacted on classroom routines, but also on a range of planned purposes. Some of the purposes were not achieved to the extent and within the time frame as originally intended. Also, initial priorities given to purposes changed - some became more important while others became less. All participants reported impacts on their purposes for development of skills. They found that using the computer to reinforce math and language arts took longer than anticipated, and was not accomplished well because of a perceived limit in the range of software. Mrs. Freer further complained that competing priorities had given her trouble in meeting the diverse needs of her students; this prevented her from integrating the computer with the curriculum. Mrs. Arthur expressed a similar sentiment: "as far as using it as a tool for math in the classroom, I haven't been able to do that yet, but I would like to spend more time on this." She attributed some of the problem to the extra time necessary for planning: "the math program needs to be so individualized and I have such a spread of abilities in my class."
Both teachers who reported that the computer had a positive effect on other subject areas felt that it motivated students to get their other work done quickly. A group of Mrs. Arthur's students completed their work sooner and more accurately in order to get extra time on the computer, and it maintained interest for students with special needs and induced them to do well.

The two teachers who used word processing found that unanticipated problems set them back and it took longer than expected to accomplish their purpose. Competing priorities prevented Mrs. Douglas from doing word processing as expected, and, although Mrs. Evans began using word processing in the third month, she also continued to use math and language games because some students were beginning readers.

Two teachers reported impacts on their purposes for curricular integration. Although Mrs. Arthur claimed she intended to enhance her program by integrating software titles, she did not attempt to do so because of complexity and time demands. Mrs. Evans, on the other hand, was able integrate the computer quickly and successfully so that it enhanced her program.

Impacts on managing student needs were reported by two teachers. The computer strongly impacted Mrs. Arthur's handling of special needs students, while Mrs. Evans reported having difficulty using the computer while attending to the diversity in her classroom.
A number of unique impacts on instructional purposes were also recorded. Mrs. Freer reported that her goal of promoting student literacy was impacted in a positive way because many of her students became motivated. For Mrs. Douglas, student accountability and cooperation were enhanced.

The four teachers perceived unique and similar impacts on their routines and instructional purposes. These varying effects on implementation can be related to four levels of computer use.

**Impacts and Levels of Use**

Perceived impacts are related to four distinct levels of use, differentiated on the basis of the teacher's clarity of purposes and complexity of implementation over time:

1. Mrs. Freer used the computer in very simple ways. It became one of her classroom centres, whereby the students were encouraged to "freely explore" the software whenever their turn came up. Her purposes remained vague and actual use did not become more sophisticated as the implementation progressed. After four months, the computer was used almost exactly as it had been in September. Students used language and math programs for simple drill and practice and games exclusively.

2. Although Mrs. Arthur's purposes were slightly more complex and specific, she did not achieve them during the study. Like Mrs. Freer,
she used the computer as one of many centres, where students used an unchanging selection of drill and practice software. Although she occasionally employed word processing software, this was mainly to keep her gifted student and her learning disabled students occupied. Her use of the computer during implementation did not change.

3. Mrs. Douglas had more precise purposes for the computer than either of the first two teachers and she was able to attain most of these during the study. Her students used the computer for a combination of drill and practice, simulations, and word processing. As the study progressed, she used the computer in more sophisticated ways and implementation, although more difficult, had more of an impact. By the end of the study, she had begun to plan more creative ways of using the computer and intended to implement her plans in the new year.

4. Mrs. Evans had previously implemented a computer and used this experience to help create sophisticated, albeit demanding, purposes. She was able to adapt her practice as the implementation demanded and was creative in the development of her purposes. Although she was more experienced than the others, her commitment was strong and she put more time and effort into the implementation in order to achieve her purposes.

These levels of use give rise to a number of questions: What factors affected these levels? Why were teachers slow in exploiting the educational potential of the computer? Why was implementation not
a higher priority? As mentioned in Chapter 2, barriers such as differential access, inadequate quality and quantity of software, inadequate teacher preparation, and lack of conclusive research contribute to making implementation difficult. Table 2 displays the teacher identified factors, both positive and negative, that affected implementation.

TABLE 2 - FACTORS AFFECTING LEVELS OF IMPLEMENTATION

1. Circumstantial
   1.1 Lack of time
   1.2 Competing demands
      1.2.1 Student teacher
      1.2.2 Special needs students
      1.2.3 Challenging class
      1.2.4 Curricular changes
   1.3 Organization of centres
   1.4 Hardware or software failure

2. Institutional
   2.1 Computer helping teacher
   2.2 Supporting inservice
   2.3 Teacher collaboration
   2.4 Limited access

3. Attitudinal
   3.1 Personal relevance
   3.2 Clear goals
   3.3 Awareness of complexity
   3.4 Motivation/commitment

Although these factors are listed separately for purposes of discussion, they are interdependent and did not affect each teacher's computer use to the same degree.
Circumstantial Factors

Circumstantial factors are related to the classroom context. Lack of time, for instance, was identified as a limiting factor by all four teachers. There was not enough time in the course of any given day, or over the course of the term, to implement the computer as effectively as they would have liked. Not surprisingly, the time factor was related to other circumstantial factors such as competing demands and equipment failure. Lack of time is a socially acceptable, and commonly identified, barrier to implementation. Using it as an excuse for avoiding implementation may reflect a teacher's priorities, or lack of commitment to and understanding of the innovation.

All of the teachers but Mrs. Evans commented on the negative effect of competing demands on implementation. Mrs. Arthur said that the Trojan Horse effect lay more in the rival encumberments that kept her from using the computer effectively; these unanticipated competing demands were more limiting than specific computer impacts. Mrs. Douglas was not able to introduce word processing when intended, largely due to hosting a student teacher; time demands and planning priorities took precedence over implementation of the computer, particularly because the new teacher required extra help with classroom management. Mrs. Arthur's two students with special needs took time away from other priorities, including computer implementation. Both Mrs. Freer and Mrs. Arthur felt frustrated by the challenging needs of their classes.
Mrs. Freer felt that her class was more needy than any she had experienced, and Mrs. Arthur described her students as "an unusually challenging class" who kept her busy establishing and reinforcing behaviour routines.

Although all of the teachers were faced with curricular changes, only Mrs. Freer and Mrs. Arthur described these changes in a negative way. Both felt that many of the new ideas were too time consuming and did not allow for enough skill development. Mrs. Arthur thought that these changes prevented her from spending enough time on development of content with the students. She suspected the computer might help in dealing with curricular change, but wasn't clear as to how this might occur and did not pursue this potential.

The validity of centres is unquestioned in the primary grades, which means that they can be used for almost any purpose. While all four teachers initially organized computer use as one of many centres, two did not move beyond a minimal centre format. Using it in this way was easy for Mrs. Freer and allowed her to demonstrate that she was upholding the school-wide expectation, while at the same time avoiding any fundamental change; she was content with this arrangement and did not plan to change her instructional purposes. Mrs. Arthur made plans to move to more complex uses, but never carried through - the computer was treated as a centre for motivating students, often for simply keeping them occupied rather than exploring its potential. While the student teacher was in charge of the class, Mrs. Douglas used the computer as a centre and then
moved to integration once the practicum was completed. Mrs. Evans allowed the students to freely explore the software in a centre format in order to assess their competency and interest levels, before moving into more complex uses.

Two teachers found that hardware and software failure checked implementation. While attempting to start word processing, Mrs. Douglas had difficulty because the software had been inadvertently modified and did not work as expected. The problem was exacerbated by the fact that it appeared to be working properly, until more advanced features were tried. The unanticipated breakdown of the hardware had an impact on Mrs. Arthur because she depended upon it to motivate her gifted and learning disabled students.

Institutional Factors
Institutional factors pertain to the school environment. Although a part of the context for all four teachers, these factors did not affect each person in the same way.

All of the teachers depended on the computer helping teacher to supply appropriate software, to set up the hardware, and to solve equipment malfunctions. They did not, however, utilize this person as well as they might have. Although he was both enthusiastic and knowledgeable, his responsibilities as a classroom teacher and vice-principal left him little time to be proactive about implementation. As a result, the majority of his extra time was spent keeping the
software organized and the equipment running. Because of these limitations, he was not able to significantly support teachers in integrating the computer into their classrooms.

There was also a lack of supporting inservice to help the teachers integrate the computer. Although the decision to place a computer in each class was made at a staff meeting in the previous spring, little thought was given to implementing a school-wide plan that would make the decision a success. Professional development days were not focussed on computer implementation nor was there any planned follow-up to deal with teacher concerns.

Although teachers discussed computer problems and solutions with their colleagues, collaboration was not regularly scheduled. It occurred only on an informal, irregular basis. This may have been because of limited time, but also, by asking for help, teachers put their professional reputation at stake. Peer support was thus limited to learning how to operate the hardware and software, rather than how to use the technology more productively.

Another factor which adversely affected implementation was limited access to both hardware and software. Problems raised by having a class of students access a single computer were reported by all teachers. All said that lack of sufficient hardware and software prevented them from using the computer as they planned. This may have been an excuse not to attempt more complex purposes, however, for only Mrs. Douglas and Mrs. Evans envisioned how they
might use extra computers if they were available. Although Mrs. Arthur insisted that limited access to software prevented her from attaining her purposes, she was unaware of many of the titles in the school other than the ones supplied by the computer helping teacher. Indeed, three of the teachers did not make use of the available software as well as they might have.

**Attitudinal Factors**
Attitudinal factors refer to each teacher's disposition regarding the implementation. Although circumstantial and institutional factors set the context for implementation, attitudinal factors largely drive its success or failure. They determine whether or not a teacher takes action when faced with circumstantial or institutional barriers.

*Personal relevance* defines the way that each teacher understands the need for the innovation. Fullan (1991) says that perceived need is an obvious factor, although the "fit" between an innovation and need may not become apparent until implementation actually begins, and even then may not be straightforward:

First, schools are faced with overloaded improvement agendas. Therefore, it is a question of not only whether a given need is important, but also how important it is relative to other needs. Needless to say, this prioritizing among sets of desirables is not easy, as people are reluctant to neglect any goals, even though it may be unrealistic to address them all... Second, precise needs are often not clear at the beginning, especially with complex changes. People often become clear about their needs only when they start doing things, that is, during implementation itself. Third, need interacts with the other factors to produce different patterns. Depending on the
pattern, need can become further clarified of obfuscated during the implementation process. (p. 69)

In an environment of competing priorities, the need to use the computer for anything more than a minimal classroom centre was only one of many considerations when planning programs. In the case of Mrs. Freer, for example, the implementation came late in her career. With retirement impending, she made a token attempt to become familiar with the computer, and complained that competing priorities prevented her from attaining instructional goals. It was considered an add-on, rather than an integral part of her instructional program because perceived need was low: "I'm not happy with what's going on in the classroom with the computer so far and it's mainly my fault because I haven't organized everything. The whole class is taking too long to get organized. Up until last week we didn't know if we were going to reshuffle the whole school (because of increased enrollment) ...As far as the work load goes, we've been doing that, but not any of the extra things." (3N)

Lack of clear goals often characterizes implementation, and Fullan makes the point that clarity of goals and means is a multi-faceted and "perennial problem" that needs to be carefully considered; even when teachers agree that a change is needed, it is not always clear how they should change practice or what should be done differently. (p. 70) The steps necessary for using the computer for more complex purposes such as word processing or problem solving are never precisely laid out. Support for teachers in the study was limited;
very little was available to help them clarify how to integrate the computer into the curriculum or how it might affect or be affected by the classroom culture.

A further complication is "false clarity," which "occurs when people think that they have changed but have only assimilated the superficial trappings of the new practice." (Fullan, 1982, p. 35) This is illustrated in the case of Mrs. Freer, who felt that she adequately understood the computer as a centre in her classroom. Implementation occurred without much frustration because she used the computer in simple ways. The vague purposes that Mrs. Freer and Mrs. Arthur held over time demonstrated that they did not take the computer seriously as a way to solve instructional problems typical of primary education, such as diverse needs and abilities of the students and individualization of the curriculum. As Fullan says,

False clarity... occurs when change is interpreted in an oversimplified way; that is, the proposed change has more to it than people perceive or realize... In Canada, new or revised provincial curriculum guidelines may be dismissed by some teachers on the grounds that "we are already doing that"; but this is another illustration of false clarity if the teachers' perception is based only on the more superficial goal and content aspects of the guidelines to the neglect of beliefs and teaching strategies. (Fullan, 1991, p. 70)

Implementation difficulties are exacerbated by unclear intentions and false clarity.
A third attitudinal factor refers to awareness of the perceived complexity of the innovation. Fullan describes this as "the difficulty and extent of change required of the individuals responsible for implementation." (p. 71) Although complexity is dependent upon each teacher's starting point, any change can be investigated in relation "to difficulty, skill required, and extent of alterations in beliefs, teaching strategies, and use of materials." (Fullan, 1991; p. 71) All of these may come into play during computer implementation, depending on the instructional purposes of the individuals involved. Mrs. Douglas and Mrs. Evans, for instance, found that complex purposes brought more unanticipated impacts and, therefore, made implementation more difficult. Because they better understood the innovation and its potential, however, these difficulties were dealt with successfully.

Mrs. Freer found that it caused her few concerns or frustrations and reported the fewest surprises because she focussed primarily on drill and practice and did not attempt a more complex level of implementation (i.e., for word processing, simulation, or problem solving). She provided students with software that required little, if any, teacher intervention, and allowed them to use it on demand; this worked well, although little was attempted in terms of reflecting upon and changing practice. On the other hand, where teachers pursue more complex purposes, there may be more negative impacts. Although Mrs. Evans' case was unique because of her previous experience with a classroom computer, unanticipated impacts still occurred on a continuing basis because of her more sophisticated
purposes. Despite previous experience, she worked harder at implementation than any of the other teachers in order to achieve more difficult goals.

Since there were no school-wide expectations for, or methods of, assessing the computer program, formal accountability for all four teachers was low; they were not extrinsically motivated to carry out complex purposes. Consequently, the personal commitment or motivation factor was a primary influence to their practice, and was intertwined with other circumstantial, institutional and attitudinal factors already discussed. Four levels of commitment, ranging from weak to strong, were apparent. Where the commitment was weak, purposes were kept simple; where commitment was strong, more complex purposes were attempted.

Having little sense of what the children were doing with the computer, Mrs. Freer's commitment was low. Since it was not clear to her what steps she might take in order to improve her effectiveness, she was not motivated to attempt to change. Although slightly more committed because of previous experience, Mrs. Arthur maintained a "wait and see" attitude hoping that if she waited long enough, implementation problems would become less important or would be solved by others. Mrs. Douglas, being a computer user, intuitively felt that the computer had potential and was motivated to plan for effective use, even in the face of barriers. Mrs. Evan's positive experience with computers motivated her to work harder
than any of the others to achieve her complex purposes; she had a clear vision of what was desirable and how it could be attained.

Summary
Common and unique unanticipated impacts on routines and instructional purposes which varied in range, frequency and intensity were reported by the teachers in the study. Effects of these impacts were related to four distinct levels of use: Where use was simple, impacts were less frequent and less pervasive, whereas where use was more complex, impacts were more frequent and pervasive. These levels of use were also related to factors that influenced implementation, including circumstantial, institutional, and attitudinal. Although these three are interdependent, attitudinal factors seemed to have the most influence on teacher practice. Not surprisingly, those with a higher level of use had a greater commitment to implementation.

Attitudinal factors helped to define the teachers' threshold for change (Werner, 1990). The threshold is defined by Werner as the decision point at which the perceived benefits are outweighed by the perceived costs. Mrs. Freer's threshold was low because she was near retirement, had no previous computer experience, didn't request a computer in her classroom, and saw it as a competing problem to be dealt with in her busy schedule. Integration was perceived to be high in cost (in terms of time and energy) and low in benefit (for herself and her students) and therefore she was content with operating under a "false front": implementation would appear
to be happening to any casual observer, whereas in reality very little change actually occurred.

Mrs. Arthur's threshold for change was also low. She had lost interest in computers earlier in her career, and her teaching style focussed on whole group learning rather than on individual needs. She perceived the implementation to be high in cost and slightly higher in benefit than had Mrs. Freer. Although she felt that the computer held educational potential, competing demands were given a greater priority.

For Mrs. Douglas, a higher threshold for change allowed her to overcome barriers and achieve more complex purposes. As a computer user who experiences the personal benefits on an on-going basis, she was committed to the successful use of computer in the class, believed in its potential, and was willing to adapt her practice. Although she saw the implementation as high in cost, she felt that the benefits were worth the effort.

Mrs. Evans' threshold was also high because past experience with a computer in the class allowed her to experience its benefits. She handled surprises confidently, considered herself to be an "avant garde" teacher, was interested in change, and understood the potential of the technology at her disposal. Although she worked hard to make the innovation a success, she saw the cost of implementation as acceptable in terms of the high benefits.
The next chapter provides a summary of the study, assesses the Trojan Horse hypothesis, outlines of some implications for implementation planning and support, and identifies the need for further research.
CHAPTER SIX

SUMMARY AND IMPLICATIONS

This chapter briefly summarizes the study, assesses the Trojan Horse hypothesis, and provides some implications for supporting computer implementation and for further research.

Summary
The study's central question was: In an elementary school where one computer per classroom is being implemented, what are primary teachers' perceptions of the nature and range of unexpected impacts on routines and instructional purposes? Four primary teachers were interviewed five times each over a four month period (September through December, 1991), in order to obtain their ongoing perceptions of what unexpected impacts arose as they were setting up their classroom routines.

The major findings can be summarized around three sub-questions:

1. What instructional purposes for computer use were planned?
2. What unanticipated impacts occurred and how did they affect management and instructional routines?
3. How did unanticipated impacts affect instructional purposes for the computer?
While there were many similarities in the instructional purposes reported, two of the teachers held vague goals, while the other two were more precise about how they wanted to use the computer. All four teachers planned to use the classroom computer for skill development in math and reading; three intended to use it to promote computer literacy, "thinking" skills, and word processing; and two for motivation. These purposes were expressed early in the term, and others emerged as the implementation progressed.

A range of unanticipated impacts on management and instructional routines were reported. All four teachers experienced impacts on the management routines of organizing access to the computer; these routines were discussed at length by the teachers because they not only had to be established, but also modified as the implementation progressed. Three teachers reported impacts on calling students to attention, the management of materials, and how students were to seek assistance. Two teachers reported impacts on routines for managing movement around the classroom and one on start up routines. Regarding instructional routines, all four described impacts on evaluation, and two on organizing student cooperation, giving instructions, reinforcing routines and finishing early. At least one teacher reported impacts upon the routines for integrating themes, tutoring individuals, accessing software, and questioning the group.

Instructional purposes were impacted in several ways. Although all four teachers, for example, initially used the computer for
development of skills (particularly in math and language arts), two moved to more complex purposes as the implementation progressed: word processing and curricular integration (using software to enhance some curricular areas). Other uses included literacy (learning about computers), motivation (increasing interest in particular curricular areas), managing student needs (aiding individuals and students with special needs), accountability (making the students accountable for work completed), and student cooperation. The two teachers who held simple purposes for the computer reported fewer impacts of less intensity upon these purposes, whereas those with complex purposes perceived more pervasive impacts.

**The Trojan Horse**

The study assumed Olson's (1988) hypothesis that unanticipated impacts of computer use upon classroom routines precipitate difficulties for implementation. Although its effects were noted, the Trojan Horse was not a major factor in implementation; those unanticipated impacts that were reported were relatively minor in nature. There are three reasons for this.

First, the nature and intensity of the Trojan Horse were dependent upon levels of use. Initially, all four teachers used the computer in ways that allowed it to fit the existing culture without much difficulty. However, two teachers moved into more complex purposes which led to higher levels of implementation becoming apparent over the course of the study, and the effects of
unanticipated impacts were more deeply felt. Integrating the computer into the curriculum, using it as a tool for graphics and word processing, and publishing written work were complex enough to allow unanticipated impacts to occur. The teachers' commitment was such, however, that they persisted, even though successful implementation meant extra work on their part. In the other two cases, simple and general purposes made implementation relatively straightforward - little change was attempted and this meant that little change in practice occurred. For them, the Trojan Horse was of minor consequence, and their frustration with the computer was fairly low.

Second, the Trojan Horse was only one of several factors affecting implementation. Circumstantial barriers included a perceived lack of time, competing demands, and hardware or software failure, whereas institutional barriers related to a lack of teacher support, collaboration, and inservice. Although all of the teachers faced similar circumstantial and institutional factors, the ways in which they dealt with them were related to attitude. These attitudinal factors were essential to the success of the innovation and directly related to levels of use. Implementation was adversely affected in two cases because teachers did not recognize the need for computers, hold clear goals, or feel committed to the innovation. In the other two cases, teachers were more committed and their threshold for change was higher.
Third, there was sometimes a poor match between software and purposes for computer use. A factor that may account for this is the nature of primary classroom culture. Primary teachers often plan and describe their purposes in quite general terms, without referring to specific ends and means. In contrast, often software is designed to serve very specific purposes. This is particularly true of drill and practice programs, which are well suited to narrow purposes. As a result, there may be at times a poor match between the teachers' general purposes and some software. Conversely, application software such as graphics and word processing are more adaptable to teachers' general purposes. Where the latter kinds of programs were used, teachers found that the computer could be more closely matched to their curricular goals.

Implications
Because the innovation (one computer per classroom) represents a school level change, there are implications for the role of the school-based computer helping teacher. All of the teachers in the study mentioned the importance of this role to them. In order to facilitate this complex change with colleagues, the person in this role needs to be aware that there are various factors which influence implementation and that more is required than just distributing hardware and appropriate software. Three points are particularly relevant for this role in relation to primary teachers.

First, the computer helping teacher can encourage colleagues to think in terms of clear, precise purposes for computer use. This may
require opportunities for discussion and collaboration among teachers when beginning to plan goals for the year. They may also be encouraged to start with manageable goals and simple programs as they gain familiarity and until routines are established, before moving into more complex applications related to graphics, word processing and simulations. Fullan (1991) cautions, though, that: "Simple changes may be easier to carry out, but they may not make much of a difference. Complex changes promise to accomplish more... but they also demand more effort, and failure takes a greater toll." (p. 71) Before attempting more complex changes, teachers may need to break the innovation into "components and to implement them in a divisible and/or incrementable manner." (p. 71) The computer helping teacher can aid in this process by being involved at the early planning stages, facilitating a school-wide plan and requesting proactive help from district support staff (who may be able to supply articles on computer implementation, provide demonstration lessons with students, and facilitate professional development planning sessions).

Second, the computer helping teacher can encourage ongoing recognition that complex uses may precipitate more unanticipated impacts upon classroom routines and purposes. Through such awareness, teachers can then anticipate, recognize and deal with impacts effectively. However, teachers cannot simply be encouraged to monitor impacts on their routines and modify accordingly. They may need support through inservice of various types (i.e., training, classroom observation) to become proactive about planning for
changes in practice brought about by computer use. They could benefit from setting aside some time to learn the programs by running them with colleagues, while being willing to let students help them get better acquainted with software. (Often students have spent time getting to know their favorite programs intimately and are pleased to share this knowledge.) Regular support groups of teachers may include those who have experience implementing a classroom computer. Computer helping teachers can facilitate the functioning of these groups by listening carefully to their concerns and responding to requests.

Third, an obvious point is that in order to help teachers become aware of purposes and impacts, and to facilitate school-based support systems, the computer helping teacher must have time to do this adequately. Time is needed not only for maintenance of equipment, but for school-wide and classroom planning. In this study, teachers called for more support, not only in using computers and accompanying software, but in integrating the computer into the daily classroom curriculum. Unfortunately, the helping teacher had little or no time to fulfill his role. He needed specific time away from other duties to be able to support teachers as they progressed through the process of implementation.

While computer helping teachers could be effective in aiding implementation, they should be cautious about becoming distracted by the technology. For in the end, it is teachers, not technology, that are important to the improvement of learning. As Olson says: "The
computer on its own is not going to create improved educational opportunities in schools... Improvement will come as teachers see how computers can help them reform their practice and as they see how this can be done in actual and imperfect school systems." (1988, p. 55)

Further Research

Until the values and the problematics of classroom routines are taken more seriously, until the ideas and assumptions of software are made more transparent, and until illusions about computers are punctured, it will be difficult for innovators and researchers to converse. Action research into these issues by teachers and outsiders is called for - inquiry which is sensitive to their complexity. (Olson, 1988, p. 124)

This study focused on teachers' perceptions rather than classroom observations. The difficulty with the former is that teachers are not experienced in articulating the effects of unanticipated impacts upon their classroom routines. Research of an observational nature would allow for assessment of the pervasiveness of these effects of unanticipated impacts of computer use upon classroom routines. In particular, the Trojan Horse may be different in the intermediate as opposed to the primary classroom because of different routines for organizing students, time, space, and subject matter; research in the intermediate grades may therefore be justified.
REFERENCES


Appendix A

PILOT TEACHER SURVEY (JUNE, 1991)

These questions refer to the use of the computer in your classroom over the course of the past year. Do not put your name on this sheet. Responses are anonymous.

Male__  Female___  Grade(s)___

How many years have you been using the computer with students?___

1. List the two most important instructional purposes that you were trying to achieve with the computer in your classroom this year.

Most important:

________________________________________________________________________

Second most important:

________________________________________________________________________

2. List the two major difficulties you encountered in achieving these purposes.

Most important difficulty:

________________________________________________________________________

Second most important difficulty:

________________________________________________________________________

3. Placing a computer in the classroom may cause unexpected (surprising, unplanned) things to happen:

a) List the two major unexpected difficulties of computer use in your classroom over the course of this year. (e.g., organization of time, space, students, subject; teacher planning; instructional style; management procedures; student social relationships, etc.)

First unexpected difficulty:

________________________________________________________________________

Second unexpected difficulty:

________________________________________________________________________

b) List the two major unexpected benefits of computer use in your classroom over the course of this year. (e.g., organization of time, space, students, subject; teacher planning; instructional style; management procedures; student social relationships, etc.)

First unexpected benefit:

________________________________________________________________________

Second unexpected benefit:

________________________________________________________________________

Thanks for your time and effort in answering the questions.
Appendix B

PILOT TEACHER INTERVIEWS (JUNE, 1991)

Background Information
- What is your teaching experience?
- What hardware do you currently have in your classroom?
- What software are you using?
- How is this software organized/accessed?

1. What were the two most important instructional purposes that you were trying to achieve with the computer in your classroom this year?
   - For what purposes and how did you plan to use the computer?
   - What routines to accommodate these purposes have been set up over the course of the year?

2. What were the two major difficulties in achieving these purposes?
   - What did you do to respond to these difficulties?
   - What routines for computer use have been most difficult to set up and maintain over the course of the year?

3. What were the major unexpected difficulties of computer use on your instructional and management routines over the course of the year. (For example, organization of time, space, students, subjects; instructional style; management procedures such as attention and transition control.)
   - How did the use of the computer interfere with existing classroom instructional routines?
   - How did the use of the computer interfere with existing classroom management routines?
   - How did you change (modify/add/delete) your instructional or management routines in order to implement the computer in your room?
   - Were there any other unexpected adverse effects?

4. What were the major unexpected benefits of computer use on your instructional and management routines over the course of the year. (For example, organization of time, space, students, subjects; instructional style; management procedures such as attention and transition control.)
   - How has computer use enhanced instructional and management routines?

5. How did these unexpected impacts affect implementation of the computer in your classroom?
   - How were these difficulties related to your planned instructional purposes?
   - Have you been surprised by other benefits that have arisen from using the computer?
Appendix C

UNANTICIPATED IMPACTS ON ROUTINES AND INSTRUCTIONAL PURPOSES

Pilot Study (June 1991)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impacts on Management Routines</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>4</td>
</tr>
<tr>
<td>Calling Attention</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td>Management of Materials</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Seeking Assistance</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1</td>
</tr>
<tr>
<td><strong>Impacts on Instructional Routines</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Cooperation</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Giving Instructions</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>2</td>
</tr>
<tr>
<td>Finishing Early</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Tutoring</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Accessing Software</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>2</td>
</tr>
</tbody>
</table>

A = Gr. 1/2 Female  B = Gr. 2/3 Female  C = Gr. 6 Female  D = Gr. 7 Male
Appendix D

TEACHER SURVEY (SEPTEMBER, 1991)

These questions seek your purposes for the computer in your classroom over the course of this year. Refer only to your classroom. Do not put your name on this sheet, as responses are anonymous.

Male___ Female___ Grade(s)___

How many years have you been using the computer with students?___

List the three most important instructional purposes that you intend to achieve with the computer in your classroom this year.

Most important purpose:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Second most important purpose:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Third most important purpose:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Thanks for your time and effort in answering the questions.
Appendix E

INSTRUCTIONAL PURPOSES FOR COMPUTER USE

SURVEY RESULTS N= 12 (SEPTEMBER, 1991)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>1st Choice</th>
<th>2nd Choice</th>
<th>3rd Choice</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Familiarizing students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with hardware and software.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Encouraging students to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>complete assignments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>quickly and efficiently.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill Building</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Drill and practice and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>games in math, language,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and reading.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word Processing</td>
<td>7</td>
<td>2</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Writing stories and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>journals and printing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>them out on the printer.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphics</td>
<td></td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Using technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to draw pictures and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>illustrate stories.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking Skills</td>
<td>1</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Exploring software</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to help students become</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>better problem solvers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>To aid a special</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>needs student</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total 12 12 12 36
Appendix F
FIRST TEACHER INTERVIEW QUESTIONS
(SEPTEMBER, 1991)

1. Background Information
   - What is your teaching background?
   - What experience/training with computers have you previously had?
   - What hardware do you currently have in your classroom?
   - What software are you using?
   - How is this software organized/accessed?

2. What are the most important instructional and management routines that you have begun to establish with your students? Why are they important?
   (For example, instructional routines may be related to questioning, monitoring, reviewing, instructing, demonstrating, giving instructions, evaluating, disciplining. Management routines may include calling for attention, establishing smooth transitions between activities, distributing materials, beginning or ending the day, leaving the room finishing assigned work early, or accessing resources.)
   - How do you establish these routines? (e.g., overt teaching, modelling, reinforcing correct behaviour.)

3. What are the most important instructional purposes that you intend to achieve with the computer in your classroom this year? For what purposes and how do you plan to use the computer?

Note: These questions were used to focus the one-hour discussion with each teacher.
Appendix G

ONGOING INTERVIEW QUESTIONS
(SEPTEMBER - DECEMBER, 1991)

1. What impacts on your classroom have occurred to date as a result of adding the computer?
   - What impacts upon instructional and management routines have occurred?

2. Were any of these impacts on routines unanticipated or surprising?
   - Why did you find them surprising?

3. How have unanticipated impacts affected your use of the computer?
   - Have you added/refined/dropped any routines specifically around the computer
   - Have any of your purposes for computer use been refined/dropped/added?
   - Have you decided to use different software because of these impacts? If so, why?
   - How did unexpected impacts affect instructional and management routines?

4. You said you intended to use the computer for __________
   - What difficulties, if any, have you encountered in trying to achieve these purposes?
   - What benefits, if any, have you encountered in trying to achieve these purposes?

5. How are your questions about computer use dealt with?
   - Have you talked to other teachers or the school computer helping teacher?
   - Have you observed other teachers and students using computers?

Note: As each interview was completed, the researcher examined the data in order to identify vague or unclear responses. These were pursued in subsequent interviews in order clarify information and deepen understanding of the implementation.
Appendix H

ADMINISTRATOR INTERVIEW

(DECEMBER, 1991)

What school policies for computer use have been developed? (i.e., agreed upon rules of use, goals, etc. What were the reasons for decentralizing the computers?)

What documents have been produced? (i.e., handbooks, written policies, rules for software distribution, meeting minutes, newsletters, staff bulletins, etc.)

What kinds of school-based support have been offered for computer use this year? (i.e., release time, inservice, etc.)

Note: The computer helping teacher/vice-principal was asked these questions.