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Computer Integration into the Curriculum: A Concerns-Based Adoption Model Perspective

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "Computer Integration into the Curriculum: A Concerns-Based Adoption Model Perspective" submitted by Patricia Gail Jardine in partial fulfillment of the requirements for the degree of Master of Science.

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ABSTRACT

The appropriateness of two of the assumptions of the Concerns-Based Adoption Model (CBAM) for planning computer applications staff development was investigated. An analysis was carried out on the data from a questionnaire administered to a random sample of 1000 elementary and secondary public school teachers. This questionnaire had inquired about the teachers' attitude to computers, their past, present, and planned future use of computers applications in their classrooms, and their preferences for various staff development activities. There were two objects of inquiry: (1) Were there teachers in the sample at each of the first six Levels of Use of the CBAM? and (2) Were the teachers' reported staff development preferences significantly different between each LoU?

Frequencies showed that 457 teachers were classifiable under the operational definitions of the first six CBAM LoU. There were teachers at each LoU. Seventy-four teachers were unclassifiable. Discriminant analysis performed on all of those cases in LoU II, III, IVA, and IVB which had no missing data (N = 283) found a significant difference ($p < .001$) between LoU II (Preparation) and LoU IVB (Refinement) on the one hand and LoU III (Mechanical) and LoU IVA (Routine) on the other. Teachers in the former two LoU seem interested in staff development which can help them expand their use of computer applications, while teachers in the latter do not. The results support the assumption that the CBAM LoU do describe real differences in teachers' interest in and use of computer applications in the classroom. This study's results also support the idea that staff developers should begin to expect to use a variety of activities to meet the changing interests and needs of computer applications innovators.

These conclusions and recommendations are tentative. The validity of classifying LoU through a mailed survey needs to be verified in further research. These results need to be replicated on other samples. There is also a need for more research into the various types of computer applications staff development support that is perceived as appropriate by teachers at each LoU and effective at helping them implement this innovation.

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CHAPTER I

Introduction

While staff development is often considered to be an effective way to improve classroom teaching, teachers frequently report being dissatisfied with this process (Thompson & Cooley, 1986). Staff development practices will be improved if they are based upon a realistic understanding of innovators' changing interests and challenges as they learn to implement an innovation and upon the expectation that a changing variety of staff development activities is needed to help teachers meet these challenges and interests effectively. This thesis is an investigation of the potential appropriateness of the assumptions of the Concerns-Based Adoption Model of innovation (Hall, Wallace & Dosset, 1973) for improving the staff development practices offered to classroom teachers who are trying to integrate various computer applications into the curriculum.

Word processors, desktop publishing software, databases, spreadsheets, telecommunications, graphics packages and computerised access to laserdisks and CD-ROM disks are all computer applications that have the potential to be used in many subject areas, in classrooms of all levels, in educationally sound, educationally exciting ways (e.g., Lockard, Abrams & Many, 1990). They are all tools that can be used to revolutionise not only what is learned, but how it is researched, understood and communicated (Schrum, 1991).

However, use of these applications is low (Becker, 1991; Blair, 1991; Diem, 1984; Ellis & Kuerbis, 1988; Jardine, Rilstone & Hunter, 1990; Lockard, Abrams & Many, 1990; Tauber, 1985; Wedman, 1988). Recently, Knezek (1991-2) observed:

> ...reflect on the last decade--a decade of general availability of computing to education--and on the energies expended to promote computer use among educators. In truth, frustration is understandable for there are few too examples of students, teachers or others in education working any differently than we did in 1981. (p. 2)

Most teachers currently in classrooms received their teacher training before either microcomputers or most computer applications were invented. Although some teachers have been pioneers and learned to use computer applications in their classrooms by themselves, such innovators are typically in the minority (Fullan, 1982; Rogers & Shoemaker, 1971). McLaughlin and Marsh (1979) presented the results of a four year Rand study investigating factors affecting the implementation success of 393 nationally-funded innovative programs. They concluded that effective staff development is necessary whenever an innovation is planned for a classroom, regardless of what the innovation is. Thompson and Cooley (1986) surveyed 50 school districts across The United States which had a reputation for providing exemplary staff development. They concur in their findings that staff development can improve the effectiveness of teachers and school administrators. Fullan, Miles and Anderson (1989) also concluded that due to the complexity and difficulty of the task of integrating computers into subject areas, teachers will definitely need training and various types of ongoing assistance as they learn to use computers effectively in their classrooms.

In this thesis, the term "staff development" is taken to refer to any activity which is designed and delivered to teachers with the purpose of facilitating any knowledge, skills or attitudes they must acquire at any phase of their adoption of any innovation. There is a consensus in the staff development literature that effective staff development plans involve a combination of at least these factors:

> - a comprehensive assessment of needs,
> - staff input for planning,
> - participation of [local] personnel in conducting [inservice training] activities,
> - delivery systems compatible with adult learning theories,
> - support and reinforcement of teachers following staff development activities, and
> - evaluation of programs and teacher competencies following implementation
> (Thompson & Cooley, 1986, p. 95)

In practice, this full sequence of staff development activities is rarely given, even though it is known to be effective (Thompson & Cooley, 1986). Although appropriate introductory

training/demonstration sessions and follow-up support during teachers' attempts at implementation are important, they are expensive and time-consuming and are frequently not provided (Fullan, 1989, p. ii). Moreover, staff development efforts, regardless of the innovation they are directed toward, are often severely criticised by teachers as being irrelevant and a poor use of their time (Daresh, 1985, p. 223; Thompson & Cooley, 1986).

Computer applications staff development practices often demonstrate a general lack of appreciation of both the number of skills teachers must learn in order to use this innovation effectively with their students and the amount of ongoing staff development support necessary if the use of computer applications is going to become widespread. Many boards purchase computers and act as if they expect the teachers to be able to use them effectively with no further support. Inservice training sessions are provided far less frequently than the importance and complexity of computer innovations would lead us to expect (Nuccio, 1990; Moskowitz & Berman, 1985; Zuk & Stilwell, 1984). When inservice sessions have been provided, they have typically failed to address and resolve many teachers' concerns with using technology, in favour of emphasising an understanding of the hardware itself or of programming (Boe, 1989). Often in inservice sessions all of the time is spent introducing teachers to the operation of the software and the teachers are not given opportunities to practice, or even discuss, using it in lessons (Baird, 1985; Collis, 1988; Stasz & Shavelson, 1985). At best, a short series of workshops is given to teachers just prior to the beginning of the school year. However, this training format is known to be ineffective because it fails to give teachers enough practice using the innovation and also does not give them any opportunities to ask about the issues and problems that arise once they begin using any innovation with students (Hall and Hord, 1987). Often inservice training is expected to be adequate to support the whole innovation process. Staff developers are still trying to establish that adopting an innovation is a long process that involves much time and ongoing support (Gunn, 1991). Teachers are rarely given any support in their classroom as they make their initial attempts to use a computer application with their students (Clemente, 1991; Evans, 1986; Fullan, Miles & Anderson, 1989;

Geisert & Futrell, 1990; Knupfer, 1988; Nuccio, 1990; Ragsdale, 1982; Stasz & Shavelson, 1985).

There is a need for staff developers, administrators and policymakers to make their expectations more realistic and appropriate about the amount, timing, and variety of support that teachers will likely need to integrate computer applications into the curriculum effectively. It is common to have false expectations about how quickly or easily this innovation can be adopted. It is also all too easy for policymakers and administrators to address the aspects of the innovation process that are most salient to them, while neglecting those that are unfamiliar to them, but which are difficult realities for the teachers making the change and which therefore need to be addressed (Fullan, 1982). Policymakers, administrators, change facilitators and teachers all need a model which will help them understand, plan for, assess and communicate about all of the phases of an innovation process.

This thesis presents the results of an investigation into the potential of the Concerns-Based Adoption Model of the innovation process (Hall, Wallace & Dossett, 1973) to

(1) identify possible deficiencies of computer applications inservice training to date,
(2) provide a description of the phases involved in implementing this innovation and
(3) establish the expectation that teachers staff development needs will change as they gain expertise with this innovation.

The Concerns-Based Adoption Model: A Critique and a Guide for Computer Integration Efforts:

The Concerns-Based Adoption Model (CBAM) consists of several assumptions and assessment tools that can be potentially useful in facilitating the implementation of any kind of innovation. This model has been developed and tested during approximately the last

thirty years by a team of university-based researchers (and change facilitators) working with school boards from a base at the University of Texas at Austin (Rutherford & Hall, 1990). Its effectiveness has been investigated for several complex innovations which have involved major changes in teachers' classroom methods. It has been found to be effective by CBAM change facilitators (Heck & Goldstein, 1980; Loucks & Melle, 1982; Loucks & Pratt, 1979; Loucks & Zigarmi, 1981), by independent staff developers who adopted the model (Coletti & Russell, 1988) and by change facilitators who have used the model to offer computer applications staff development (Ellis & Kuerbis, 1988; Wedman, 1988).

In the following sections each of the five major assumptions of the CBAM will be presented along with a brief suggestions as to each one's relevance to computer applications staff development.

(1) Change is Accomplished by Individuals

One of the important assumptions of the CBAM is that a change only occurs when the individual teachers involved have experiences which allow them to acquire the new knowledge, skills or attitudes that will allow them to change not only what they know, but also what they do (Hall & Hord, 1987, p. vii). In this characterisation of the change process, changing what a teacher does cannot be a matter of writing and distributing a new policy, a mandate, or a curriculum guide. Nor can an innovation be adopted and used just by delivering useful materials to a teacher's classroom (Fullan, 1989, p. 3.2). This is because there is no mechanism in written descriptions of an innovation or in the presence of the classroom materials themselves to change what teachers **can do** with students in their classrooms. Efforts to help teachers integrate computers have often taken the form of writing a new curriculum guide or buying hardware (with or without some software) and then blaming the individuals involved for being "resistant to change" when the innovation was not used effectively after all (Cuban, 1990). This assumption of the CBAM leads to the expectation that such an approach is not likely to be effective because the teachers'

interest in and ability to use the innovation have not been addressed and changed.

(2) The Innovation Must be Specified Clearly

The CBAM gives us a procedure to follow to specify clearly the components that make up an entire innovation (Hall & Loucks, 1981). "Computer applications" is the name of a complex innovation which currently means many different things to many different people. The school-wide case study described in Woodward and Mathinos (1987) is just one example where administrators and teachers had not clarified and did not agree upon the use of computers the teachers were to implement. The administrators wanted students to be using the tool uses of computers (word processors. etc.) while the teachers almost exclusively used CAI (especially Drill and Practice programs).

(3) Change is a Process

The CBAM holds that change is a process, not an event (Hall & Hord, 1987). Moreover, it is a complex process consisting of several distinct phases which innovators typically pass through as they move from being initially uninvolved to finally being expert users of an innovation. This process takes time.. Becoming a proficient user of an innovation of any complexity is expected to take 3 to 5 years (Hall & Hord, 1987). However, time alone is not expected to improve teachers' level of expertise. Staff development (motivation, training and implementation support) is important during this whole process to help teachers as they constantly meet new problems and challenges and need to acquire more knowledge and develop more skills. Staff developers still find they need to plead the case that learning to teach using computer applications is a process like any other learning (Gunn, 1991) because implementation support is still not commonly provided (Clemente, 1991; Evans, 1986; Fullan, Miles & Anderson, 1989; Geisert & Futrell, 1990; Knupfer, 1988; Nuccio, 1990; Ragsdale, 1982; Stasz & Shavelson, 1985).

(4) Concerns and Skills Develop Throughout a Change Process

The CBAM describes a developmental series of concerns which emerge as adoption of an innovation progresses (Hall & Loucks, 1978). Table A-1 (See Appendix A) provides a description of these Stages of Concern. The skills involved in the innovation that a teacher can use also change throughout the whole process. The CBAM identifies the interests, goals, needs, and problems of eight Levels of Use of an innovation (Hall, Loucks, Rutherford & Newlove, 1975). These are described in Table B-1 (See Appendix B). Stages of Concern (SoC) and Levels of Use (LoU) are used to monitor the progress of teachers' attitudes and behaviours regarding an innovation and also to diagnose their staff development needs. Since a teacher's Stage of Concern and Level of Use will change throughout an innovation process, both need to be regularly assessed and addressed (Loucks & Pratt, 1979, p. 214). CBAM change facilitators accept the reality and inevitability of both concerns and problems and expect that these must be addressed and resolved or else the teacher will stop attempting to learn to use the innovation.

Writers speculating about why teachers are so slow to adopt the use of computer applications frequently do not legitimise either teachers' personal concerns or the problems that arise as they try to use an innovation with their students. Cuban (1990) and Wolcott (1981) are typical of what is commonly done in educational technology journals. Speculating about why so many educational innovations involving technology fail, they each speak of "teacher resistance to change" and present their own theory explaining why teachers are such a resistant group of professionals. This approach fails to address the difficulties teachers can have in their classrooms that make them decide against using an innovation (Gross, Giaquinta & Bernstein, 1971) or to expect that personal concerns can be resolved with support and adoption of the innovation can continue when this is done successfully (Hall, 1979; Wedman, 1988).

(5) Deliver a Succession of Appropriate Staff Development Activities

The CBAM researchers have been investigating the effectiveness of various types of staff development activities with teachers at each Stage of Concern and Level of Use. They do not expect that any single staff development approach is equally effective for teachers at all Stages of Concern or Levels of Use. In their opinion, a mismatch between the needs of the teacher and the staff development activity provided has serious consequences.

> One reason that change processes are not successful and that many worthwhile actions meant to support change are rejected by the participants is that the interventions are not made at appropriate times, places, or in ways perceived to be relevant. (Hall & Hord, 1987, p. 8)

Anecdotal accounts from computer applications inservicing often describe such mismatches. For example, Baird (1984) gives a dramatisation of what he has observed is typical for a computer applications inservice. An enthusiastic teacher who is the leading user of computers in her school is sent to exactly the same workshop as another teacher who is a highly apprehensive nonuser. The workshop failed to meet either of their needs. The experienced teacher wanted to learn more about the realities of using the computer applications in the classroom and did not want more information about the hardware. The demonstrations of hardware and software did nothing more for the nonusing teacher other than to reinforce his idea that this was a complicated innovation he wanted to avoid.

The Investigations of this Thesis

There appears to be a prevalent expectation that "the computer revolution in our schools" will happen instantly and almost effortlessly. There is also too great a tendency for computer applications staff development to rely upon the inservice workshop almost exclusively for bringing this "revolution" about. In light of this, two of the assumptions of

the CBAM are particularly important to investigate. The CBAM assumes that innovation is a multi-stage process consisting of a developmental succession of Levels of Use each with its own interests, goals, problems and needs. The CBAM also assumes that teachers at different Levels of Use will have needs and interests which are most appropriately addressed by participation in a variety of staff development activities.

This thesis was an investigation of these two questions:

(1) Is learning to integrate use of computer applications into the curriculum the multi-stage process of emerging Levels of Use that the CBAM describes?

(2) Do teachers at different Levels of Use report preferring significantly different types of staff development?

CHAPTER II

Literature Review

This chapter begins by reiterating the need for a model which will help identify appropriate staff development activities to offer teachers who are attempting to use computers with their students. Then it presents a detailed decription of the Concerns-Based Adoption Model including its recommendations for effective staff development activities at each Level of Use.

The argument in this thesis is that the assumptions of the CBAM can (1) be used to gain a realistic understanding of the process teachers undergo as they learn to use an innovation and (2) help establish the expectation that teachers in different phases of the innovation process find different types of staff development activities relevant. Typical computer applications inservice efforts to date are examined from the CBAM perspective to identify the extent to which they already make use of the major CBAM assumptions, including whether or not they appear to be based on a realistic understanding of what the innovation process is like and of what types of staff development are appropriate to provide throughout this process.

The chapter ends with a description of the investigations into the appropriateness of the following two assumptions of the CBAM: (1) that it realistically characterises innovation when it describes change as a process and not an event (Hall & Hord, 1987; Hall & Loucks, 1978) and (2) that it is correct in assuming that since needs and interests change with each Level of Use, the staff development activities that are appropriate also change.

The "Laundry List" Approach to Staff Development

Researchers on school change and staff developers trying to determine effective ways to facilitate educational innovations often take a survey approach, merely trying to identify and describe a complete compendium of factors. There is no consensus, no paradigm, that everyone agrees should guide researchers' investigations into the relative effectiveness of factors or into their interactions. In Hall and Loucks' (1978) opinion,

> The swirl of pros and cons, complaints and praise, moans and musings [about staff development activities] will make any listener's head spin. The greatest common denominator seems to be, however, that trainees and trainers alike are awash in a sea of complexities. Even success often appears to result more from a benevolent confluence than from guiding concepts. (p. 37)

The usual content of works published on staff development is a list of factors, perhaps divided into organisational and personal factors or into "characteristics of the innovation" and "local conditions" (Fullan, Miles and Anderson, 1989), but a list which gives us no indication as to how these factors may interact during both effective and ineffective innovation processes.

Table 1 presents the most commonly mentioned factors affecting school change. Whether it is a report of a large scale Rand corporation study (McLaughlin & Marsh, 1979; Marsh, 1990), or prestigious writers in the area of school change (Fullan, 1982; Loucks-Horsley et al., 1987), or journal articles (the remaining table entries), most of the factors are mentioned each time but there are no theories about how they interact.

Research directed particularly to computer applications staff development also shows a conspicuous lack of models being used. For example, Fullan, Miles, and Anderson (1989) have written a comprehensive implementation plan for the integration of computers into Ontario classrooms. However, they merely provide us with the following "laundry list" of factors, making little or no attempt to explain how these factors interact:

Table 1

Commonly-Mentioned Factors Effecting An Innovation's Adoption

Studies	Teacher Characteristics	School Climate	Administrative Support	Innovation-Philosphy Congruence	Quality of Inservice	Quality of Implementation Support
Ferguson, M. (1980)	*			*		
Fullan, M. (1982)	*	*	*	*	*	*
Johnston, J.H. (1987)		*	*			
Kanter, R.M. (1985)	*	*	*	*	*	*
Loucks-Hosely,et al. (1987)		*	*	*	*	*
McLaughlin, M.W. (1990)	*	*	*	*	*	*
McLaughlin, M.W. & Marsh, D.D. (1979)	*	*	*	*	*	*
Renihan & Renihan (1989)			*	*		*

Factors Influencing Implementation
Characteristics of the Innovation

1. Clarity and complexity
2. Consensus/conflict about the change
3. Quality and practicality of the change

Local Conditions

4. Central office direction, commitment, and support
5. Process for implementation and institutionalization
6. Professional development and assistance
7. Implementation monitoring and problem solving
8. Principal's leadership
9. Community Support
10. Environmental Stability (p. 3.4)

In their remaining chapters, Fullan et al. provide an account that is unsatisfying and hard to remember because they describe each of these factors in isolation and do not relate them into a theoretical system. Possibly connected factors, such as "central office direction" and "principal's leadership," are not even close together on the list. "Process for implementation and institutionalization" and "implementation monitoring and problem solving" are also separated, giving the reader a list which does not even hang together conceptually.

A model is needed which is based on an accurate understanding of the innovation process. Such a model will be able to help establish realistic expectations about what implementing a substantial educational change involves for teachers and also help identify appropriate staff development interventions.

The Concerns-Based Adoption Model of Any Innovation

The CBAM proposes to be a model of the steps any individual must go through as he or she implements *any* educational innovation. As the CBAM defines it:

> ...the concept of "innovation" means any process or product that is new to a potential user. This would include reading texts, instructional modules, and team teaching, as well as organizational innovations such as organized classrooms, new

staffing systems, or accounting procedures. (Hall, 1979, p. 203)

Computer applications in education is a complex set of innovations. Teachers must learn to (1) use the hardware, (2) operate the various software applications, (3) assess when and how the application is useful for reaching curricular goals, (4) teach students how to use the software, and (5) design interactive lessons that use the software as a tool to find, organise or communicate the content of these lessons, (6) function in the classroom as a facilitator of learning rather than a dispenser of information, (7) assess the rate and depth of learning as it is occurring and (8) assess learning outcomes. The assumptions of the CBAM apply to each of these different innovation components. In each case, implementing the innovation will be a process involving developmental changes in the teacher's concerns and skills.

An Overview of the Concerns-Based Adoption Model

The major assumptions and procedures of the CBAM are: (1) change is accomplished by individuals; (2) change is a process; (3) the innovation process consists of a series of differentiated, developmental changes in individuals' concerns about the innovation; (4) the precise classroom activities any innovation involves should be clearly specified; (5) individuals' nonuse and use of an innovation also go through a progression of stages--each with its own set of typical interests, needs, and problems; (6) different types of staff development activities will be appropriate to meet the changing needs of each Level of Use involved in the process. Each of these assumptions will be examined in detail below.

(1) Change is Accomplished by Individuals

An important assumption operating in CBAM's approach to change is that even when the overall goal is to have a whole school change, an innovation cannot be

implemented unless the individuals attempting it change what they know, feel and can do about it (Coletti & Russell, 1988, pp. 20, 21; Hall & Hord, 1987, vii, p. 53; Hall & Loucks, 1978, p. 38; Hall, Loucks, Rutherford & Newlove, 1975, p. 265; Loucks & Pratt, 1979, p. 213; Loucks & Zigarmi, 1981, p. 4; Sparks, 1990, p. 3).

The CBAM holds that possession of the required curriculum materials is necessary, but is never to be considered sufficient to ensure teachers' use of the desired innovation. Innovating is a matter of changing the beliefs and skills the teachers have--not just of providing them with new equipment or materials or with new hardware and software (Hall, G. E. 1986, p. 4; Hall, 1979, p. 204; Hall & Hord, 1987, p. vii; Hall & Loucks, 1978, p. 38, p. 53; Hall, Loucks, Rutherford & Newlove, 1975, p. 52; Hall, Wallace & Dossett, 1973, p. 1; Hord, 1987, p. 54; Loucks and Zigarmi, 1981, p. 4). Hall (1976) echoes the complaints of many classroom teachers that there is too little awareness of this among administrators and policymakers:

> Few seem to recognize that change is only accomplished in fact when the individuals who are to use the things change.... At the system level, there [can be] additional curricula, new organizational structures, and other things; however, on the individual level, there is little change--just system overload. (p. 22)

Moreover, each teacher who is adopting an innovation does so as a result of the combination of factors that contribute to his or her own individual situation. How the innovation is implemented will be affected by each teacher's style of teaching, by the culture of the school, and by the learning needs, interests and aptitudes the students who must also adopt the innovation (Hall, Loucks, Rutherford & Newlove, 1975, p. 52; Loucks & Pratt, 1979, p. 213).

Although it is the individual who must change, he or she does not do this alone. For long-term, effective implementation of an innovation to occur, organisational conditions must support the teachers' attempts all through the innovation process. Supporting equipment, materials, scheduling, etc. all must be there for the teachers or they will not be able to cope with the resulting problems. Yet teachers cannot always make the

necessary supporting changes in school-wide schedules or in fellow teachers' attitudes to the innovation. Administrative support in terms of supplying teaching materials and supplies and in training new teachers is also important. The CBAM identifies the principal as having an important role to play in providing both practical and moral support for teachers using the innovation. Otherwise teachers often fail to be able to resolve the problems they are encountering and stop attempting to implement the innovation.

(2) Change is a Process

The CBAM holds that the adoption of an innovation is a process, not an event (Hall, G.E., 1986; Hall & Hord, 1987, p. 8; Hall & Loucks, 1978, pp. 37-8; Hall, Loucks, Rutherford & Newlove, 1975, p. 52; Hall, Wallace & Dossett, 1973, p. 2, p. 5; Loucks & Pratt, 1979, p. 212, p. 213; Loucks & Zigarmi, 1981, p. 4). Therefore it can only be accomplished over an extended period of time (Coletti & Russell, 1988, p. 20; Hall, 1979, p. 204; Hall & Hord, 1987, p. 8, p. 23, p. 105, pp. 155-6; Hall & Loucks, 1978, p. 38; pp. 52-3; Hall, Loucks, Rutherford & Newlove, 1975, 56; Loucks & Pratt, 1979, p. 213; Sparks, 1990, p. 3).

> Too often policy-makers, administrators, and even teachers assume that change is simply the result of an administrative decision, legislative requirement, new curriculum acquisition, or procedural revision. The conviction lingers that somehow, with the opening of school, the change will have been made. However, R&D Center research indicates that three to five years are necessary to implement an innovation that is significantly different from current practice. (Loucks & Pratt, 1979, p. 213).

(3) The Stages of Concern about the Innovation

From "extensive experience with educational innovation in school and college settings" (Hall & Loucks, 1978, p. 37), the CBAM researchers and change facilitators have identified a succession of qualitatively different concerns (feelings, attitudes, orientations) teachers typically reveal as they are learning to adopt an innovation (Hall, 1976, p. 22;

Hall, 1979, pp. 203-4; Hall & Loucks, 1978, p.38, p.52).

Hall (1976) characterises innovators' typical progression of concerns this way:

> In general, it appears that as individuals first become aware of and consider using an innovation, their most intense concerns are *self*-oriented. They are concerned about what the use of the innovation means for them personally, and they are concerned about what the innovation is. As use of the innovation begins, users have more intense *task* concerns. Their dominant concerns are focused on logistics and management of the innovation. It is only after many of the task concerns are resolved that innovation users begin having more intense *impact* concerns. These concerns focus directly on the learners and innovation effects. (p. 22)

See Appendix A for a more complete description of the seven CBAM Stages of Concern.

As teachers choose to learn about and use an innovation, they will typically have concerns at more than one Stage, but significantly more concerns at some stages than others. It is the total profile of concerns that CBAM researchers identify (Hall & Loucks, 1978). They have observed that profiles change predictably as an innovator becomes more and more proficient at using an innovation (Hall, 1979, p. 204). The CBAM change facilitators have recognised that Stages of Concern profiles change as use of the innovation progresses:

> ...it is clear from several samples with many innovations that nonusers of an innovation have their most intense concerns on stages 0, 1, and 2. They are most concerned about having general descriptive information about the innovation (stage 1) and the personal implications of the innovation (stage 2). Further, they are not as concerned, relatively speaking, about the impact of the innovation upon students (low intensity in stages 4, 5, and 6). (Hall & Loucks, 1978, pp. 44-5)

> As implementation of the innovation takes place, Stage 3, management concerns begin to increase. Informational and personal concerns begin to decline and there is a gradual increase in the intensity of impact concerns (Stages 4, 5, and 6).

> If the innovation is appropriate, if the change process has been effectively facilitated, and if other contextual factors do not interfere, it is then possible for individuals to develop Stage 4, consequence and Stage 5, collaboration concerns. These stages describe someone who is experienced in using the innovation and who has intense concerns about the consequences of use for students. It takes a great deal of skill on the part of the innovation users, change facilitators, and key administrators for innovation users to develop and maintain an impact concerns

profile. (Hall, 1979, p. 204)

The CBAM insists that all Stages of Concern are legitimate and appropriate parts of adopting an innovation (Hall & Loucks, 1978, p, 52; Loucks & Hall, 1977, p. 18 Sparks, 1990, p. 3). To progress from the initial concerns typical of nonusers to those accompanying sophisticated use, these initial concerns must be addressed and resolved (Hall, 1979, p. 208).

> Educators would like to think that they always function at the *impact* concern level. However, it is a basic finding of the CBAM research that almost everyone, when first confronted with a "new" innovation, will have relatively intense personal and informational concerns. It is important to recognize that self-concerns are a legitimate part of change. Rather than indicting people for having self-concerns, the role of adoption agents and policy/decision makers should be to aid in the resolution of self-concerns and to facilitate movement toward task- and impact- related concerns. When planning for innovation implementation, managers of change need to anticipate self-concerns and initiate actions to accommodate and resolve them at the outset of the innovation effort. The crime is not in having self-concerns, but in others not accepting their legitimacy and constructively addressing their resolution. (Hall, 1976, p. 23)

The CBAM researchers use the information in teachers' Stages of Concern profiles to plan the staff development they provide (Hall, 1976, p. 23; Hall & Loucks, 1978, p. 37, 47; Loucks & Hall, 1977, pp. 18, 20). Since innovators can have qualitatively different concerns, CBAM change facilitators expect teachers to need different activities and experiences if all their concerns are going to be resolved throughout an entire innovation process (Hall & Loucks 1978, p. 39). Hall and Loucks (1978, pp. 50-1) report that when they have planned staff development activities appropriate to the Stages of Concern they expected teachers to have, teachers have selected the activities that the CBAM change facilitators anticipated they would choose. Loucks and Melle (1982) also describe delivering staff development support designed to be responsive to teachers' changing Stages of Concern profiles in a three year, district-wide effort to implement a new, inquiry-based science curriculum which was judged to be successful (Loucks & Pratt, 1979).

(4) Innovation Configurations

The CBAM researchers found it necessary to develop a vocabulary and conceptual framework to use to characterise the precise forms any innovation can take in various classrooms (Hall & Loucks, 1981). This procedure has these steps:

(1) Identify and describe all of the essential behaviours teachers must use if they are using the innovation as its developers and planners intended. These are referred to as the essential innovation components.

(2) Make classroom visits and interview users to identify and describe as many variations as possible in how the innovation is actually used.

(3) Create an Innovation Configuration component checklist, listing all of the essential and the commonly used components that have been observed.

(4) Ask individual teachers to indicate on this checklist which components describe his or her own use of the innovation. The pattern of components each teacher uses is referred to as his or her Innovation Configuration.

(5) Make further investigations to find out the frequency of each configuration in a school or district, etc.

Use of a checklist to communicate which of many possible innovation configurations are being used has many advantages (Hall & Loucks, 1981, p. 54). Once the components of an innovation can be clearly specified, teachers, administrators, researchers and students can all know whether or not a teacher is using the innovation as policy intends (Hall & Loucks, 1981, p. 47, p. 57). Teachers will also have a clear picture of what they are being asked to do and can judge their interest in the innovation, their progress and their needs for themselves (Hall & Loucks, 1981, pp. 54-5).

When a teacher is using a less desirable Innovation Configuration, a change facilitator can appreciate what has already been learned, but intervene with clear objectives and a targeted staff development intervention to help the teacher acquire each remaining behaviour, skill, knowledge or attitude involved in the innovation that the teacher is to

implement. A grasp of both essential and inessential innovation components can also guide the content, sequencing and pacing of inservice training (Hall & Loucks, 1981, p. 47, p. 49, p. 55).

(5) The Levels of Use

The third diagnostic tool of the CBAM is the Levels of Use scale. This section will introduce the Levels of Use, describe how they are used in the CBAM, and specify how they are measured.

(a) Definition of the Levels of Use

The Levels of Use dimension describes a developmental series of eight sets of typical **behaviours** that the CBAM researchers have observed innovators engaging in as they progress through an innovation process (Hall, Wallace & Dossett, 1973, p. 11).

> The Levels of Use (LoU) dimension describes the various behaviours of the innovation use through various stages--from spending most efforts in *orienting*, to *managing*, and finally to *integrating* use of the innovation. ... Experience is essential but not sufficient to insure that a given individual will develop high-quality use of an innovation. (Hall, Loucks, Rutherford & Newlove, 1975, p. 52)

See Appendix B for a complete description of the eight Levels of Use.

As is true for the Stages of Concern, each of these Levels of Use identifies a necessary phase in learning to use an innovation effectively with students. A teacher-innovator at any one Level will be able to use the innovation in some ways, but not in others. One Level of Use is not better than another. Each one simply represents what the teacher has already learned and indicates what he or she should learn next (Loucks & Hall, 1977, p. 21).

> Once acknowledged, these levels need to be accepted as legitimate steps in growth toward sophisticated use. Strategies must then be developed that deal with a user's present LoU and facilitate growth. For example, support for innovation adoption needs to be extended across several cycles of use rather than consisting mainly of no support or an initial two-day "hit and run" workshop. It also seems likely that the same interventions will not be appropriate or relevant for all levels. (Hall et al., 1975, p. 56)

The CBAM researchers stress that whenever the innovation is a complex one involving many changes in teaching style, in course content, in materials, etc., it is important to measure a separate Level of Use for each component of the Innovation Configuration a teacher is using (Hall et al., 1975, p. 56; Loucks & Hall, 1977, p. 21).

(b) Three Uses of the Levels of Use

(i) To Set and Monitor Implementation Goals

Levels of Use provide a conceptual structure and a vocabulary that can be used to assess exactly how effectively and to what degree a teacher is using an innovation with students (Hall & Hord, 1987, p. 172; Hall, Loucks, Rutherford, & Newlove, 1975, p. 56). The descriptions of the Levels of Use recognise that a teacher's interest and proficiency develop throughout the innovation:

> Until recently, the status of individuals in the change process was not systematically conceptualized. Success in making a change was typically summarized in the form of declarative statements made by principals and others--teachers were using the program because they had been through a training experience or because the materials had been delivered to classrooms. With [Stages of Concern, Levels of Use, and Innovation Configurations], however, it is possible to more carefully and systematically assess the state of change for individuals and an organization as a whole.
> ...The important point is that these three diagnostic dimensions provide a way to assess movement or nonmovement in a change process across time. They provide standardized and generalized scales for understanding and communicating the rate of movement in a change process, and they can guide the planning of interventions needed to attain implementation success. (Hall & Hord, 1987, pp. 332-4)

Use/nonuse is not a dichotomous event, but a long process with identifiable milestones. Teachers, change facilitators and administrators alike can benefit from knowing that progress is being made in using the innovation--even if proficiency has not yet been reached (Hall & Hord, 1987, p. 341).

(ii) To Ensure Valid Evaluation of the Innovation's Effectiveness

Using Levels of Use to assess the actual extent of use of an innovation in classrooms can prevent "false positives" and "misses" during empirical evaluations of the effectiveness of any innovation (Hall & Loucks, 1977). Too often an innovative program or treatment is judged to be not significantly different in its effects from the method it is replacing. But this may well be because program evaluators have often assumed a teacher is using an innovation effectively and as intended, when in fact the teacher's use is disjointed (Level of Use III, the Mechanical Level of Use), or he or she is using a downgraded version of the innovation--using components that do not provide the full, intended benefit of the innovation to the students, or is not using the innovation at all (Hall & Hord, 1987, p. 83; Hord et al., 1987, p.54). The CBAM researchers stress that you cannot assume that an innovation is being used. Each teacher's use of the innovation must be observed to ascertain that it is really being used before any evaluation of the effects on students is carried out--and to ensure that no teachers in any control group are actually using the innovation but not identifying it as such (Hall & Loucks, 1977, p. 269; Hord et al., 1987, p. 66).

The CBAM Levels of Use scale allows us to see another source of spurious results. If evaluators are measuring the effectiveness of an innovation before the teacher is able to deliver the innovation smoothly, as it is intended, then these differences in the teachers' delivery (and therefore in the students' experiences) can be expected to affect the students in ways that need to be investigated empirically (Hall & Loucks, 1977, p. 271, p. 274).

(iii) To Plan Relevant Staff Development

Staff development activities directed at teachers' Levels of Use can help teachers learn to use the innovation as effectively as possible. Staff development activities that are not directed at teachers' Level of Use will leave them still lacking the information/guidance/experiences they need to learn to become more proficient with the innovation (Hord et al., 1987, p. 65).

In addition, if teachers have stopped moving through Levels, this can be identified, investigated and remediated with appropriate staff development activities (Loucks & Melle, 1982).

(c) Measuring a Teacher's Level of Use

In the CBAM itself, the Levels of Use are primarily a tool to measure how well the teacher is actually using the innovation with his/her students. Assumptions and verbal reports of use are not enough. The CBAM insists that use must be observed if it is to be identified validly:

> Before the mid-1970's, school leaders assumed, at least implicitly, that the use of a new program or promising practice was taking place if the materials had been delivered to the classroom. This assumption was held not only by administrators within a district but also by the developers of the innovations and, what is even more surprising, by the evaluators of the product. Questions about how the new curriculum was faring in classrooms were asked of the principal or someone from the central office. Mailed surveys were commonly used to find out in how many classrooms and schools particular programs were being used....We now know that each "user" must be assessed directly if reliable and valid information is to be gathered about whether or not new practices are in use and in what way they are being used in particular classrooms. (Hall & Hord, 1987, p. 82.)

To the CBAM researchers, assessing Level of Use by self-report is tantamount to "a partial assessment of concerns about use" (Hall & Hord, 1987, p. 95). An evaluator is still not certain that the innovation is being used as intended, in an effective Innovation

Configuration. Yet despite these assertions, the CBAM researchers realised that making intensive classroom observations on each innovator is not practical. So they developed the focused interview (Hord et al., 1987). In such an interview, a program evaluator or change facilitator questions a teacher about his or her use of the innovation and listens and probes for the teacher's statements in relation to each of the decision points in the Levels of Use scale (See Table B-1).

Hord et al. (1987, p. 56) concluded that if the intent is to research the effects of the innovation on students, then the intended use of the innovation must be verified through classroom observation. However, if information on Level of Use is being gathered to guide staff development planning, an interview is adequate.

(6) The CBAM Approach to Planning Staff Development

CBAM change facilitators operate on the assumption that the needs, problems, interests and goals of teachers that are described as emerging at each Stage of Concern and Level of Use should be addressed by a changing variety of staff development activities given throughout the entire innovation process. The developers of the CBAM have been theorising about and empirically investigating the effectiveness of various staff development interventions ever since the model was first proposed (Hall, Wallace & Dossett, 1973, p. 21; Hord, Hall & Zigarmi, 1980, p. 3).

Since the CBAM has investigated the effectiveness of many staff development interventions with teachers at each Level of Use and Stage of Concern, it offers two major advantages over planning staff development without a model:

(1) Use of the Stages of Concern and Levels of Use assessment tools can help staff developers develop realistic expectations about what the innovation process will involve. This makes it possible to anticipate teacher-innovators' typical needs. This allows staff developers to have more lead-time, plan more efficiently and extensively, use time and resources in a more organised way, and yet also have more energy left over to allow them

to recognise and deal with unanticipated occurrences in individual cases more responsively than if they are constantly occupied "reinventing the wheel" and "putting out fires" (Hall & Hord, 1987, p. 9).

(2) The assumption that teachers will have different needs and interests during different phases of an innovation process, can help staff developers avoid offering a worthwhile activity to an audience for which it is inappropriate. After years of observation of innovation processes carried out without sensitivity to the teachers' changing needs, Hall and Hord (1987) have concluded that this is a serious problem:

> One reason that change processes are not successful and that many worthwhile actions meant to support change are rejected by the participants is that interventions are not made at appropriate times, places or in ways perceived by the clients as relevant. (p. 8)

For example, lectures are an efficient way to raise teachers' initial awareness of an innovation which may be beneficial for their students. But, if teachers have already begun to use the innovation, they no longer need general information. Instead they will benefit from specific training, practice and problem-solving directed to dealing with the obstacles they are meeting as they use it.

CBAM change facilitators always begin their staff development planning by assessing each teacher's Stages of Concern profile (Hall & Loucks, 1978) and their Level of Use (Hall, Loucks, Rutherford & Newlove, 1975). Initial staff development activities will be targeted to whatever level of involvement with the innovation the teachers show. Each teacher's concerns and use will be regularly reassessed throughout an innovation process and staff development activities provided to attempt to meet needs as they arise (Hall & Loucks, 1978, p. 39; Loucks & Melle, 1982, p. 104).

Table 2 is a collection of several staff development activities compiled from Hall (1979), Hord (1987), Hall & Hord (1987), Loucks & Zigarmi (1982), Sparks (1990). This summary table indicates the activities that the CBAM researchers have identified as being effective in addressing the needs and interests of each Level of Use.

Table 2

CBAM Staff Development Recommendations for Each Level of Use

Activity	Level of Use							
	0	I	II	III	IVA	IVB	V	VI
Conversational Information Sharing	*	*						
Short Media Presentations/Newsletters		*				*		
Relate It to Teachers' Other Priorities	*	*	*	*				
Involve Teacher in Planning	*	*	*					
Decree Use	*							
Examine Teaching Materials			*					
Visit Sites Using Innovation Successfully		*				*		
Encourage Use (No Pressure)		*	*					
Clearly State Realistic Costs-Benefits		*	*					
Assure Innovators of Personal Adequacy			*	*				
Legitimise Personal Concerns			*	*				
Demonstrate Skills, Knowledge Involved			*	*				
Practice of Skills in a Safe Environment /During Training			*	*				
Provide Organisational Support				*	*			
Plan a Gradual Introduction			*	*				
Regular, Accessible Personal Consulation (With Peer(s) or Staff Developer)		*	*	*				
Appreciate their Efforts				*	*	*	*	*
A Variety of Self-Instruction Modules						*		
Teacher Acts as a Resource Person						*	*	*
Arrange Meetings for Idea Exchange				*		*		
Administrative Support					*	*	*	
Give Opportunities to Attend Conferences						*	*	*

Early recommendations for staff development (at LoU 0 and I) are intended to motivate the teachers, to raise their interest in learning about what the innovation involves and to have them begin to consider how they might use the innovation with their students (Hall, 1979; Hord, 1987). At LoU 0 and 1, the CBAM suggests sharing small but pertinent amounts of general information through a variety of media in order to raise the teachers' awareness of the innovation. Teachers at these Levels of Use need to acquire a clear picture of what the innovation involves (Hall & Hord, 1987, p. 125; Loucks & Zigarmi, 1981, p. 5) and how its use will effect them personally (Hall & Loucks, 1978, p.45; Hall & Hord, 1987, p. 75; Sparks, 1990, p. 4).

LoU II (Preparation) teachers are seen to begin to need more specific information about how to use the innovation than would interest teachers at the earlier Levels. They need opportunities to have their questions answered. Teachers benefit when they are provided with inservice training that demonstrates the new knowledge and skills the innovation involves and allows the teachers to practice them in a safe, helpful environment. In many cases, this can alleviate teachers' reluctance to risk trying new teaching methods with their students. In other cases, teachers may still be personally threatened by even the thought of using the innovation even though they have been provided with the knowledge and skills to use it (Hall, 1979). The CBAM researchers have found that unless such personal conflicts and perceived inadequacies about their own use of the innovation are addressed, they will undo the innovation attempt (Hall & Hord, 1987, pp. 99-100, p. 334). Table 2 shows that CBAM staff development recommendations anticipate meeting these needs particularly at this and at the next Level of Use.

Even within the first 24 hours of using an innovation with their own students, teachers' requests for help with various logistical problems escalates. Workshops are helpful to give teachers demonstration and practice with various materials/classroom management techniques that can address common problems (Hall, 1979; Hord, 1987; Loucks & Pratt, 1979; Sparks, 1990). Teachers at the Mechanical Level of Use prefer indepth workshops. Hall and Loucks (1978) observe

> Interestingly, such a workshop would likely provide too much detail for the nonuser, who wants general descriptive information and information about potential personal implications, not all the nitty-gritty detail the Management-concerned user wants. (p. 47)

However, each LoU III teacher is also expected to meet problems unique to his or her classroom situation. The CBAM change facilitators have found that regular opportunities for individual consultation with them and with peer teachers also using the innovation are both effective techniques for meeting the need to solve Mechanical Level of Use problems as they arise (Hall, 1979; Hall & Hord, 1987; Hord, 1987; Loucks & Zigarmi, 1981; Sparks, 1990).

The CBAM change facilitators point out the importance of the recognition of a teacher's accomplishment in using an innovation smoothly and stress the need to monitor whether or not the teacher is using the innovation as intended or has reached Routine Use by implementing only the easier aspects of a complex Innovation (Hord, 1987). They also point out that long-term implementation of an innovation requires administrative leadership to continue to officially value the innovation, supply new materials and train new teachers (Loucks & Zigarmi, 1981, p. 6).

Refinement Level of Use teachers have divergent needs (often best met with options within staff development sessions that the teachers self-select (Loucks & Pratt, 1979, p. 215). They are able to be mentors (peer consultants) for teachers just beginning to use the innovation but also want to be exposed to new ideas which can expand and refine their evaluation and use of the innovation with their students (Hall, 1979, p. 207; Hord, 1987, p. 68; Loucks & Hall, 1977, p. 20).

According to the CBAM, effective support for teachers at the higher Levels of Use (V/Collaboration and VI/Refocusing), consists of positive reinforcement for use of the innovation (Hall, 1979; Hord, 1987; Loucks & Zigarmi, p. 6), peer sharing (Hall, 1979; Hord, 1987; Loucks & Zigarmi, p. 6) and providing teachers with access to new information about the innovation through written information, attending workshops or peer

interactions (Hall, 1979; Hord, 1987; Loucks & Zigarmi, p. 6).

Loucks and Zigarmi (1981) give this overview of the succession of types of interventions the CBAM researchers have found effective:

> School improvement can be successful if staff development and support activities are designed according to the developmental needs of the participants. Early awareness activities should aim at information and personal concerns. Experiential skill development training should occur next, followed by specific and timely problem-solving. Finally, self-analytical, student-oriented, classroom application activities are merited. Add to this phasing the continuous input of participants, monitoring of progress and needs, and administrator support--and the trend of failure in innovative efforts has a significant chance of being reversed (p. 8).

"The Computer Revolution" from a CBAM Perspective

In this section of the literature review, some of the CBAM assumptions will be used to identify deficiencies in and suggest ways to improve our understanding of three aspects of the computer integration innovation:

(1) the extent of implementation of the computer applications in schools to date,

(2) the understanding of the characteristics of an educational change, and

(3) the expectation that staff development activities need to be provided throughout the implementation process.

CBAM change facilitators are critical of the ways "the computer revolution" has been handled in schools:

> '[Innovations] should be "classroom friendly." We have a long history of practices being introduced that are unfriendly. One of the best negative examples is the introduction of microcomputers into the classroom.' (Loucks-Horsley, interviewed in Sparks, 1990, p. 4)

Hall and Hord (1987) give us a description of both an effective and an ineffective innovation using the Stages of Concern and Levels of Use scales to assess the degree of progress in implementing an innovation:

> The more *effective* change process occurs when users more quickly and easily resolve self and task concerns, implement the innovation to LoU IVA or higher, and use more acceptable configurations of the innovation. Less successful implementation efforts take longer to achieve these ends and do so at lower levels. (p. 344)

> When an innovation is perceived as bad, indications of such will be manifested in the Stages of Concern data. At the beginning of implementation, the general pattern will be that of the nonuser, but there will be a tendency toward higher Stage 2 Personal concerns and possibly a tailing up on Stage 6 Refocusing. Stage 1 Informational concerns will typically be lower than the Stage 2 personal concerns. One implication of this profile is that descriptive information about the innovation will not be accurately heard or understood. The personal concerns will act as a filter that distorts the intent and meaning of the information provided....
>
> Related scenarios can be predicted for Levels of Use and Innovation Configurations data when an innovation is inappropriate for some reason. Levels of Use will not progress as rapidly. There have been indications in some studies that movement from Level of Use I to Level of Use II, and from Level of Use II to Level of Use III is not as rapid. A longer period of time will be spent at the Mechanical Level of Use. Innovation Configurations data will likely reflect more drastic mutations and alterations of the innovation and less use of the ideal components and variations. (p. 345-6)

The Extent of Adoption of Computer Applications in our Schools

The general consensus is that educators have not adopted the use of computer applications in classrooms at anywhere near the rate that was originally expected (Diem, 1984, p. 15; Knezek, 1991-2, p. 2; Tauber, 1985, p. 10; Wedman, 1988, p. 26). In CBAM terminology, there is only slow progression for most teachers from LoU I, Orientation to the Innovation, to LoU II, Preparation, to LoU III, Mechanical Use.

Many teachers do not use computers in their classrooms (The National Governors' Association Monitoring Report: Time for Results, 1986, quoted in Blair, 1991, p. 7). The Office of Technology Assessment's Power ON! New Tools for Teaching and Learning (1988) also documents infrequent use of the computer applications innovation. This report observes

> Today's classrooms typically resemble their ancestors of 50 years ago more closely than operating rooms or business offices resemble their 1938 versions. (p. 3)

> Although computers are widely distributed and access to them by students has increased significantly, the vast majority of schools still do not have enough of them to make the computer a central element of instruction....The number of computers in U.S. public schools translates to approximately 1 computer for every 30 students. In practice, there is wide disparity--one computer in a classroom, clusters of computers in the library or classrooms, full computer laboratories, and classrooms with no computers. Not all students use computers, and it is estimated that those who do spend on average a little more than 1 hour per week on the computer, about 4 percent of their instructional time. (p. 6)

Power ON observes that some teachers are experimenting productively with the use of computer applications with their students, although this is not a wide-spread, standard activity. Becker (1991) concurs. He points out that there are some highly innovative teachers who are extending their students' opportunities to learn with computer applications, but refers to his recent national survey of United States classrooms and concludes that such teachers are "relatively rare" (p. 39). Accounts of such activities by individual teachers can be found in journals such as The Computing Teacher, Journal of the Computer-Using Educators of British Columbia, The Telecommunications in Education News or The Writing Notebook. The activity of integrating computers still seems to be a grass-roots movement, depending on the energy, dedication and time of those who are making "an heroic effort" (Robert Hodgins, a computer-using elementary school teacher active in his school and district for many years, Personal Communication, May, 1992).

In their study of the Calgary Public Board of Education, Jardine, Rilstone and Hunter (1989; 1990) found use of all common computer applications very low among their respondents (See Appendix D). A high of 32 percent of respondents reported using word processing in Language Arts courses during the year of the survey (1989-90); nine percent reported using desktop publishing in Language Arts, six percent Logo and graphics packages and 14 percent used games and CAI--all in Language Arts. Twenty-two percent of teachers reported using CAI in Mathematics and 21% used games. All other uses of all other applications (See Section II of the questionnaire in Appendix C) were used only by zero to three percent of the responding teachers. Teachers are tending to use less desirable

forms of the innovation (in CBAM terminology, less effective Innovation Configurations). The 32% of teachers using word processing in Language Arts is an example of the computer used as a tool to teach the process of writing more effectively (or at least it might be--the questionnaire did not asked for information which would indicate if this were being done). But the other uses of computer applications do involve one of the least desirable forms the innovation can take. CAI and games were reported used by 14% of Language Arts teachers and CAI and games by 22% and 21%, respectively, of mathematics teachers. It is fast and easy to prepare to teach with "canned CAI"--but this is not using the power of the computer as a tool to promote higher order thinking skills, or using its power for easy revision of a product (as word processors, graphics packages and spreadsheets can), or as a quickly searchable source of information (whether it is stored on a disk or on a remote database searched using telecommunications links). Planning lessons which use the computer as a tool for promoting these educational objectives is the most promising configuration of the integrated use of computers in the classroom (Fullan et al., 1989; Technology in Education Committee, 1987).

Hall and Loucks (1981) declare that "our experience has shown that unclear expectations are one way to guarantee nonimplementation" (p. 54). There is ample evidence that "the computer revolution in education" is not only a complex innovation, it is an unclearly specified one. What teachers need to know about computer use has been a matter of constant debate (Blair, 1991, p. 9). This debate has centred around the issue of whether teachers need to be programmers and hardware technicians or whether they should concentrate on competence in using the tools uses in the subject areas they teach (Bruwelheide, 1982; Norton, 1988).

The task of specifying in behavioural terms exactly what the computer applications innovation involves is exacerbated because (1) it is a complex innovation whose essential elements will vary depending upon whom you are talking to (Stasz & Shavelson, 1985, p. 2) and (2) the capabilities of the technology and the software changes so quickly (Fary, 1984, p. 2). Giving direction to use of this innovation is a constant, demanding task that

takes "the insight of a true seer" (Moskowitz & Birman, 1985, p. 7). However, writers in the area of computer applications are almost unanimous in insisting that this innovation should be specified clearly and concretely if we want it to be used (Diem. 1984, p. 14; Moursund, 1987; Preskill, 1988; Schiffman, 1986, p. 9; Stasz & Shavelson, 1985, p. 14; Wedman, 1988, p. 27). Moskowitz and Birman (1985) report that in most of the ten school districts they had observed for 1.5 years, "officials had not tackled [defining the goals of computer use]. Some did not even understand the importance of making the decision" (p. 8). The expectation that each teacher will work this out for himself or herself has been prevalent. Zuk and Stilwell (1984) provide just one example of this common expectation that this innovation can proceed effectively without articulation and leadership:

> Patience, flexibility and freedom for experimentation will have to be accepted until we have all had experience. If the district will provide the opportunities for creativity, good teachers will find the better methods.
> (p. 382)

Woodward and Mathinos (1987) document a case study that illustrates the importance of clearly specifying the innovation in order to bring about desired use. The staff development provided to the teachers in this school was extensive. It consisted of "summer literacy workshops, training of newly hired teachers, and specialised training in the use of Logo, word processing, and management applications. In addition, a building computer coordinator and computer laboratory staff person were available to assist teachers" (p. 1). However, the computers were not only left unused most of the day (p. 2), the innovation that the teachers wanted differed from what the administrators wanted and assumed they had achieved (p. 5). It seems that during these extensive inservice efforts, there was a lack of clear specification of the use of computers that was wanted and therefore of the type of staff development the teachers needed to get them there. Nowhere do Woodward and Mathinos suggest, however, that there was too little staff development or staff development overly directed to learning the software, instead of learning to teach with the software. Rather, they use phrasing that suggests that providing the computer, not

changing the teachers' methods of teaching, is the innovation:

> At the moment it seems that microcomputers could become just another supplementary resource or the vehicle that transforms education. The danger and the opportunity exist side by side. (p. 6)

This statement also illustrates the rhetoric that is typical of computer applications literature and that tends to replace concrete practical suggestions about what is likely to be effective. Nowhere in Woodward and Mathinos was there a list of staff development goals and activities which the authors recommend to increase teachers' processed oriented instruction. These authors do recommend that initial use of CAI may make teachers more comfortable with the machines and so be a good beginning, but they speak in empty metaphor about how to proceed with staff development for this innovation:

> It was clear it was not enough for administrators to state what should be and then expect changes to occur in classrooms. Their role as mediators of the innovation was crucial in creating the bridge that would allow teachers to move from very utilitarian, familiar uses to ones that would truly effect fundamental change in how teachers' [sic] teach and students' [sic] learn. (Woodward & Mathinos, 1987, p. 6)

The CBAM suggests that when an innovation is having a slow rate of adoption and less desirable, down-graded uses of the innovation are being implemented, clearly specifying the innovation components and the configurations that are desirable will help the situation. It will allow the characteristics of effective use to be clearly communicated to teachers (Hall & Loucks, 1981, p. 54). Teachers' use of the innovation can be monitored in a straightforward way through use of an innovation components checklist and inservice training can be targeted to giving teachers expertise in the components of the innovation they are not yet using (Hall & Loucks, 1981, p. 55).

A CBAM Perspective on the Implementation of Computers in Schools

Two assumptions essential to the CBAM are typically ignored in computer applications staff development: (1) implementing any innovation is a complex, multi-stage process involving emerging and developing concerns and changing expertise regarding the innovation and (2) the staff development activities that will be relevant change as teachers' concerns and expertise do. In this thesis, the results of an initial investigation into the appropriateness of these two assumptions for facilitating teachers' implementation of computer applications in their classrooms are reported.

Innovation is a Process Involving Predictable Changes in Concerns and Expertise

In the CBAM, the adoption of any innovation is characterised as a learning process. CBAM change facilitators expect that it will takes three to five years to learn to use a substantially different innovation effectively (at the Refinement Level of Use) (Loucks & Pratt, 1979). This means they avoid the kind of unrealistic pressure that administrators or change facilitators can apply if they think of a change as an event.

In 1991, staff developers working in the computer integration area are still explaining the need for everyone concerned to see innovation as a process.

> As teachers, merely accepting a professional responsibility to become computer competent is not enough. Effective staff development must be seen as a *process*. As part of this process, teachers need time to learn and practice using the computer....Teacher support may be provided through consultants, but also through interaction with peers as they work together, brainstorming and designing projects and sharing failures and successes at comparable stages of learning.
>
> As educators, we know these things. We don't expect out students to learn a foreign language, or algebra, or how to read in a day, a week, or even a month. As teachers, we break the process into small steps, allow time for practice, encourage peer support, reward successes along the way, and above all, help our students trust the learning process--even when the process is unquestionably slow at times. We owe ourselves no less than that. (Gunn, 1991, p. 12)

This is in contrast to the norm for computer applications where change is often conceptualised as being an event and use-nonuse a simple dichotomous state. Geisert and Futrell (1990, pp.226-230) give us a prototypical account of a school's receiving hardware but very little software and no staff development. Although the teachers were initially interested, they became confused and alienated as they could find no place for computers in their teaching. This scenario has been frequently replayed as documented by Bliss, Chandra, and Cox (1986), Jenkins (1983), Maddux, (1989), Ream, (1991), Preskill, (1988), Stevens, (1984) and Zuk and Stilwell, 1984. The practice of equating bringing "the computer revolution" about simply by providing hardware to schools was so prevalent that Cory (1983) built it right into her "4-Stage Model of Development for Full Implementation of Computers for Instruction in a School System" (p. 11). At both Stage 1, Getting on the Bandwagon, and Stage 2, Stage of Confusion, "acquisition of hardware is the primary focus" (p. 12).

The CBAM uses the Levels of Use and Stages of Concern to identify significant milestones in the use of an innovation so that everyone involved (administrators, teachers, change facilitators) will know that time and effort are resulting in progress--even if use of the innovation has still not reached routine use by the time it is evaluated (Hall & Hord, 1987). In the Levels of Use scale, nonuse has three levels, use has five. This is in contrast to the way teachers' computer use is conceived of as a use-no use dichotomy.

In the computer applications literature, there are claims of almost "magical" success--with little or no mention of teachers' implementation problems and hurdles (D'Ignazio,1990). The tendency to view teachers' computer use as an event rather than a learning process is also seen in the amount of extensive effort that have sometimes gone into formulating policies for educational computer use but which are unaccompanied with a corresponding detail of how these policies are going to be implemented (Technology in Education Committee, 1987; Vakos, 1986).

In the CBAM, individual innovators are expected to change both their concerns and their level of expertise with an innovation. It is particularly important to assess and deal

with these on an ongoing basis as as they are expected to change throughout the entire innovation process. Both Stages of Concern and Levels of Use develop in a predictable and necessary sequence. Each phase involves real problems and challenges which must be resolved before an individual non-user will be able to learn to use an innovation effectively. Problems individuals are experiencing, particularly with high Stage 2, Personal Concerns and serious LoU III problems of Mechanical Use, must be addressed by staff development support (Hall, 1979; Hall, Loucks, Rutherford & Newlove, 1975). Hall (1979) observes, "It is not possible to simply inform a person to 'get rid of your personal concerns....' That process requires work by all who are supposed to be supporting professional teachers as they attempt to develop new skills" (p. 208).

In the computer applications area, it is more common to present the conclusion that adoption of the computer applications innovation is progressing so slowly because teachers have a motivation problem and as a group are resistant to change (Balajthy, 1988; Cuban, 1990; Friedman, 1985; Stieglitz & Costa, 1988; Wolcott, 1981). Cuban (1990) and Wolcott (1981) bring high powered theories from political science and anthropology, respectively to analyse the meaning and power structures that leave teachers free to "shut their classroom doors and proceed as usual" even in the face of demands for change. These authors assume that it is true that the teaching profession is resistant to change. They do not ask if the teachers have been provided with the necessary curriculum materials and retrained in the skills necessary to use the innovation. Friedman (1975) devotes nearly his whole article to describing teacher's emotional resistance to computers. In his conclusion, he does mention that "it's important to recognise the specific skills and knowledge that teachers want and need in order to become more effective computer-using teachers" (p. 15). However, he does not recommend that any staff development activities be offered to teachers to help them do this. He merely states, "We should encourage teachers to learn..." (p. 15).

Steiglitz and Costa (1988) surveyed the participants (elementary and secondary teachers) in Rhode Island's state-wide inservice program to estimate the degree of computer use these teachers practised with their students afterwards. This inservice plan consisted of

three workshops giving 12 hours of introduction to computer applications, followed by another three offering exposure to more advanced topics in educational computing. Steiglitz and Costa found that 89% of the respondents agreed or strongly agreed that "Students can benefit from the use of microcomputers in the classroom" and 73% agreed or strongly agreed that "Teachers should integrate the microcomputer into the curriculum" (p. 95). Unfortunately, the implication here is a common one in the computer applications in education area. Steiglitz and Costa (along with the designers of this state-wide inservice initiative) appear to have expected that positive attitudes and a very small amount of inservice training would automatically lead to high levels of computer use. They find this result so puzzling they do not even suggest directions for further research in the following conclusion of their article:

> Finally, a positive attitude toward microcomputers does not always lead to a high level of use. Less than half the respondents indicated they are using microcomputer for instruction or for other professional purposes. For those using a computer for instruction, the simple drill-and-practice type of program was the most popular. For teachers using a computer for professional purposes, the number of hours per week devoted to accomplishing certain tasks was relatively small.
>
> In closing, the data from this study show that a state-funded training program can serve as an effective vehicle for introducing large numbers of teachers to the educational applications of the microcomputer. However, the data also reveal that the majority of program participants are not using microcomputers with their students. Future research efforts must be directed toward explaining why teachers who have access to microcomputers fail to make greater use of them. (pp. 97-8)

This belief that teachers' attitudes to using computers is the essential component behind high levels of successful classroom use appears in other writers in the computer applications field (Knupfer, 1988; Wedman, 1988; Winner,1982). A CBAM change facilitator will not expect teachers to have all the skills they need after a few hours of introductory inservice demonstrations.

Knowledge of the Levels of Use scale leads them to expect individual problems and impediments to arise during the Mechanical Level of Use (LoU III). When mechanical problems impede effective use of an innovation, teachers do often exercise their

professional judgment and decide that "This innovation is not for them" (Gross, Gianquinta and Bernstein, 1971). Steiglitz and Costa did ask respondents to indicate (1) the number of hours they were using computers "for instruction or other professional purposes" (p.96) and (2) which applications they were using. However, they do not enquire about the experiences of teachers that are even more important in the CBAM perspective on staff development. They do not ask (1) how many teachers tried to use computers with their students only once or twice and (2) what problems made them stop. CBAM change facilitators assume that implementation support is necessary for most teachers and would want to know the specific problems that arose so that staff development support could be delivered to that teacher. Then, and only then, would the CBAM model assume that the degree of use would rise substantially.

There is frequent confusion in the computer applications literature between resistance which arises from some teachers' deeply rooted negative attitudes to change and hostility to an innovation which results from meeting too many unresolved problems as they tried to use it with their students. Comments stemming from teachers showing Stage 2 (Personal) concerns are intermingled with comments from those experiencing Level of Use III (Mechanical) implementation problems in spite of the fact that they need two different types of staff development interventions. To give a brief example, Wedman (1988) lists several comments of teachers expressing personal concerns and problems associated with the Mechanical Level of Use. Comments like "There are too many things to keep track of" are not differentiated from ones like "I don't want anything else to do with computers (p. 26)." Use of the CBAM diagnostic dimensions keeps separate these two distinct types of problems. This is important because Personal concerns and lack of resources and support for Mechanical problems are best addressed and resolved with different types of staff development activities.

Both concerns and the knowledge and skills needed for effective use of an innovation can be addressed through staff development efforts. The CBAM literature is full of descriptions of the needs of each Stage of Concern as well as of each Level of Use and

also provides many examples of appropriate, relevant staff development activities that can be used to address and resolve both Concerns and the learning needs of each Level of Use (Hall & Hord, 1987, p. 346). Wedman (1988) speaks about the concerns and attitudes of teachers which can impede their use of an innovation as "Execution deficiencies" (p. 28). Unfortunately, this is all too typical of computer applications staff development. It often fails to legitimise teachers' concerns, let alone make them the target of staff development interventions.

Treating the issue of the widespread adoption of computer applications as an event that succeeds if teachers sincerely have positive attitudes about it and fails when they do not has not resulted in a high degree of classroom use. The CBAM has also found that staff development activities change in their degree of relevance to the concerns and skills that emerge throughout the entire innovation process. In the next section of this chapter, the extent that computer applications staff development has recognised and provided a succession of staff development support during the whole innovation process is examined.

Staff Development Must Meet Teachers' Developing Needs

Change facilitators working within the CBAM's outlook will expect the innovating teachers to go through a series of developmental stages in both their concerns and their expertise with the innovation. Each of these stages is qualitatively different with its own interests, needs, problems, knowledge and skills that need to be learned. It becomes essential to know the Stage of Concern and Level of Use of teachers in order to know which staff development activities are appropriate to plan. Each time a teacher masters some aspects of using the innovation, they then face new demands for further information and for the further acquisition and practice of skills. The teacher-innovator's Stage of Concern, their Level of Use and the parts of the innovation (the innovation components) that they have mastered and are using effectively will change continually throughout their adoption of

the innovation (Hall & Hord, 1987, p. 17, p. 87, p. 339). These changes need to be regularly assessed (Sparks, 1983, p. 66) so that staff development can be planned to met needs, interests and goals as they emerge (p. 104).

Within the CBAM, teachers, administrators and change facilitators no longer expect that any one type of training or implementation support will be sufficient to "make an innovation happen." Nor do they expect that **one type** of inservice **given once** will be equally effective for all persons regardless of their level of use of the innovation. Once the needs, problems, interests and goals that characterise each Level of Use are known, it is possible to anticipate, plan for and provide the type of training and implementation support that is likely to be most relevant to innovators at each level. In the rest of this chapter, the staff development typical for the CBAM will be contrasted to that for computer applications.

(1) Staff Development for Computer Applications is Sparse

It appears that not only are computer applications inservice and implementation support not only not given regularly over the entire innovation process, they seem to be rarely given at all (Knupfer, 1988, pp. 37-8). After conducting an extensive literature review of computer applications staff development and surveying 60 outstanding teachers who made extensive use of computers to teach math and science, Stasz and Shavelson (1985) concluded

> However, few districts have the facilities, resources, staff, and reward structure to offer a systematic training program for microcomputer-based instruction (Sturdivant, 1983). Moreover, such efforts typically fall short in the number of teachers trained, in the length of training, in the amount of "hands-on" experience provided in the topics covered, and in the provision of in-class follow-up after the staff development activity. (p. 1)

These authors appear to be aware of some of the necessary components for effective implementation support; but they observe that this knowledge is not widespread among computer application staff developers (p. 2). Computer applications resource people often

have either an instructional design and/or an educational psychology background. They are knowledgeable about how to provide effective training sessions and about the psychological factors involved in the act of "learning a lesson" but are often not familiar with the extensive literature on the adult learner (Brundage & Mackeracher, 1980), on the process of school change (Fullan, 1982), or on models of staff development (Orlich,1989).

The Office of Technology Assessment (1988) found

> The vast majority of those now teaching or planning to teach have had little or no computer education or training. The most recent data available indicate that only one-third of all K-12 teachers have had as much as 10 hours of computer training. And much of this training focused on learning *about* computers, not learning how to teach *with* computers. (p. 18)

Boe (1989) aptly terms the educational use of computers "The Revolution that Money Couldn't Buy (p. 39)" and provides us with this description of its tactics:

> During the early stages of technology implementation in schools, training was often overlooked entirely. Machines and software were purchased, installed, and pushed at teachers. Where training was part of a school's technology plan, the rules of effective change were often sidestepped. Administrators sometimes stayed clear of the whole process. Computers were introduced into the curriculum as ends in themselves, and teachers were trained to teach artificial courses in computer familiarity. Trainers who had the requisite technical expertise but no understanding of the culture of school teaching were hired. Teachers were often provided with neither the time not the resources to follow up their training with practice. (pp. 39-40)

Evans (1986) takes a perceptive look at the hardware and software that are likely to be most useful in schools, given our educational goals and almost totally neglects specifying staff development activities. By 1992, we can see he was often insightful about the hardware and software which would be educationally sound to use. However, he "reduces" the whole problem of implementation by teachers to a "battle." He recommends that unconvinced teachers should merely be "placed where their influence will be felt less" (p. 68), while, in his view, school administrators would ensure the success of the computer revolution in their schools by competing with other administrators for as many resources (hardware and software) as they could obtain.

Nuccio (1990) reports "Only three states require teacher inservice in the area of technology while an additional fifteen recommend this type of training" (p. 283). He concludes, "This level of state involvement is woefully inadequate given the type of problems that veteran teachers report when using computers in the classroom" (p. 283).

Moskowitz and Birman (1985) describe the initial efforts to make educational use of computer applications in ten geographically spread out American urban and suburban school districts between late 1982 and early 1984. The picture is one of aimless anarchy. In a few of the districts they observed, administrators had bought machines but they were not being used because the teachers did not know how to use them. One district was training teachers as fast as they could but was not providing them with any kind of [illegible] plan for what was to be taught (pp.7-8). Moskowitz et al. observed that the most frequent and serious difficulties were

> (1) lack of clearly presented goals for computer activities;
> (2) lack of implementation plans;
> (3) the assurance of access [equity] (p. 8).
>
> Officials who were acquiring hardware at a rate that exceeded their acknowledged ability to train teachers or develop curriculum exuded confidence that everything would "work out." This sense of confidence and optimism was found in nine out of ten of the districts. (p. 9)

This situation is still being recognised and addressed in 1992. For example, the Rocky View School District, a fast-growing, suburban-rural district close to a major Canadian city (Calgary), decided only in October, 1991 that rather than react piecemeal, it was time to develop a five-year plan for the implementation of technology. They then began a "Strategic Planning Process" (John Znider, Personal communication during an Action Team Meeting, March 9, 1992).

In the December/January, 1991-2 issue of ISTE Update, Knezek calls for "new" ways of effecting the slow pace of the adoption of educational technology by educators. He suggests, "Lets try smarter rather than harder":

> Without an infrastructure that includes adequate and appropriate 1) access to technology, 2) staff development and training, 3) on-site context sensitive support, 4) communications, and 5) planning and evaluation, chances of success are not great. Implementers need input into how technology is applied. Microteaching and peer observation too often are not available to teachers yet it is very difficult to learn a new dance if you have never seen it done! (p. 3)

(2) Computer Applications Inservices are Often Inappropriately Taught

Stasz & Shavelson (1985) point out that the inservice topics that are needed will vary with a teachers "experience or computer expertise" (p. 7), but teachers' needs for microcomputer topics varies also with the demands of their teaching situation" (p. 8). Stasz et al. found one of the most important topics for teachers' staff development was far too rare in the literature they reviewed:

> A critical element of staff development, and one that we saw most lacking in our study, is training on how to integrate the microcomputer-based instruction with subject matter and class activities. Simple logistical procedures should be considered, such as rules for student use, transitions between computer and non-computer activities, and grouping strategies.... [Teachers] need sufficient information to begin to make reasonable choices about matching the computer and available courseware to their instructional goals, the structure of the subject matter, the nature of the students, and the content of instruction. Moreover, they need to acquire interactive teaching skills that will help them carry out their plans, monitor and evaluate instructional activities, and make adjustments when required. (p. 16)

Without the knowledge and skill to do these things, the CBAM predicts that teachers will find the problems they encounter when they first begin to implement the innovation, i.e., at the Mechanical Level of Use, insurmountable.

Computer applications workshops are too frequently given by non-educators, by people who are knowledgeable and excited about the technology from the point of view of "the latest". They are uninformed about the needs and realities of classroom teaching and fail to meet those needs (Baird, 1985; Benson, 1984, p. 75; Collis, 1988, p. 316; Neiss, 1990, p. 11; Wedman., 1988; Winner, p. 155). This is one source of the reputation inservice has for being irrelevant (Johnson & Johnson, 1980). Stasz and Shavelson

(1988) report that many teachers are vocal about wanting staff development "that is immediately applicable to [their] instructional needs. [They say,] 'Give teachers something they can do on Monday'" (p. 14).

In inservice courses, teachers are often taught as students who are to learn the software, not as teachers who are going to use it to teach their subject areas more effectively (Boe, 1989, p. 41; Fisher, 1991, p. 3). Teachers, as longtime students, fall into the trap. Davis, Helms, Norman and Ponte (1984) report the effects of teaching Logo to elementary school teachers during a two week summer camp. The inservice was trying to prepare the teachers return to their classrooms and use Papert's (1980) ideas about active learning, problem-solving and having a positive attitude to mistakes. The teachers worked hard on their Logo programs, but ended up using Logo to design their own drill and practice and tutorial programs. "Most were not planning to have their students become actively involved in writing computer programs" (p. 22). These workshop deliverers realised that they had taught their teachers Logo and not how to teach with Logo as they had intended. They suggest that their camp would have been more effective had they required the teachers to

> ...identify and examine areas in the curriculum where students' learning would be enriched by writing programs....[and] produce sample programming tasks for students involving the material that is usually taught (p. 22-3).

(3) Effective Staff Development Involves More than Just Workshops

Computer applications staff development seems to rely almost exclusively on the quick, hands-on, half-day workshop (or perhaps a series of three or four workshops) which offer teachers the bare minimum knowledge and skills they will need to handle the mechanics of using the hardware and software. These are usually given at the beginning of the teacher's acquaintance with the innovation. The teachers are then left all on their own afterwards to implement the innovation. The CBAM perspective suggests this is too little staff development--given at the wrong time. Although some computer applications staff developers concur. For example, Stasz & Shavelson (1985, p. 6) state that this awareness

is rare among staff developers, but not among computer-using teachers. The teachers responding to Stasz and Shavelson's (1985) survey reported preferences for their own staff development that are quite similar to the activities CBAM change facilitators have found effective (Loucks & Zigarmi, 1981):

> [They wanted] a series of meetings, held during school hours or after school, located on-site, averaging about 13 hours in duration with as much hands-on practice as possible. One additional recommendation was to involve students in the staff development activity as a way to see how the courseware works with its intended audience...
>
> The teachers also recommended varying staff development activities in level of sophistication and topic, in order to meet the needs of teachers at different stages of microcomputer use...[with teachers [free to] attend only those sessions that fulfilled their needs. (pp. 12-13)

Winner (1983) gives us a description of the efforts to introduce computers into the classrooms of the United Nations International School. School climate was supportive of change (p. 156). Inservice training was given in the form of workshops. One-third of the staff participated regularly throughout the school year (p. 156) and "all participating teachers used the computer in their class at least once during the training period; and some went much further" (p. 163). We are not given a complete list of workshop topics. Programming is most often mentioned in passing as the focus of workshop. Winner is definitely focussed upon the training sessions themselves as the significant form of staff development. She sees them as primarily responsible for any implementation success the teachers achieved. Her evaluation of her school's staff development effort takes the form of table after table of participant ratings of how the workshops themselves were conducted.

Reading this article from the CBAM point of view, two comments that Winner mentions in passing raise the question of the effectiveness of these workshops. She states:

> [Teachers] felt that they did not have enough time either during the school day or on their own to fully explore and experiment with the material introduced at the workshop sessions. The greatest strength of the series, as perceived by the participants, was the introduction of new ideas in familiar, non-threatening surroundings by a colleague. (p. 160)

From the CBAM perspective, this type of activity would be expected to raise awareness, but not to produce wide-spread, effective use of computers in classrooms. Teachers in this school are reported to be "committed to continuous development" (p. 156). But this is often not enough, particularly given the comment above that these teachers lack the extensive amounts of time to put an innovation into practice by themselves. This seven page article gives the impression that the inservices are nevertheless sufficient to account for the implementation success here. If this is not true, giving the impression that awareness raising workshops did the job is a disservice to future computer applications staff development efforts. In the whole article, there is one sentence that provides the kind of explanation for the success that any CBAM change facilitator would expect was necessary. Winner mentions this in passing and never again refers to it. The teachers certainly rate it as important, although, not working on the CBAM assumptions, Winner briefly mentions but never again refers to the staff development activity that any CBAM change facilitator would suspect was in fact responsible for the success this project achieved:

> And, of significant importance was the supportive assistance provided in the intervals between the bi-weekly training sessions held throughout the school year. This individualized assistance between sessions proved to be as important as the regularly scheduled instruction. (p. 157)

(4) Support during the Mechanical Level of Use is Critical

Leaders in the field of computer applications staff development continue to announce the need for the provision of more follow-up for innovating teachers, follow-up that is conceived of as more than "hand-holding" (Boe, 1989, p. 41-2; Clemente, 1991, p. 29; Collis, 1988, p. 316; Fullan et al., 1989; Lindsay & Marini, 1989).

Aside from needing support with logistics as they begin to implement an innovation in their classrooms, teachers do appear to need time to work independently in order to become comfortable using the technology themselves (Gunn, 1991, p.10; Schrum, 1991,

p. 10; Stasz & Shavelson, 1985, p. 6). The CBAM assumes that there will always be mechanical problems regardless of the teachers' ability to ultimately use the innovation effectively--these are seen to be an inevitable outcome of adapting the knowledge and skills involved in an innovation to a particular teacher, class and school.

In their composite characterisation, Geisert and Futrell (1990) describe teachers' reactions when they receive too little help with problems at the Mechanical Level of Use:

> Initially, most of the teachers...seemed willing to give the computers a try, at least for a while. But, if the barriers are too high, or if computers do not fit into a normal routine, or if computers cannot demonstrate effectiveness, or if the machines do not begin to contribute soon in some effective way, the technology's early welcome is very likely to wear thin. (p. 231)

This is not just the case when the innovation is teaching with computer applications. Gross, Giaquinta and Bernstein's (1971) case study of a school's trying to switch suddenly to open classrooms with activity centres rather than teacher directed lessons documents the same progressive disenchantment. There was too little support for the teachers during the inevitable problems that arose during implementation and the teachers began to resist using it. These observers recommended:

> In conceiving of educational change as a complex process, administrators will also need to recognise that most innovations require considerable alteration in the usual patterns of teacher behavior. To break away from old modes of behavior and begin to act in new ways is no easy matter and may take considerable time.
>
> Administrators also need to be aware that in the process of their staff's attempts to change from old to new behavioral patterns, some stressful periods are almost sure to occur. Although likely to appear to teachers as setbacks, such periods may actually constitute required forward steps toward the implementation of an innovation. If administrators anticipate these periods, and recognise that they probably are largely functional in "unfreezing" old patterns of behavior, then they will be prepared to provide, at the right times, the types of support and help teachers require if they are to benefit from these experiences. (p. 209)....Our study also stresses the need for management to think through a strategy which emphasizes *its* leadership role not only in setting new goals and initiating innovation..., but in seeing to it that the organizational conditions it specifies as necessary for implementation are established and maintained. (p. 215)

Nuccio (1990) observes

> Initially, the use of computers gets in the way of and takes more time when used with the lessons that the teacher knows how to teach...without models to emulate (and to verify the effectiveness of this new method of instruction), veteran teachers seem reluctant to change. (p. 283)

Gunn (1991) presents the results of a study that did try to give support at the Mechanical LoU and the experienced emphasised to her how immense and difficult it is to make a significant innovation. She reiterates that teachers need help, not censure:

> A study I completed last spring,...gave me the opportunity to see first-hand some of the very real obstacles that prevent teachers from integrating technology into their classroom curricula. If we are to do more than pile more guilt on teachers, we need to develop some strategies that address the problems they face. (p. 8)

Gunn gives us a litany of personal and classroom obstacles that interfered with a grade one teacher's attempt to have her students use a word processor during their Writer's Workshop activities (p. 9). This classroom teacher tried to learn how to use a word processor as she planned and delivered a demanding Language Arts program. By April, she still did not know how to respond to the prompts to save correctly (p. 10). This teacher remained "extremely dependent" upon the computer consultant throughout the whole year. Yet she was initially willing to learn to use the word processor. Gunn concludes that there was insufficient attention paid to the idea that there are Levels of Use to pass through in learning to use an innovation. She observes

> This was a time of risk-taking, of problem solving, and Lynne's sole role model was a computer consultant... [With access to peers attempting the same innovation,] Lynne could have been celebrating each risk taken, each problem solved, and each small step with others who were also taking risks, solving problems, and taking small steps. Teachers working together, sharing failures, successes, and strategies at comparable stages of learning, is an important component for effective implementation of curricular changes. (p. 12)

However, recognition of this need is beginning. Teachers are calling for implementation support. Stasz and Shavelson (1985) report this from their survey of

computer-using science and mathematics teachers:

> During implementation, teachers need a variety of support services or expert resources to assist with hardware repair, evaluation, selection, and modification of courseware, an day-to-day troubleshooting. At the very least, teacher-networks might be formed to exchange ideas and experiences concerning microcomputer-based instruction. (p. 15)

Writers are recommending that it be so--with a degree of explanation as to why and a tone that implies it is not yet done. Ragsdale (1982) insists that implementation support is essential:

> The major component which all inservice programs must contain is the continuing, interactive consultation and support for teachers who are attempting to incorporate the use of computers in their classrooms. This attempt to change their behavior will produce stress, and any further increase in frustration for teachers, due to inadequate support, could cause serious damage to any attempts to make effective use of computers in education. (p. 48)

Strundler is still actively justifying and stressing the need for implementation support in 1991, quoting the conclusion from a classic nation-wide case study of innovating schools reported in 1982 as he does so:

> In all cases, being available for follow-up support seems critical in providing technical assistance as well as personal reassurance....As Hubermann and Crandall (1982) state in their study of innovative programs, 'Innovations entailing significant practice change, live and die by the amount of assistance they receive.' (pp. 7-8)

Stevens (1984) concluded on the basis of survey results that

> Computers fail in classroom instruction because of ...(3) teachers [sic] attitudes and lack of skills to implement instructional computing, and (4) principals who do not effectively manage the change process necessary to implement computers in classroom instruction. (p. 370)

Stevens shows an understanding very similar to CBAM's regarding how complex and

difficult adopting the computer applications innovation is and what we must try to do to facilitate it (pp. 374-5). Unfortunately, Stevens does not follow-up her description of what happens during the implementation of computer applications in classrooms with specific suggestions for appropriate staff development activities. She mentions "the wisdom of Solomon" is necessary and "Multiple resources will need to be made available to staff members" (p. 375). However, she calls for general truisms such as, give teachers time (one to three years), have teachers take small steps at a time and reward their efforts, do formative evaluation and make all of your decisions to proceed or draw back on the basis of empirical data.

Nathan (1991), an experienced Michigan Language Arts consultant, makes these recommendations which she feels are essential for effective staff development:

> Inservices should be repeated whenever possible. It's hard to learn something in one shot (which is often the expectation). Related to this is follow-up. Many teachers are willing to try new techniques, but would appreciate follow-up sessions with professionals to work out details, handle trouble spots, and discuss extension, integration, and evaluation issues. (p. 5)

Lindsay and Marini (1989) describe well-organised, intensive training and implementation support given to a staff of 24 teachers at a residential school for students with learning disabilities. Half of the staff and many of the students were using computers in a productive and fulfilling way by the end of the three year project. There had orgiginally been a plan to provide weekly indivdual consultation with lessons and trouble-shooting for inoperative equipment by the staff developers. However, this vastly underestimated the amount of implementation support needed even by these enthusiatic, dedicated teachers if they were going to be able to learn to use the innovation. Some weeks, the staff developers were at the school daily. (Anthony Marini, Personal Communication, June 15, 1992).

(5) A Variety of Staff Development Activities is Needed

Nathan (1991) recognises the importance of ongoing support--but is still looking for that one type of effective inservice for all occasions. This is an example of what even an experienced, insightful staff developer can learn from the CBAM assumptions: we should stop looking for one, all-purpose type of effective staff development activity.

> Ongoing inservice must be provided once the change has begun. Some districts offer inservice beyond initial encounters with "experts." This is necessary for many reasons, but one that stands out is morale. When change is seen as something that occurs over time, teachers don't feel they need to be comfortable with the change(s) right away. Recently, peer coaching has served as a type of ongoing inservice and seems to be a trend that might effectively replace our continual dependence upon inservice that, historically, has taken the form of workshops or lectures. (p. 5)

From the CBAM perspective, peer coaching is not seen as a replacement for workshops and lectures. The latter are effective ways to increase teachers' knowledge and skills about an innovation in a necessary way that peer (not expert) coaching cannot be expected to do. Yet lectures and workshops ineffective for implementation support, while peer coaching appears to be a very effective way to support teachers as they begin implementing innovations in their classrooms (Garmston, 1988; Joyce & Showers, 1982; Moursund; 1988).

The Investigations in this Thesis

(1) Is innovation a complex multi-stage process?

The CBAM assumes that any innovation process is made up of a succession of the eight Levels of Use which the model describes. This expectation was tested in this thesis by carrying out an analysis on survey data which consists of information about elementary and secondary public school teachers' attitudes to using computers with their students,

about their past, present and future use of various computer applications. These data were used to form operational definitions of the first six CBAM Levels of Use. Frequency counts were used to establish whether or not there are teachers at each of these Levels of Use.

(2) Do teachers' staff development preferences change with their Level of Use?

The CBAM change facilitators operate on the assumption that teachers at different Levels of Use have different interest, needs, problems and goals concerning an innovation and will find different types of staff development support most appropriate for addressing and resolving them. Discriminant analysis was performed on the data from 20 staff development items to test whether or not teachers at each of the first six CBAM Levels of Use do report preferring significantly different types of staff development.

The CBAM literature presents many descriptions of activities which are found to be effective at addressing the needs and interest of various Levels of Use. The data analysed in this thesis extends the investigation of the types of staff development support that are seen as relevant by teachers classified into each of the first six Levels of Use. Teachers were asked about what formal role they would like a staff developer to have (for example, peer, consultant, or principal), what forms of organisational support they need, and how effective they find self-instruction activities.

The investigations of this thesis depart from standard CBAM procedure in that it was the relationship between Levels of Use and staff development preferences that was investigated. CBAM researchers always begin diagnosing staff development needs by assessing the teachers' Stages of Concern profiles. Moreover, they insist that Level of Use cannot be identified reliably unless teachers' classroom use has been observed or, at the very least, unless the teachers have each been interviewed (Hall & Hord, 1987). Although both Level of Use and Stage of Concern contain useful information, it is more efficient and easy to obtain a measure of teachers' progress in implementing an innovation by using one

measure rather than two. If the Levels of Use scale is used, then the staff development needs and objectives are being framed directly in terms of what is to be supported, namely the skills the teachers need to make effective use of the innovation.

CHAPTER III

Method

Research Design

In this thesis, an analysis of three year old survey data is reported (Jardine, Rilstone & Hunter, 1989; Jardine, Rilstone & Hunter, 1990). In this survey, teachers reported their interest in, and use of, computer applications in all subject areas. They also reported their relative agreement or disagreement to Likert items inquiring about their staff development preferences.

For this analysis, the first six CBAM Levels of Use were operationally defined in terms of the teachers' reports of their interest in and current and planned future use of computer applications. Frequency counts were used to investigate whether or not this sample contained teachers at each of these Levels of Use.

Since this is an initial, exploratory analysis, step-wise discriminant analysis was performed on the Likert items to investigate whether or not teachers at different Levels of Use do report preferring significantly different types of staff development activities.

Subjects

The original questionnaire was sent to 1,000 classroom teachers (a 10% sample). The computer consultant from the Calgary Public Board of Education's Human Resources Department provided the researchers with a list of teachers' names and school addresses which had been randomly selected from a database of all teachers currently employed full-time by this Board. The sample was stratified by division. There were 500 kindergarten to grade 6 teachers, 200 junior high and 300 senior high teachers in the sample.

This large board is one of two serving a Western-Canadian city (population in 1991: 705,550). Calgary contains one university and two technical and applied arts colleges which offer various computer applications courses. Calgary is also a city with a large number of industries which make extensive use of computer technology.

The data being analysed was provided by 559 respondents.

The proposal for this study was approved by both the University of Calgary and the Calgary Board of Education Ethics Committees.

Materials

The Questionnaire

The original questionnaire was developed to collect reports from teachers about the types of training and implementation support (staff development) they felt would help them become able to use computer applications appropriately in each of their subject areas (Jardine et al., 1989; Jardine et al., 1990).

Students (who either were or had been educators) and their professor researched and designed this questionnaire in a graduate level course entitled Computer Applications in Education.

The survey contained four sections (See Appendix C). The first three sections asked for information pertaining to these three questions:

(1) Do YOU think that computers will be playing a larger role in education in the future?

(2) How are computers used in YOUR classroom?

(3) What would be effective ways for YOU TO LEARN to integrate computers into your curriculum?

In the fourth section, the respondents were asked for demographic information which the researchers felt might be relevant to the teachers' reported learning preferences.

Responses to the question, "I have no interest in using computers with my students" (Section I, question 5) and the teachers' reports of their present and planned future use of computers (Section II, questions 2 and 3) were combined to form the operational definitions of the first six Levels of Use in the CBAM (See Table 3).

Twenty of the 22 Likert items in Section III were used in the analysis of teachers' reported staff development preferences. Two questions were eliminated from this study's analysis because they were poorly written:

(1) Question 5, "I want to take a computer-related course, but I do not know where to start." is a double-barrelled question.

(2) Question 22 asked respondents to agree or disagree to "I feel it should not be the responsibility of each individual teacher to determine how computers are to be integrated into the curriculum." The difficulty of the task of agreeing or disagreeing to a lengthy, syntactically complex sentence which also contains a negative makes this question much more difficult to comprehend than any of the others in the questionnaire and answers to it may be unreliable for this reason alone (Carpenter & Just, 1975).

Procedure

The Pilot Study of the Questionnaire

The principal of an elementary school located in an adjacent, rural/suburban, public school board agreed to let one of the researchers contact his staff to ask them to volunteer to be subjects in a small pilot study. A cover letter asked these teachers' assistance in identifying any items in the questionnaire which they found confusing or irrelevant. There was a 50% response rate in this pilot study. None of the teachers indicated that any questions were confusing or objectionable. Therefore this version was used in the larger study.

The Administration of the Questionnaire

Administering the questionnaire was a cooperative venture between university-based researchers and the administration of the Calgary Public Board of Education. The subjects were mailed the survey through this Board's internal mail system. A cover letter stated that the Board was supporting the survey and would be given a summary of the results even though it would not be directly involved in the data analysis. Principals of all of the Board's schools were sent a letter requesting that they mention the survey to their staff and ask for each teacher's cooperation. However, the cover letter sent to individual teachers clearly stated that each teacher was free either to participate or decline.

Within two weeks of mailing out the questionnaire, the researchers had received 59% of them back. No follow-up of non-respondents was done since it had been decided previously that there would be no follow-up attempts provided there was at least a 40% response rate.

Individual teachers marked their responses directly on their copy of the questionnaire and again used their internal mail system to return it in a self-addressed envelope to one of the researchers who was currently teaching for this Board.

The Research and Measurement Department of the Calgary Board of Education worked from a codebook designed by the researchers to enter all responses into a machine readable file. All analyses reported in this thesis were done on this file.

Operational Definitions of the Levels Of Use

The eight CBAM Levels of Use are primarily defined in terms of (1) how interested the teacher is in the innovation and (2) his or her planned or current use of it. The first six CBAM Levels of Use were operationally defined in terms of these questions. Table 3 presents the definitions used for each Level of Use in all of the analyses of this thesis.

Respondents had answered strongly agree, agree, undecided, disagree or strongly disagree to this question: "I have no interest in using computers with my students." The teachers had also been asked to indicate any subjects in which they used the following applications: CAI (Drill and Practice, Tutorials, Simulations), word processing, desktop publishing, database, spreadsheet, electronic mail, graphics package, games, Logo, Pascal, BASIC, or Other Uses. Teachers reported their use of these applications in the year previous to the survey (in 1988-89), for the current year of the survey (1989-90) and also reported all of the applications that they would like to be using in various subjects by the year 1995 (assuming the necessary hardware and software to be available).

The final two CBAM Level's of Use, Integration and Renewal, could not be measured by any questions in the survey. The exploratory analyses of this thesis therefore investigated the relationship of Level of Use and staff development preferences for teachers up to and including the Refinement Level of Use only.

Verification of Existence of the Levels of Use

The frequency of teachers who could be classified into each of the operationalized Levels of Use was calculated to test the CBAM assumption that change is a process consisting of discrete, developmental stages.

Investigation of Staff Development Preferences

A stepwise discriminant analysis was performed to test whether or not the staff development Likert items could successfully distinguish all six of the operationalized Levels of Use.

Pooled within-groups correlations between each discriminant function and its discriminating variables were examined to identify the cluster of variables that was important for defining each of the mathematically distinguishable groups. The staff development variables that had the strongest single effect of distinguishing the groups with the effects of correlations between the variables removed were also identified.

Table 3

Operational Definitions of the First Six Levels of Use in the CBAM

LoU	I have no interest in using computers with my students.	AND	Present Use	AND	Future Use	Frequency (N = 531)
0	A or SA		= 0		= 0	27
I	U		= 0		= 0	19
II	D or SD		= 0		≥1	70
III	D or SD		≥1		= 0	44
IVA	D or SD		-		Fut = Pres	102
IVB	D or SD		≥1		Fut > Pres	195
Unclassifiable	N/A		N/A		N/A	74

CHAPTER IV

Results

In this chapter, the frequencies are reported that establish whether or not there are teachers at each of the first six CBAM Levels of Use as operationalised in this study. This is followed first by a description of the data used in the stepwise discriminant analysis which tested whether or not groups show significantly different staff development preferences and secondly by presentation of the results of that test which was carried out on cases from Levels of Use II, III, IVA, and IVB.

(1) Verification of the Levels of Use

The frequency of teachers in this sample who were classifiable into each of the first six CBAM Levels of Use was calculated for all 531 respondents. As Table 3 indicates, there are teachers at each of these Levels of Use, although the number of respondents for each Level varies widely. Four hundred and fifty-seven respondents were categorised. Seventy-four did not fit into classification rules for any Level.

(2) Differences in Staff Development Preferences between Levels of Use

A stepwise discriminant analysis was calculated to investigate whether or not the respondents at each Level of Use reported significantly different staff development preferences.

Missing Data

Levels of Use 0 and I contained only 27 and 18 cases, respectively. These groups are too small to use in a discriminant analysis, particularly one which uses 20 predictor variables. Therefore these groups were eliminated. The discriminant analysis used only data from cases which were classified into the operationalized CBAM Levels of Use II, III, IVA, and IVB. Respondents at these Levels had all answered disagree or strongly disagree to the question, "I have no interest in using computers with my students." Therefore, the discriminant analysis reported in this thesis is assessing whether or not there are differences in the reported staff development preferences of teachers who are already interested in the innovation (whether or not they are actually using it yet).

Since the discriminant analysis program requires complete data sets, cases in which

even one of the survey's Likert items were unanswered were eliminated. This resulted in 248 cases being excluded from the analysis. There did not seem to be a systematic pattern to the missing data. There were missing answers from all Levels of Use and for all Likert items. The percentage of complete questionnaires returned from LoU II, III, IVA and IVB were 68.6%, 68%, 49% and 79%, respectively. The percent of missing data on the Likert items ranged from 12% to 19%. Part of the explanation for these missing answers was due to an uncaught printer's error. Twenty-six of the questionnaires that were returned to the researchers had Likert items 10 to 22 missing (See Appendix C to examine these questionnaire items).

Results of the Analysis

Three discriminant functions were calculated which are significant, χ^2 (39, N = 283) = 81.668, $p < .001$. The first discriminant function accounts for 58.16% of the variance (canonical correlation = .395). Once the first discriminant function is removed, the discriminating power of the remaining two functions is no longer significant, χ^2 (24, N = 283) = 35.18, $p = .07$.

Table 4 indicates which staff development items correlate with the greatest magnitude to the first discriminant function. The groups the function distinguishes seem to differ on an underlying dimension of whether or not the teachers in these groups want to expand their use of computers. The variables that are most involved in discriminating the groups are the items which asked whether or not teachers wanted more software, a computer at home, a board plan, and more hardware. The groups also differ in whether or not they have problems scheduling time in the computer lab and whether or not they report being interested in and having the time to devote to this innovation. "Involved and wanting more" is one way to characterise the dimension that distinguishes these groups.

Table 5 presents the centroids for Levels of Use II, III IVA, and IVB on each discriminant function. Respondents at Level of Use II (Preparation) and at Levels of Use IVB (Refinement) score positively on the first function. These two groups are characterised in the CBAM Levels of Use as containing teachers who want to expand their use of the innovation. Preparation teachers have committed themselves to beginning to use a computer application with their students at a definite point in the future. Refinement teachers are actively trying to incorporate new ideas to meet the needs of their students more effectively. These two groups are distinguished from Levels of Use III (Mechanical) and IVA (Routine). In the CBAM characterisation, LoU III users are having all they can do to plan and deliver their lessons from day to day. Routine users (LoU IVA) have stabilised

Table 4

Correlations Between the Variables and the Discriminant Functions

Variable	Function 1	Function 2	Function 3
Need More Software	0.51	0.20	0.33
Use at Home Helpful	0.45	0.28	0.14
Want a Board Plan	0.45	0.12	-0.25
Insufficient Hardware	-0.37	-0.29	-0.03
Scheduling Problems	0.37	-0.12	-0.28
No Time	-0.36	0.04	0.02
Buy a Computer	0.35	0.24	0.15
No Interest	-0.34	-0.07	0.10
More Budget Expenditures	0.28	0.18	0.03
Magazines Helpful	0.24	0.23	0.02
Learn Best by Self	0.09	0.04	0.06
Hardware Maintenance a Problem	0.16	0.55	-0.16
Use Peer in School	0.20	-0.30	0.12
Want a School Plan	0.24	0.29	-0.16
Use Computer Consultant	0.12	-0.12	0.01
Use Curriculum Consultants	0.27	-0.21	0.42
Want Computers in their Classroom	-0.02	0.29	0.36
Want Computers in a Lab	0.04	0.05	-0.34
Do Not Want to Switch Manufacturers	-0.20	0.02	0.26
Need Principal's Support	0.04	0.04	-0.06

Table 5

Group Centroids for Each Level of Use on Each Discriminant Function

Level of Use	Function 1	Function 2	Function 3
II Preparation	0.33	-0.55	-0.14
III Mechanical	-0.59	-0.36	0.27
IVA Routine	-0.56	-0.09	-0.53
IVB Refinement	0.19	0.27	0.17

and are not investigating any new uses of the innovation. Thus it is consistent that respondents in these latter two groups score negatively on the discriminant function.

Table 6 contains the standardised canonical discriminant function coefficients for each function for the variables which were left in the stepwise analysis. These variables are the best discriminators for this sample. Teachers who score high on the first discriminant function are more likely to agree that a board plan would be helpful, to want more software and hardware, to think a computer at home would be helpful, to report having the time for this innovation and to agree that they would find a peer in their school helpful. Table 6 also includes a list of the variables that are not needed in the discriminant function, given that the other variables are in the analysis.

The classification procedure using these discriminant functions classified 44% of the cases correctly (See Table 7). Consistent with the results of the discriminant analysis, teachers at LoU II/Preparation were most likely to be placed into the LoU IVB/ Refinement group and vice versa. However, the same confusion between related groups does not occur for the LoU III/Mechanical and LoU IVA/Routine cases. If misclassified, these cases were most likely to be assigned to the Preparation group.

Table 6

Standardised Canonical Discriminant Function Coefficients Included in the Analysis

Variable	Function 1	Function 2	Function 3
Use at Home	0.42	0.28	0.09
No Time	-0.38	0.08	0.03
Insufficient Hardware	-0.28	-0.31	-0.25
Use Curriculum Consultants	0.01	-0.38	0.50
Use Peer in School	0.31	-0.31	0.13
Scheduling Problems	0.29	-0.51	-0.47
Hardware Maintenance a Problem	-0.05	0.60	-0.24
Do not want to Switch Manufacturers	-0.26	-0.01	0.41
Need More Software	0.43	0.08	0.42
Want Computers in a Lab	-0.20	0.29	-0.40
Want Computers in their Classroom	-0.27	0.51	0.29
Want a Board Plan	0.45	-0.21	-0.42
Want a School Plan	-0.25	0.39	0.03
Learn Best by Self	-	-	-
No Interest	-	-	-
Need Principal's Support	-	-	-
More Budget Expenditures	-	-	-
Use Computer Consultant	-	-	-
Magazines Helpful	-	-	-
Buy a Computer	-	-	-

Note. - indicates variables not included in the analysis after the final step

Table 7

Classification Results

Actual Group	No. of Cases	Predicted Group Membership			
		II Preparation	III Mechanical	IVA Routine	IVB Refinement
II Preparation	55	25 (45.5%)	7 (12.7%)	9 (16.4%)	14 (25.5%)
III Mechanical	35	10 (28.6%)	13 (37.1%)	6 (17.1%)	6 (17.1%)
IVA Routine	60	14 (23.3%)	11 (18.3%)	25 (41.7%)	10 (16.7%)
IVB Refinement	175	39 (22.3%)	30 (17.1%)	26 (14.9%)	80 (45.7%)

Note. Percent of grouped cases correctly classified: 44.0%

CHAPTER V

Discussion

This chapter presents the practical implications and the limitations of the results of this thesis for staff developers. The theoretical implications and limitations of this study for the Concerns-Based Adoption Model itself are also discussed. Suggestions are made for further research in both of these areas.

(1) Verification of the Levels of Use

Teachers were found in the sample at each of the first six CBAM Levels of Use as they were operationalized in this thesis (See Table 3 to re-examine the operational definitions of the Levels of Use). This result reinforces the CBAM assumption that the innovation process is a complex, multi-stage process consisting of a series of developmentally distinct phases each of which has its own characteristic level of interest in and use of the innovation. It supports the CBAM conclusion that all nonusers of computers do not relate to this innovation alike nor do all users. For example, finding teachers at LoU III demonstrates that teachers can currently be users and yet have no definite plans or commitment to use any computer applications in the future. Routine Users (LoU IVA) have no plans to enhance or expand their use in the future. Teachers at the Refinement Level of Use (LoU IVB) have definite plans to increase the number of applications they are intending to give their students the opportunity to use. Likewise, nonusers also differ in their interest in using computer applications with their students. The 27 teachers at LoU 0 reported having no interest at all in this innovation. The teachers at LoU I indicated they were undecided about the use of computers with their students. Teachers preparing to use computers with their students by a specific date (LoU II) reported that they were interested in using this innovation, even though they are currently nonusers.

Finding that there are teachers at each of the CBAM Levels of Use also is consistent with the CBAM assumption that since innovation is a multi-stage process undergone by individuals who must carry out this learning and changing, this process takes time.

Practical Implications for Staff Developers

It can help staff developers to know that for some nonusers, interest, or motivation, is a problem and for others it is not. It can also help them to be aware that users can be expected to differ in their future plans to use an innovation. Knowledge of this can help

staff developers see that since all users and all nonusers are not alike, they should not be approached alike. For example, a staff developer should not assume that because a teacher is currently using a computer application with his or her students, that teacher's commitment computer use is going to continue. Forty-four teachers in the sample analysed in this thesis reported no such commitment.

A staff developer can use the data provided by this survey and others like it to diagnose staff development needs. Using the assumptions of the CBAM to characterise and predict the staff development needs of the teachers in this sample, two groups of teachers appear to be in particularly urgent need of staff development support. There are 70 nonusers who have plans to begin using computer applications by a specific date in the future. These are the teachers at LoU II (Preparation). According to the CBAM, they need to be provided with specific information about using the computer applications they have chosen in various subjects to teach higher-order thinking skills. They will benefit from inservice training sessions where they have the opportunity to see demonstrations of the effective use of these applications with students, followed by opportunities to practise doing this themselves in a safe environment (Loucks & Zigarmi, 1981). There are also 44 teachers in this sample at the Mechanical Level of Use (LoU III). The CBAM recommends that these teachers be given individualised consultation to help their problem-solving about the particular obstacles to use that they are meeting in their own classrooms, with their own students (Loucks & Zigarmi, 1981).

Since these data are consistent with the CBAM assumption that learning to use computer applications effectively is a multi-stage process which takes time, staff developers, administrators and teachers should be conscious of the need to have realistic expectations about how long any significant innovation takes and about how complex a process it actually is for individuals to carry out. If it is accepted that teachers do have to make all of the changes described in the CBAM in order to move from being nonusers to effective users, then this can increase our appreciation of the amount of work that is involved. Demands that teachers institute multiple, substantial innovations simultaneously (what Hall (1976) calls "the MAD approach (Multiple Adoption Design)") need to be eliminated.

Verification of the existence of the CBAM Levels of Use can encourage staff developers to begin to use the descriptions of the needs, interest, goals and problems of each Level of Use as a starting point in their efforts to diagnose teachers' needs and interests. Once a teacher's Level of Use is identified, the CBAM provides information about what needs they typically have. To the extent that these expectations give insight into what a teacher is likely to be confronting, they can promote more efficient, effective intervention. Although each teacher's needs will be different, inquiring about the needs

typical to his or her Level of Use first can be an efficient way to proceed. Being aware of the importance of the interests and problems that are expressed if progress in learning to use an innovation is to proceed can also help a change facilitator target, plan and deliver their interventions more effectively.

Theoretical Implications for Using the Levels of Use

The CBAM researchers rely on the Levels of Use Scale primarily to identify the presence or absence of classroom implementation prior to evaluating the effectiveness of an innovation on students. They insist that each teacher's use of an innovation be observed by the researchers involved. They normally begin to diagnose teachers' staff development needs by using the Open-Ended Statement of Concerns (Hall & Hord, 1987). Since some variation in Stages of Concern profiles can accompany various Levels of Use of an innovation, the CBAM change facilitators also regularly assess teachers' Levels of Use. They will do this either through extensive classroom observations or through a semi-structured interview (Hord et al., 1987) where the interviewer listens and probes for the teacher's identification of his or her position on the various decisions that individuals make as they move from one Level of Use to another (See Table B-1 for a description of the Levels of Use and of these decision points). Hall and Hord (1987) are adamant that mailed surveys cannot adequately assess Levels of Use:

> Since LoU is a behavioral concept, paper/pencil questionnaires will not work. In spite of our best efforts to discourage researchers from building pencil/paper LoU questionnaires, however, several abortive attempts have been made. Attempting to assess Levels of Use with such a questionnaire is similar to attempting to read semaphore signals by turning on the radio: The receiver medium does not fit the format of the message. A behavioral variable cannot be assessed with a nonbehavioral measure. When someone attempts to assess Levels of Use with a questionnaire, the result is a partial assessment of concerns about use rather than a direct description of use or a direct assessment of concerns. (p. 94)

However, identifying staff development needs from the Levels of Use Scale, rather than by using the Stages of Concern, has the advantage of focussing everyone's attention on the final goal of staff development, namely, changing the teachers' classroom skills (behaviours) so that they will be able to use the innovation effectively. This is not to suggest that concerns are not important. Teachers' attitudes to the innovation (their concerns) must be interested and positive about their own use of the innovation and provide motivation for them to use it. Otherwise, use of the innovation can be expected to falter. When a teacher has high Personal concerns about using an innovation, these need to be

regarded as legitimate and real and must be resolved. However, to begin every staff development effort by assessing the teachers' Stages of Concern profile seems too indirect--a diversion from what everyone needs to be focussing on, namely, the skills and knowledge the teachers must acquire to use the innovation effectively.

The teachers in this study were categorised into a Level of Use on the basis of their responses to a mailed survey which asked them to report their interest in, their current use of, and their future plans for using computer applications with their students. If this proves sufficient to assess teachers' Levels of Use correctly, then this result provides staff developers with an efficient, easy-to-obtain set of only three questions which can replace intensive classroom observation or a lengthy, one-to-one focussed interview with teachers for the purpose of identifying their Levels of Use for planning appropriate staff development. Furthermore, researchers making further investigations into the relationships between Levels of Use and staff development preferences will also have an efficient, easy-to-obtain, clearly interpretable, machine-codable measure of Level of Use at their disposal.

Limitations to this Result

It is essential to realise that it has not been independently verified that the teachers in this sample are accurately classified into their actual Levels of Use. A validation study is needed which will assess each teacher's Level of Use through classroom observation as well as through their answers to a mailed out survey which asks them to report their interest in, current use of, and future plans for using computer applications with their students. If there is high agreement in the classifications these two methods make, then staff developers and researchers can use this assessment method with more confidence.

The variables that the discriminant analysis identified as distinguishing the groups are consistent with a CBAM interpretation of how two of these groups are alike and two of them differ in terms of the staff development choices measured. This offers some support for the success of the classification scheme used here. This support is made stronger by the fact that the designers of the questionnaire were not familiar with the CBAM and were not writing items directed to the typical interests of any Level in particular. These researchers (Jardine, Rilstone, & Hunter, 1990) were interested in the responses of the whole sample. They also had plans to examine differences in staff development preferences among the four division levels and between teachers who make high vs. low use of computers at home, but they were not working from within a set of systematic model, such as the CBAM, which specifies expectations and recommendations about how staff development preferences differ as teachers move through an innovation process. (See Appendix D for a presentation of the results and early conclusions of the Jardine et al., (1990) study).

There were 74 teachers in this sample that were not classifiable into the pattern of interest in and use of computer applications that operationalized the first six CBAM Levels of Use. The profile these respondents show on these three questions needs to be identified. For example, since computer applications is a mandated innovation, perhaps there is a group of teachers who reported no interest in using computers with their students yet have been assigned lab time and therefore also reported that they are current users. It will be interesting to identify the number of profiles these unclassifiable teachers have, to find out the proportion of teachers in each profile, and also investigate the relationship between their "Use Profiles" and their reported staff development preferences. The CBAM Levels of Use assume that interest is there before the teacher is attempting to use the innovation. In the case of computer applications in the classroom this may not be so. A new Level of Use may need to be added, "The Reluctant, Mandated User." Kember and Mezger (1990) also observed this limitation to the CBAM. They are instructional designers who have worked with professors who were required to participate on a team which was writing distance education courses. They found that the model had very little to offer any staff developer who is trying to work with "innovators" who are required to implement a change which they are actively resisting. Presumably a CBAM change facilitator would concentrate on addressing the Personal/Stage 2 Concerns of such innovators. However, resistance can also be rooted in professional, philosophical objections to an innovation. This requires a different type of intervention than do teachers' feelings of personal inadequacy. However, the CBAM assumes that Stage 1/Informational concerns will be met and teachers will have decided to use the innovation before they must attempt it (See Decision Point B in the Levels of Use Table (Table B-1)).

(2) Some Levels of Use Differ in their Staff Development Needs

The discriminant analysis significantly distinguished the Preparation and Refinement Levels of Use (LoU II and IVB) from the Mechanical and Routine Levels of Use (LoU III and IVA) in terms of the staff development items in the questionnaire (See Table 2 for a list of these items). This result supports the CBAM assumption to the extent that teachers at some Levels of Use did find different types of staff development activities, but not others, relevant and interesting, while teachers at other Levels of Use showed the opposite pattern.

Examination of the significant discriminant function shows that the differences between Levels of Use II and IVB on the one hand and Levels of Use III and IVA on the other are consistent with a CBAM characterisation of the interests and attitudes to staff development of these four groups. Teachers at the Preparation (LoU II) and Refinement

(LoU IVB) Levels of Use are both interested in expanding their use of computer applications with their students. They want more of everything--more software, more hardware, more planning at the district or board of education level. Mechanical Level of Use teachers (LoU III) are characterised as having all they can handle learning to solve all of the management problems that are involved in teaching with the software they are currently attempting to use. These teachers do not want to be exposed to anything more, let alone be required to incorporate it into their teaching. Routine Users (LoU IVA) have reached the amount of use they are satisfied with and have little or no interest in changing what they are doing. These teachers often feel that taking time to expose themselves to more ideas is a waste of their time because they do not intend to modify what they are doing regardless of any new ideas they meet.

Practical Implications for Staff Developers

Teachers are often characterised in the literature as finding staff development ineffective, irrelevant, inappropriate (Fisher, 1991; Hall & Loucks, 1978; Thompson & Cooley, 1986). The results of this thesis support the idea that this situation may be helped if staff developers adopt the expectation that it is inappropriate to use the same staff development activity to facilitate the implementation of computer applications for all teachers regardless of their level of expertise in using the innovation. Staff developers need to stop trying to find and use one activity (for example, workshops spaced regularly over a school-year or peer coaching) that will be perceived by all the teachers as relevant and worthwhile. If the CBAM characterisation is valid, all users do not face the same interests and problems. Nor do all nonusers. And teachers at different Levels of Use do not necessarily want the same staff development activities. Identifying teachers' Levels of Use may help improve staff developers' ability to plan relevant staff development activities.

Specifically, the results of this thesis suggest that it is appropriate to approach teachers at the Preparation and Refinement Levels of Use with more software, more ideas, more access to computers, more peripheral devices (CD-ROM drives, etc.) and expect that they will be interested in such information and opportunities. However, it seems that it would be unrealistic and inappropriate to expect this response from teachers at either the Mechanical or Routine Levels of Use. Some attention would probably need to be paid to stimulating the interest of Routine Users. Attention to the plight that Mechanical Level of Use teachers are frequently in may explain both why it is inappropriate to ask these teachers to consider doing more at present and also alert a staff developer to the need for individualised consultation about these teachers' implementation efforts.

Although the result of this study is promising, it must be considered to be tentative.

Once again, there are definite limitations to the investigations of this thesis. The findings of this study need to be followed up by further research.

Limitations to the Conclusion that Levels of Use Differ in their Staff Development Needs

The first limitation to be discussed has to do with the nature of the statistical test itself. The Levels of Use were distinguished in terms of their reported staff development preferences through the use of a discriminant analysis. This statistical test is a "*mathematical maximization* procedure (Stevens, 1986, p. 233)." The variables that contribute to the discriminant function are weighted so as to produce the largest possible differences between the groups in the sample. Data from a different sample can result in the calculation of different weights and can even discriminate different groups simply due to the effect of chance differences. The stepwise discriminant analysis used in this study capitalises even more on chance differences between groups in a sample (Tabachnick & Fidell, 1983, p. 313). Stepwise discriminant analysis was used in this thesis because it was an exploratory study and because it is "preferable when the number of variables is very large, especially if the sample sizes are not commensurately large (say, if the smallest group size is less than three times the number of variables)" (Tatsuoka, 1976, p. 216). Even though the differences in staff development preferences found between some of the Levels of Use is readily interpretable given the CBAM characterisation of these Levels, the result cannot be asserted with confidence until it is replicated on a different sample of teachers.

Secondly, uneven sample sizes for the Levels of Use and very small numbers of respondents in LoU II and III again mitigate the confidence we can have in this result. With fewer responses, chance differences in the answers (the effects of a biased sample) can result in more easily finding differences in the sample that do not reflect real differences in the population of each group. Future research needs to be done with sample sizes that estimate the proportion of each Level of Use in the population (even though, presumably, this is steadily changing regarding the computer applications in education innovation). This will give us a better sample of the lower Levels of Use (LoU 0, I, II and III). This can also help reduce the response bias in the data. Jardine et al. (1990) made the decision not to follow-up nonrespondents to their survey. Since they had more than half of the questionnaires returned, they assumed that even if nonrespondents did differ in their needs, recommendations for a staff development plan could still be made on the basis of answers from the majority of teachers in the sample. Use of the Levels of Use Scale allows us to see the response bias in the data more clearly. Conclusions about staff development needs for teachers at the Refinement Level of Use are primarily represented in the data (See Appendix D). However, the CBAM assumes that these teachers' preferences should not be

taken to be representative of what all teachers will find appropriate.

A third limitation lies in the narrowness of the information a discriminant analysis yields. The outcome of a discriminant function analysis does not allow the conclusion that the groups themselves are different. It is false to conclude from the investigations of this thesis that teachers at Levels of Use II and IVA are always unlike those at Levels of Use III and IVB. The result of the discriminant analysis only indicates that these groups differ significantly in terms of the variables that were measured. For example, the respondents in the former two groups agreed more often that more software is needed than did those classified into the latter two groups. However, we cannot assume that the former also want more inservice courses or want better manuals or want to attend more conferences where new software is being demonstrated. Teachers at these Levels of Use may or may not differ on these staff development options.

There is also a serious alternative interpretation which can explain the result of the discriminant analysis carried out in this thesis. This explanation needs to be eliminated before more extensive research is carried out on this conclusion. The CBAM asserts that each individual teacher-innovator passes through all eight Levels of Use of the Innovation for each Innovation Component that they learn to use effectively and that his or her staff development preferences change as the Level of Use does. The results of the investigations of this thesis are consistent with the CBAM assumption that different staff development activities are more appropriate at different Levels of Use. However, in this study, the relationship between Level of Use and staff development preferences has been measured at only one point in time. We cannot distinguish with certainty that it is these teachers' Level of Use which was guiding their agreement or disagreement with the various staff development items. It is possible that the teachers in this sample would prefer these forms of staff development regardless of their Level of Use regarding this innovation. Future research into this issue is needed which will use a longitudinal design to investigate whether the same teachers change their staff development preferences as their Level of Use changes.

There is a great deal of further research to be done to establish the specific forms of staff development support that are preferred by teachers at some Levels of Use, and not at others. Some of the facets of staff development that need to be investigated are: (1) the effectiveness of the various types of interventions the CBAM change facilitators have used successfully at various Levels of Use for the computer applications in education innovation components, (2) the role teachers prefer a staff developer to have (computer consultant, subject area consultant, principal, peer,etc.), (3) what organisational support teachers need (hardware, software, location of computers, scheduling, release, etc.). A Delphi technique (Chaney, H. S., 1987) would be an effective method to use to collect a range of staff development preferences from teachers previously categorised into each Level of Use.

Questionnaires could then be written which include items intended to be relevant to the needs and interests of teachers at each Level of Use and administered to new samples of teachers. Further discriminant analysis could then support or reject the idea that people at different Levels of Use do differ in the staff development preferences that each questionnaire investigates. If there is converging evidence that the relevance of at least some staff development activities varies with the teacher's Level of Use, then hopefully, staff developers will begin to expect to need to assess teachers' Levels of Use and plan staff development in response to this throughout the each of the innovation processes they facilitate.

Theoretical Implications for Use of the CBAM

In this thesis, it is argued that it is important for computer applications staff developers to become familiar with the CBAM Levels of Use and diagnose these Levels as their first step in assessing and planning relevant staff development to each Level of Use. However, if the results of this study are valid, then there are sometimes underlying similarities between some of the Levels of Use. It may be helpful for teachers at certain Levels of Use to be grouped together for certain purposes. For example, during an inservice focussed upon subject area uses of a new piece of software, the result of the discriminant analysis suggests it might be helpful to group teachers at the Preparation Level of Use with those at Refinement. Both are interested in learning something new. It needs to be investigated whether or not teachers at both Levels of Use will learn from working together. Would Preparation teachers learn from seeing how an experienced person becomes acquainted with a new piece of software and from hearing their descriptions about how they have seen their students react? Would teachers at the Refinement Level learn from having to explain what they are doing and why as they explore software and from reflecting and trying to characterise what they expect students would learn from the software and how it should be integrated into a subject area for teachers at other Levels of Use?

To recommend grouping teachers for certain forms of staff development on the basis of underlying similarities between these Levels of Use calls for much more research on these underlying dimensions and on their relationship to various staff development preferences. This is a new way to characterise the CBAM Levels of Use and also a new way to recommend they be used during the delivery of staff development. The CBAM research suggests that it will always be important to monitor an innovator's progress through the Levels of Use of an innovation so that everyone may know when progress is (or is not) being made and react by providing appropriate encouragement, recognition and/or staff development support. And it is also important to identify each Level's separate

staff development needs and goals and preferences. However, it may be an improvement if a system is developed for combining teachers at various Levels of Use for some staff development activities to their mutual benefit. Which staff development activities are addressing which underlying dimensions shared by various Levels of Use needs to be investigated empirically.

It is not simply that teachers at each Level of Use share interests and specific needs with the teachers in immediately preceding or succeeding Levels. However, this can also happen. For example, teachers at LoU 0 who are about to make the decision that they are interested in this innovation enough to want to learn more about it do not differ from teachers who are early in LoU I. Both teachers have a need for general information about the innovation. The amount of information wanted gradually increases through both LoU. Somewhere during LoU I, teachers begin to want more and more specific information. This need is shared by LoU II teachers who, by the time they are almost ready to begin using the innovation with students have a need for total familiarity with the specific teaching materials and methods they will be using at that set time in the near future. LoU II teachers' familiarity with their teaching materials and methods needs to include practising these new teaching situations in safe environments, with lots of constructive feedback. This need is shared by LoU III teachers--who need support with their actual use of the innovation's materials and methods. The necessary teaching resources and organisational support must be made available by administrators to all teachers from LoU III to VI. Teachers from LoU IVB to VI all need support in their efforts to modify the innovation to benefit their students. This kind of support includes access to time and opportunities to share their experiences, problems and solutions with other teachers (through informal or formal support networks of teachers, school visits and through giving and attending conference sessions). However, this study has raised the question that there are more than just steadily increasing or decreasing interests that carry over between adjacent Levels of Use. This study has found an analogical similarity in the interests of the Preparation and Refinement Levels of Use. They both appear to find activities that will help them expand their use appropriate and interesting. An issue for further research is can or should any CBAM Levels be permanently collapsed for staff development planning?

Finally, it is also necessary to verify empirically that these staff development preferences that teachers at various Levels of Use have reported preferring actually are effective in helping the teachers who receive them implement an innovation more quickly, more adequately and more effectively with their students.

Conclusions

This study has attempted to verify the CBAM assumption that adopting the use of computer applications with students is a lengthy, multi-stage process. The phases of this process can be identified using the CBAM Levels of Use Scale. It has been suggested throughout this thesis that the knowledge that teachers at various Levels of Use can differ in their interest in using the innovation, in their present use of it, and in their plans for using it in the future can begin to suggest to staff developers that the needs and interests of all users are not the same, just as the needs and interests of all nonusers are not the same.

The results of this thesis also provide tentative support for the idea that teachers at different Levels of Use do find different staff development activities relevant and appropriate. It has been argued that there is a need for extensive further research to help establish realistic, humane expectations about the staff development needs of teachers at each Level of Use.

Staff development, like all teaching, can be improved when everyone involved has realistic expectations about the the needs, interests, goals and problems of those who are learning and then uses these insights and expectations to plan relevant activities. The ability of gifted teachers to do this cannot been codified into a strict set of rules. Hall and Hord (1987) provide the following caveat against the slavish use of the recommendations from the CBAM in practice:

> There are general classes of interventions that have been most relevant for addressing particular diagnostic profiles; however, the interventions can not be used in cookbook fashion. Replacing the diagnostic genius of the more effective change facilitator with some sort of calculator or computerized prescriptive process will never be possible. (Hall & Hord, 1987, p. 339-40)...Still, the actual intervention used at any moment in time will have to be tailored to the concerns-based diagnosis, the particular context, and the style of the facilitator. (Hall & Hord, 1987, p. 341)

Certainly it is inappropriate to expect to be able to find and successfully apply universal rules to individual situations (Aristotle, 1971). Individual situations are unique. Any general rules that can be found must be applied to each situation in ways that meet the needs and goals of the teachers, of the innovation, and of the students. This does take "diagnostic genius," but such genius is improved when it is operating within informed, realistic expectations.

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APPENDICES

APPENDIX A

Table A-1

Stages of Concern About the Innovation

SoC	Description
0 Awareness	Little concern about or involvement with the innovation is indicated.
1 Informational	A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.
2 Personal	Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.
3 Management	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizinf, managing, scheduling, and time demands are utmost.
4 Consequence	Atttention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.
5 Collaboration	The focus is on coordination and cooperation with others regarding use of the innovation.
6 Refocusing	The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative.

Note: From "Teacher concerns as a basis for facilitating and personalizing staff development" by G.E. Hall and S.F. Loucks, 1978, Teachers College Record, 80(1), p. 41.

APPENDIX B

Table B-1

Levels of Use of the Innovation

Level 0 Non-Use	State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.
Decision Point A	Takes action to learn more detailed information about the innovation.
Level I Orientation	State in which the user has acquired or is acquiring information about the innovation and/or has explored or is exploring its value orientation and its demands upon user and user system.
Decision Point B	Makes a decision to use the innovation by establishing a time to begin.
Level II Preparation	State in which the user is preparing for first use of the innovation.
Decision Point C	Begins first use of the innovation.
Level III Mechanical Use	State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.
Decision Point D-1	A routine pattern of use is established.
Level IV A Routine	Use of the innovation is stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
Decision Point D-2	Changes use of the innovation based on formal or informal evaluation in order to increase client outcomes.
Level IV B Refinement	State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere of influence. Variations are based on knowledge of both short- and long-term consequences for clients.
Decision Point E	Initiates changes in use of the innovation based on input from and in coordination with colleagues for benefit of clients.
Level V Integration	State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
Decision Point F	Begins exploring alternatives to or major modifications of the innovation presently in use.
Level VI Renewal	State in which the user re-evaluates the quality of use of the innovation, seeks major modifications of or alternatives to present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.

Note. From "Levels of Use of the innovation: A framework for analyzing innovation adoption" by G.E. Hall, S.F. Loucks, W.L. Rutherford, and B.W. Newlove, 1975, Journal of Teacher Education, 26(1), p. 54.

APPENDIX C

The Computer Integration Questionnaire (Jardine, Rilstone & Hunter, 1989)

Computer Integration And *YOUR* Needs

Section I - Do YOU think that computers will be playing a larger role in education in the future?

1. I think that today's students will require computer skills when they graduate.	**SD**	**D**	**U**	**A**	**SA**
2. I think that students are generally more eager to work when they use computers.	**SD**	**D**	**U**	**A**	**SA**
3. I think that parents want their children to use computers at school.	**SD**	**D**	**U**	**A**	**SA**
4. I expect that soon Alberta Education will mandate the use of computers across the curriculum.	**SD**	**D**	**U**	**A**	**SA**
5. I have no interest in using computers with my students.	**SD**	**D**	**U**	**A**	**SA**

Section II - How are computers used in YOUR classroom?

1. Please list all the subjects in which **your** students **used** computers **during the 1988-1989 school year.**

APPLICATIONS **SUBJECT(S) USED IN**

CAI (Drill and Practice, Tutorials, Simulations) Used in _____

Word Processing Used in _____

Desktop Publishing Used in _____

Database Used in _____

Spreadsheet Used in _____

Electronic Mail Used in _____

Graphics Package Used in _____

Games Used in _____

Logo Used in _____

Pascal Used in _____

BASIC Used in _____

Please describe any other ways **your** students **used** computers.

_____

2. Please list all the subjects in which **your** students **will use** computers **during the 1989-1990 school year.**

APPLICATIONS	SUBJECT(S) USED IN
CAI (Drill and Practice, Tutorials, Simulations)	Used in _____
Word Processing	Used in _____
Desktop Publishing	Used in _____
Database	Used in _____
Spreadsheet	Used in _____
Electronic Mail	Used in _____
Graphics Package	Used in _____
Games	Used in _____
Logo	Used in _____
Pascal	Used in _____
BASIC	Used in _____

Please describe any other ways **your** students **will use** computers.

_____

3. Please list all the subjects in which **you would like** your students to be using computers by the year 1995.

(Assume that you will have unlimited access to computers and software.)

APPLICATIONS	SUBJECT(S) USED IN
CAI (Drill and Practice, Tutorials, Simulations)	Used in _____
Word Processing	Used in _____
Desktop Publishing	Used in _____
Database	Used in _____
Spreadsheet	Used in _____
Electronic Mail	Used in _____
Graphics Package	Used in _____
Games	Used in _____
Logo	Used in _____
Pascal	Used in _____
BASIC	Used in _____

Please describe any other ways **you would like** your students to **use** computers.

_____

Please **CIRCLE** your answer.

4. Which students most often use computers in your class?

(a) participation is equal

(b) students who need remediation on specific concepts

(c) students who need enrichment

(d) none

(e) other Please specify. _____

5. Approximately how many hours a week do your lessons include computer-related activity for all or some of your students? If you are a high school teacher, answer with reference to the subject area you spend the most time teaching.

(a) Not at all
(b) Less than 5 hours
(c) 5 to 20 hours
(d) 21 to 49 hours
(e) 50 hours or more

Section III - What would be effective ways for <u>you to learn</u> to integrate computers into your curriculum?

1. I learn how to use computer programs most effectively when I experiment by myself.	**SD**	**D**	**U**	**A**	**SA**
2. A computer at home would help me learn to use computers more with my students.	**SD**	**D**	**U**	**A**	**SA**
3. I am not interested in taking any computer-related courses.	**SD**	**D**	**U**	**A**	**SA**
4. I do not have the time to take a computer-related course.	**SD**	**D**	**U**	**A**	**SA**
5. I want to take a computer-related course, but I do not know where to start.	**SD**	**D**	**U**	**A**	**SA**
6. I have access to a sufficient number of computers to integrate their use across the curriculum.	**SD**	**D**	**U**	**A**	**SA**
7. I would need the moral support of the principal to make extensive use of computers in my classroom.	**SD**	**D**	**U**	**A**	**SA**
8. Our school needs to put more of its budget toward using computers across the curriculum.	**SD**	**D**	**U**	**A**	**SA**

9. Curriculum consultants should give inservice to teachers on computer use in their subject area(s).	**SD D U A SA**
10. I think that a fellow teacher familiar with computers would be my best source of support when I try new computer activities.	**SD D U A SA**
11. I would call on a district computer resource teacher for help.	**SD D U A SA**
12. The scheduling of computer time in my school makes it difficult to organize effective lessons.	**SD D U A SA**
13. My school needs a more reliable procedure for maintaining the hardware.	**SD D U A SA**
14. I am reluctant to learn how to use my school's computers because I expect that we will switch manufacturers in the near future.	**SD D U A SA**
15. We need more software to begin using the computer in all curriculum areas.	**SD D U A SA**
16. I could make the best use of computers if they were all together in a lab.	**SD D U A SA**
17. I could make the best use of computers if one or two were in my class.	**SD D U A SA**
18. I would find it helpful if my school subscribed to magazines that describe computer activites that teachers have used effectively with pupils.	**SD D U A SA**
19. I would buy a computer for my home if the board gave me incentive to do so.	**SD D U A SA**
20. It would help me if my board had a long-range plan for integrating computers into my classroom.	**SD D U A SA**
21. I feel that my school should have a long-range plan for integrating computers into my classroom.	**SD D U A SA**
22. I feel that it should not be the responsibility of each individual teacher to determine how computers are to be integrated into the curriculum.	**SD D U A SA**

23. WHERE would **you prefer to learn** about the integration of computers into your teaching?
Please use a **1**, **2**, and **3** to indicate your **first**, **second** and **third** choices from the list.

_____ Session(s) at a Conference in my Subject Area
_____ Session(s) at a Computer Conference

_____ In-School Professional Development
_____ College Computer Course (e.g., SAIT, Mount Royal)
_____ Undergraduate Course in Computer Applications in Education
_____ Graduate Course in Computer Applications in Education
_____ University In-Service Course
_____ School Board In-Service Course

24. Please circle **all** courses below that **you would enrol in.**

I would attend an in-service course that would teach me how to

(a) teach Logo programming
(b) teach keyboarding
(c) use word processing in my subject area
(d) use databases in my subject area
(e) use spreadsheets in my subject area
(f) evaluate educational software
(g) use desktop publishing in my subject area
(h) use electronic mail in my subject area
(i) use graphics packages
(j) use educational games to supplement my teaching
(k) teach Pascal programming
(l) teach BASIC programming
(m) perform simple maintenance (changing ribbons on the printer, etc.)

Please list any other topics for computer-related courses that you would be interested in taking:

_____

Section IV - We are interested in knowing what background characteristics of teachers may relate to how they prefer to learn about computers. Please help us one last time by supplying us with the following information.

1. Please check the grade(s) you teach:

E.C.S. - Grade 3 _____
Grades 4 - 6 _____
Grades 7 - 9 _____
Grades 10 - 12 _____

2. Approximately how many hours a week do you use a computer?
For your personal use at home _____
To Prepare Lessons, reports, etc. _____
With my students at school _____

Please **CIRCLE** the following.

3. I do my own typing or word processing
   (a) never
   (b) seldom
   (c) often
   (d) always

4. Do you put your class lists and marks into a computer?
   (a) never
   (b) seldom
   (c) often
   (d) always

5. When did you last take a computer-related course?
   (a) never
   (b) within the last two years
   (c) three or more years ago

6. When did you last take a course in any subject that was related to your teaching?
   (a) never
   (b) within the last two years
   (c) three or more years ago

APPENDIX D

Questionnaire Results and Early Conclusions (Jardine, Rilstone & Hunter, 1990)

RESPONSE RATE: **56% overall** return

34% -- **E.C.S.** to grade **3** level

23% -- grades **4** to **6**

22% -- **junior high** level

30% -- **secondary** level.

(Sum exceeds 100% because some teachers teach at more than one level.)

How do teachers feel about the integration of computer applications across the curriculum?

95% agree* -- "... today's students will require computer skills when they graduate. "

86% agree* -- "... parents do want their children to use computers at school."

64% agree* -- "...students are more eager to work when they use computers (**26%** were **undecided** about this statement)

82% disagree° -- "I have no interest in using computers with my students".

* These figures represent the sum of the "agree" and "strongly agree" responses.

° This figure represents the sum of the "disagree" and "strongly disagree" responses.

What obstacles hinder the integration of computers across the curriculum?

	SD	D	U	A	SA	MI
Clearly obstacles						
Lack of **software**	3	10	13	34	28	12
Insufficient **access to hardware**	6	18	6	26	27	16
May be obstacles						
Scheduling problems	6	21	15	27	17	14
Machines should be located in **labs**	8	20	19	24	14	15
Machines should be located in the **classroom**	6	14	15	29	22	14
Apparently **NOT** obstacles:						
Maintaining **Hardware** is a problem	5	21	32	16	10	14
Expected **change of hardware** is a problem	22	42	18	4	1	13

Teachers' interest in self-instruction

	SD	D	U	A	SA	MI
Computer at **HOME** helpful	1	6	4	35	38	16
Learn most effectively **by MYSELF**	3	14	5	36	25	16
Would **BUY** a computer, if given Board incentive	3	11	10	32	25	18
MAGAZINES about teachers' use of computers would help	2	9	26	40	9	14

Teachers' attitudes about **taking computer-related courses:**

	SD	D	U	A	SA	MIS
NOT INTERESTED in computer- related courses	31	38	9	5	2	15
NO TIME for computer- related courses	10	32	13	21	7	16
NO IDEA where to start with computer-related courses	16	37	10	18	2	16

PREFERRED MODE and **LOCATION** FOR COURSES:

In-School Professional Development	43%	14%	10%
School Board In-Service Courses	16%	32%	17%
At a Conference in Own Subject Area	15%	14%	19%
University In-Service Course	4%	8%	13%

Other Choices Provided:
(none chosen by more than 2% of respondents)
Sessions at a Computer Conference
Undergraduate Course in Computer Applications in Education
Graduate Course in Computer Applications in Education
College Computer Course

What type of implementation support do teachers report wanting?

	D	U	A	SA	SD	MI
Need **principal's** moral support	9	18	11	31	13	19
More of **school budget** should be spent on computers	8	19	19	25	12	17
Need a **long range plan (board)**	2	6	14	45	21	13
Need a **long range plan (school)**	2	6	15	46	16	15

	D	U	A	SA	SD	MI
Integration of computers in curriculum is **NOT the responsibility of individual teachers**	7	21	16	29	15	13
Prefer an **in-school support person**	1	5	10	53	21	11
Curriculum supervisors should conduct computer integration inservice in the subject areas	1	3	9	44	29	16
Would use a district-level **computer resource teacher**	2	18	21	40	7	12

EARLY CONCLUSIONS

1. Computer Applications In-Service Courses should offer material that is already integrated into various subject areas.

<> Following Principles of Adult Learning (Hands-On Experiences, Relevant to their jobs)

<> As shown by Teachers reporting that they want to learn about computer applications from their Curriculum Consultants rather than a Computer Resource Person, by wanting input from their Subject Area Conferences rather than Computer Conferences, by wanting in-service courses on the tool applications.

2. Teachers want to know that their board, their school and their principal will be supporting their efforts.

3. Teachers need implementation support.

<> Coaching has been shown to be effective for educational innovations.

4. There is currently insufficient hardware and software in the schools to allow teachers to implement a high degree of computer integration across the curriculum.