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IMPLEMENTING INTEGRATED LEARNING SYSTEMS IN ELEMENTARY CLASSROOMS

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ABSTRACT

Integrated learning systems (ILSs) provide a multi-year curriculum sequence of computer-based instruction controlled by a sophisticated management system. ILS implementation is better understood when the focus of implementation is shifted from the technology to the people who use the technology. When the emphasis of research is on what people actually do using an ILS, implementation becomes a function of user attitudes and instructional strategies in using the ILS. This study examined the concerns and the operational patterns of teachers implementing an ILS in elementary schools in a metropolitan school district.

To investigate the research questions posed by this study, several tasks were undertaken. A measure was developed that described the major components of implementation of ILS technology. Process data were collected that provided contextual variables of the implementation including teacher concerns about ILS technology, the operational patterns of teachers using ILS technology, and learner achievement using an ILS. These data were collected from 65 teacher questionnaires, 30 teacher interviews, and 608 learner gains reports from 4 elementary schools.

The findings of the study provided evidence that teacher perceptions about an ILS influenced implementation of the ILS. Highest levels of concern for respondents were at the awareness stage and second highest levels of concern were at the informational stage. The best ILS implementation practices included integration with classroom instruction, training in the use of an ILS, and the use of motivational

strategies. Most of the math gain achieved by learners using the ILS was explainable by the amount of time learners spent using the ILS for instruction.

Using an ILS to improve the teaching/learning process was more complex than earlier understood. Just because a teacher was an effective implementer of an ILS was no guarantee that learners realized higher achievement from the ILS. Without the necessary organizational support, the expectation for instructional technology to improve the teaching/learning process cannot be sustained.

Change agents and stakeholders in the ILS implementation process should understand that implementation is a developmental process and that teachers' concerns influence the way in which they implement an ILS.

CHAPTER 1

INTRODUCTION

Integrated learning systems (ILSs) are computer-based instruction (CBI) packaged as comprehensive software systems operating on networked hardware platforms. ILSs provide a multi-year curriculum sequence of instruction that is controlled by a management system enabling teachers to assign lesson sequences, monitor learner performance, and generate learner progress reports. An ILS is intended to provide a seamless progression of instruction across grade levels and curriculum areas. ILS sales dominate the educational software market and ILS appeal seems to be based on the fact that ILSs offer a comprehensive one-stop solution to instructional computing (Robertson, Stephens & Company, 1993).

The introduction of an educational innovation into schools and classrooms often generates a debate about its educational benefits and effectiveness for learning. Consequently, the question of effectiveness has long been at the forefront of research into CBI (Burns & Bozeman, 1981; Bozeman & House, 1988; Kulik, Bangert, & Williams, 1983; Kulik & Kulik, 1987; Kulik, Kulik, & Cohen, 1980; Niemiec & Walberg, 1985; Norton & Resta, 1986; Skinner, 1990). Although this research suggested that CBI had the capacity for improving learning, how best to organize and implement CBI remained as important questions.

ILS instruction is currently being subjected to the same scrutiny as many of its technological predecessors. ILS vendors publish and freely distribute evaluation summaries that lend support to their claims of increasing learner achievement. Becker

(1992a) concluded that many of these evaluation studies did not stand up to methodological analysis and the research had such serious flaws that no definitive conclusions could be drawn from the evaluations. Becker reported that a general weakness of all the evaluations he considered was the reliance on standardized tests as the measure of ILS effectiveness.

Empirical research supporting the effectiveness of ILSs appeared to be inconclusive (Alifrangis, 1990; Becker, 1992b; Bender, 1991; Bracey, 1991; Norton & Resta, 1986; Taylor, 1990; Trotter, 1990). However, both critics and supporters agreed that the way in which an ILS was implemented was critical to its effectiveness (Albers, 1994; Cook, 1993; Gleghorn, 1993; Van Dusen & Worthen, 1992). The complexity of ILS design and the variety of curricular programs, computer platforms, and educational populations served by ILSs not only underscored the importance of appropriate implementation procedures but reinforced the need for increasing knowledge about the ILS implementation process. For example, researchers at the Apple Classrooms of Tomorrow project discovered that the more an educational environment is changed by technology the more teachers must confront their beliefs about learning and the efficacy of their instructional activities (Dwyer, Ringstaff, & Sandholz, 1991).

Bozeman and House (1988) declared that mistakes had been made and promises left unfulfilled concerning the effectiveness of CBI and appealed for evaluation methodologies pertaining to the implementation of CBI based on a research agenda that acknowledged a more qualitative approach to evaluation and analysis:

1. Different evaluation paradigms for CBI must be explored. Strategies which examine qualitative aspects of CBI may provide much richer analyses of the strengths and weaknesses of the programs.
2. Implementation processes must be taken more seriously by administrators than in the past. Resources without appropriate faculty development will be of little value.
3. Intelligent integration of CBI into existing curricula is critical, as few programs will rely upon CBI as the primary delivery system in the near future.
4. Process evaluation must be considered in CBI programs. To wait for a "no significant difference" conclusion may lead to an unwarranted and premature death for the program. (p. 86)

Since ILSs are widely used and, as such, are an important delivery system for computer-based instruction, there is a need to continually explore the fundamental processes and contextual variables included in the implementation of ILS technology.

Educational Context of the Problem

The rapid deployment of computer technology in classrooms during the last decade created many problems. Some problems were created when the proponents of instructional computing set unrealistic goals and promised more than could be delivered. For instance, it was not unusual for a school to install computers and educational software and learners use the computer systems before anyone questioned the implementation of the technology.

The people most responsible for the success or failure of computer technology in a school, the principal and teachers, often had no part in the decision-making process to adopt this technology. The problems associated with the implementation of computer technology were intensified when schools lacked adequate funding for training teachers in the appropriate implementation of this technology. The entire process by which computers and learners came together in schools was often "inefficient, poorly planned, and incredibly chaotic" (Maddux, Johnson, & Harlow, 1993, p. 220).

Cook (1993) warned that computer technology in schools was similar to other technologies that have come and gone such as programmed instruction or instructional television. The demise of computer technology in schools is accommodated by a research agenda resembling media research of past decades. Unfortunately, a review of ILS research, particularly evaluation studies published by ILS vendors, revealed that the focus of research is often on the delivery of instruction with no consideration to educational context or instructional strategy. When research is focused in this manner, the determination of effectiveness is often limited to the analysis of short-term achievement results.

The underlying assumption made by educators for using computer technology (and most innovations for that matter) is the belief that the technology substantially improves learner achievement. However, the influence of computer technology on learning often seems inconsequential because learners have minimal access to computers, courseware is rarely integrated with classroom instruction, computer-based activities do not play a significant role in instruction, and teacher training is inadequate (Becker, 1991, 1994; Van Dusen & Worthen, 1992).

When an innovative program or new technology is adopted by a school, the innovation should be used for its intended purpose. However, the goals and implementation process of an innovation are often vague or uncertain to those actually using the innovation. In the case of ILS technology when teachers are left with unclear goals and expectations, they may develop false perceptions about ILS use and its use may even become insignificant or superficial (Albers, 1994).

A more profound understanding of ILS technology is attained by shifting the focus from the technology to the people who use it. When the emphasis of research is on what people are actually doing as they use an ILS, implementation becomes a complex function contextual variables including teacher attitudes and concerns about the ILS and teacher practices and instructional strategies in using the ILS and not just a simple measure of learner achievement. This shift in focus allows the researcher to more accurately depict ILS implementation within the educational context in which implementation actually takes place.

Problem Statement

Lessons learned from research on change and innovation confirm the fact that the assimilation of computer technology into the teaching/learning experience is better understood when viewed as a complex change process that takes place over a period of time. The "quick fix beliefs" of the past have, for the most part, been abandoned in favor of efforts to examine and interpret the complex circumstances that encompass the assimilation of computer technology into schools and classrooms (Hadley & Sheingold, 1993, p. 263).

The educational benefits derived from the classroom use of computer technology often presume that this technology is being used according to its original design parameters. However, the findings about the effectiveness of innovations are sometimes questionable due to the uncertainty of the extent to which an innovation is implemented while the innovation is being tried experimentally (Churchman, 1979). A great deal of research in education has been conducted on the assumption that the treatment is present in the experimental group and not present in the comparison group. Smith and Ragan (1993) advised that "in drawing the line of causation from the instruction to the results, it is critical to be able to identify the degree to which the description of the program represents what actually occurred during instruction with the new program" (p. 416).

Questions regarding the effective use of computers for instruction are better answered by examining the assumption that computer technology is, in fact, being used in the manner in which it was designed to be used. In the literature this issue is referred to as fidelity of implementation (Fullan & Pomfret, 1977). Implicit in the fidelity of implementation perspective is the notion that use of an innovation is matched to an ideal use of the innovation as determined by the developers or designers of the innovation. Therefore, it is reasonable to assume that certain patterns of ILS usage reflect higher or lower levels of proficiency and, consequently, effectiveness (Cook, 1993).

Although ILS technology represents an exciting opportunity for enhancing and impacting the teaching/learning experience, the process by which this technology is implemented into schools and classrooms is not well understood. Therefore, the problem investigated by this study is that the educational potential for computer technology and ILSs may often remain unfulfilled, even when substantial investments have been made, because this technology is ineffectively or improperly implemented. This study collects data and makes recommendations about the effectiveness and long-term success of ILS technology through an analysis of contextual variables that are particular to the circumstance in which ILS technology is implemented.

Research Goals

The research goals for this study were achieved by examining the change process as it was experienced within schools and classrooms by teachers who were implementing an ILS. Two goals guided the research tasks of this study:

- To collect process data that revealed contextual variables of the implementation. These contextual variables included:
    a. teacher concerns or attitudes about ILS technology
    b. the operational patterns of teachers using ILS technology
    c. learner achievement using ILS technology.

- To determine and describe the differences in operational patterns of implementation and to relate differences to learner achievement.

The conceptual basis for this research was the Concerns-Based Adoption Model (CBAM) as described in Chapter II of this study (see Hord, Rutherford, Huling-Austin, & Hall, 1987). CBAM is a model for evaluating organizational change and the implementation of innovations that focuses on individuals, innovations, and context. CBAM views change as a process that is experienced and accomplished by individuals. Applying this model, this study attempted to define and measure the implementation of ILS technology and understand what happened to this technology as it was implemented at both the school and classroom level.

The operational patterns that result from implementation by different individuals in different contexts are called innovation configurations (Heck, Stiegelbauer, Hall, & Loucks, 1981). When individuals use different parts of an innovation in different ways, a number of different patterns emerge that characterize variations in the use of the innovation. Information about innovation configurations can be used to answer questions about whether an innovation has been fully implemented, what is acceptable and ideal use of an innovation, what the innovation looks like at some point after the innovation is adopted, and what relationship the implementation of the innovation has to its intended outcomes.

The research goals for this study were accomplished by answering questions about how an ILS is intended to be used in schools and classrooms, how an ILS is implemented by teachers, and the impact of variations in the implementation practices of teachers on the achievement of learners using an ILS. Implementation of ILS technology was examined by analyzing the attitudes, behaviors, and instructional strategies and practices of elementary school teachers. These phenomena were studied at both the classroom and school levels. This study demonstrated a unique approach to evaluating the implementation of ILS technology by addressing the question of how well an ILS has been implemented in order to determine how much confidence may be placed in the achievement results generated by the ILS.

Research Questions

Research was conducted for this study based on the following assumption about the implementation of ILS technology in school and classrooms:

> *Implementation of an ILS is best understood by examining contextual phenomena of the implementation including the attitudes of individuals using ILS technology, the intended and actual uses of ILS technology, variations in the patterns of use by individuals using ILS technology, and learner achievement using ILS technology.*

The purpose of this study was to identify certain patterns of ILS use among individuals implementing ILS technology that reflect higher or lower levels of proficiency and, consequently, ILS effectiveness. The following research questions provided an operational basis for the research tasks undertaken by this study:

1. What are the concerns of individuals implementing ILS technology?
2. What patterns of use occur among teachers implementing an ILS? How do these patterns differ from one another?
3. How do the implementation practices of teachers impact learner achievement using an ILS?

Significance of the Investigation

The rapid development and deployment of ILS technology inevitably create significant changes in educational delivery systems. Substantial increases in the number of computer systems in schools compel researchers to explain the conditions that influence teacher practices as they implement computer technology. This study intended to contribute to research supporting the advantages and benefits of ILS technology in schools when properly implemented.

Large-scale implementations of new technologies that significantly alter an educational organization and the teaching/learning experience should be undertaken only after formal evaluation and analysis of its educational benefits. As efforts to expand the use of technology in education become more focused and the integration of applications across the curriculum is more fully accomplished, new strategies for decision-making about technology must be employed to safeguard against those who attempt to maintain established practices or those who have a vested interest in the acquisition of new technology.

Three general trends emerged in education that caused schools to take a hard look at alternative instructional models that assimilate technology into the delivery and management of instruction (Wilson, Teslow, Hamilton, & Cyr, 1994):

1. Schools are being encouraged to undergo structural reforms and to look for new models of envisioning education. . . .
2. Advances in technology have opened up possibilities of improved delivery, management, and evaluation of instruction. . . .
3. Schools are being held increasingly accountable for student progress to justify investments and strategic direction. . . . (p. 2)

This study examined teachers' concerns and patterns of use of an instructional model incorporating ILS technology and established a framework for evaluating and operationalizing ILS technology in classrooms. Information about ILS technology provided a concrete understanding about ILS practices to other users or those who may be affected in some way by ILS technology (learners, parents, technology coordinators, school administrators), answered questions about the educational benefits of ILS technology, described the degree to which ILS technology is implemented in classrooms, explained how ILS technology functions one or more years after adoption, and more adequately defines the relationship of ILS technology has to learner achievement using an ILS.

In today's constantly changing educational environment the educators most responsible for implementing computer technology in classrooms often do not understand the complex nature of the change process. Unfortunately, this lack of understanding supports poor implementation and, ultimately, ineffective use of the technology. This study identified and described conditions and practices that contributed to high levels of implementation of ILS technology in schools and classrooms.

Finally, the methodology imposed on the research questions in this study can be used for both formative and summative evaluation purposes. In terms of formative evaluation, the research design of this study may help evaluators target areas in need of attention and decide what interventions may be useful. In terms of summative evaluation, when a program has been implemented to a high degree, evaluators can be confident outcome measures are a fair reflection of the program's success or failure while low levels of implementation allow evaluators to know that outcome data do not fairly reflect a program's potential.

Definitions of Terms

Computer-Based Instruction (CBI) - A form of instruction that uses the computer as the primary delivery medium; includes both computer-assisted instruction (CAI) and computer-managed instruction (CMI).

Gain Score - The increase in student grade level from the point a learner is initially placed on the ILS to the current average. Gains are calculated by the ILS management system.

Innovation Configurations (IC) - The operational patterns of an innovation that occur as a result of variations in the selection and use of different components or elements of an innovation.

Innovation Configuration Matrix (ICM) - An instrument developed to describe the innovation configuration of an innovation user.

Integrated Learning System (ILS) - Comprehensive collections of computer-based instruction operating on networked hardware platforms and controlled by a management system that provides a multi-year, individualized sequence of instruction.

Stages of Concern Questionnaire (SoCQ) - An instrument designed to identify seven kinds of concerns that users of an innovation may have.

CHAPTER 2

REVIEW OF THE LITERATURE

While the problem of implementing an integrated learning system is relatively new, the issue of properly or adequately assimilating technology into the classroom and promoting its effective use has been a matter of long-standing debate. About the only reasonable justification for implementing technology and other innovations in schools is to promote positive change (Cook, 1993).

This chapter reviews educational change brought about by the introduction of technology into the classroom. Three distinct themes that occurred in the literature were pertinent to this study. These themes included research on media, the implementation of educational innovations, and the use of computer-based instruction (CBI). This review posed several propositions from these research themes that directed the focus and scope of this study.

ILSs are but one of a series of technologies and innovations that were embraced by education in the last several decades. Historically, when a new technology was introduced and its relevance to education suggested, some in the educational research community conducted evaluations of the new technology by making comparisons and contrasts to classroom instruction. CBI is one such technology that was subjected to media comparison studies. This review opens with an examination of what has been learned from research on media and the implications of media research for research conducted on ILSs.

The potential of ILSs may be unfulfilled because the technology is ineffectively or improperly implemented. A problem that was often addressed by research on change and innovation was the improper or ineffective implementation of an innovation. Since the question of ILS effectiveness may be as much an implementation question as a matter of instructional design, this review established a theoretical framework for the evaluation of an ILS within the context of research on change and innovation. Three issues related to the implementation of innovations—fidelity of implementation, the adaptation of innovations, and user attitudes about innovations—are discussed in this section of the review with a focus on changes that occurred in an educational environment when ILS technology was introduced and implemented.

Educators no longer ask whether computers will have an important place in the curriculum, but rather how the computer can best be used to enhance instructional efficiency and effectiveness. There was a substantial body of research related to the use of computers for providing instruction and numerous researchers evaluated the effects of computer use in the classroom. This review classified CBI research into two categories: comparisons/evaluations of CBI and ILSs and empirical research related to CBI and ILSs. While the results of this research varied greatly from study to study, so did features and variables such as hardware, software, instructional strategies, and research design. Since ILSs are emerging as the prominent form of CBI in schools today, this section of the review gives particular emphasis to CBI research where ILS instruction is the object of research.

Research on Media--Delivery Vehicles or Cognitive Transformers

Historically, when a new technological innovation is embraced by the educational community, there is a succession of research questions that follow and a rush to compare the new technology with other media and methods of instruction. The pattern for research on media is to compare the relative achievement of different groups who have received similar subject-matter instruction from different media (Clark, 1983). The historical perspective of research on media is that short-term, single-shot studies could reveal us something about the long-range, cumulative effects of media. The history of research on media can be classified into the types of media for which the research is conducted: pictures, audio, film and television, programmed instruction, and computers. A review of the history of media comparison studies yields conflicting results (Clark, 1983; Clark & Salomon, 1986; Craik, 1969; Hartley, 1968; Kulik, Bangert, & Williams, 1983; Samuels, 1970; Schultz, 1988).

Mielke (1968) discussed the hypothetically perfect experiment in which a unit of instruction is presented to two groups of students that have been randomly assigned. In one group a teacher presented a lesson and no discussion was allowed. The other group was in another room and viewed the lesson over a television screen as it was being presented live to the first group. With this experimental design there would be no difference in learning and if there was it could not be explained because the only operating variable was the mode of transmission. Many media comparison studies used this same design and logic to conduct research.

Salomon and Clark (1977) distinguished between research *with* media and research *on* media. In research with media, media were simply the conveyance or delivery system for instruction while research on media examined particular media variables. Media research was erroneously interpreted when it suggested that learning benefits were derived from a particular medium. Salomon and Clark suggested that most media research could be classified according to one of the following categories of research objectives:

1. To obtain knowledge about the effectiveness of a chosen medium (comparison studies).
2. To increase understanding of how media function and the psychological effects of certain media.
3. To enhance educational practices through improved media (evaluation studies).

Clark (1983) incongruously compared the delivery of instruction using a particular medium to a truck that delivers groceries, noting that a medium no more influences learner achievement than the grocery delivery truck causes improvements in nutrition. Clark argued that there was compelling evidence for the confounding of variables in the media research that he reviewed. Clark disputed the meta-analytic findings of Kulik and others (Kulik et al., 1983; Kulik, Kulik, & Cohen, 1980) and maintained that the main benefits to be derived from media were primarily economic and efficiency benefits.

Clark (1983) claimed there was clear evidence of consistent confounding in CBI comparative research. Since CBI generally required a greater effort to design the presentation than the comparative media, Clark concluded that the confounding variable was the instructional design. Therefore, Clark proposed that the main contributions of comparative research related to CBI may be the cost benefits and motivational issues to be considered when using computers for instructional purposes. Since the computer did not possess any intrinsic value for increasing learner achievement, CBI effectiveness was a function of the instructional design of CBI.

Salomon and Gardner (1984) supported Clark's contention that the primary benefit of media comparison studies was to provide answers regarding the value or worthwhileness of a particular medium. They noted that the question cannot be asked as to whether a particular medium is more effective than "conventional instruction" (p. 5), because there is no universal concept of conventional instruction or any other media. Salomon and Gardner proposed that it is a medium's "symbol systems" (p. 20) that should be researched. Symbol systems were defined as representations of the mental operations that constituted the core of cognition and were acquired through the culture of an individual by one's external representations.

Kozma (1994) described symbol systems as sets of elements such as words or picture components that were interrelated within each system by syntax and were used in ways specific to the corresponding fields of reference. For instance, words and sentences in a text were used to represent people, objects, and activities that are structured in a way so as to form a story. According to Kozma, information was not only represented in memory but was also processed. Therefore, symbol systems alone were not sufficient to describe a medium and its effects on cognition. Kozma proposed that media can also be distinguished by characteristic capabilities that were used to process or operate on the available symbol systems. These processing capabilities of a medium complemented or facilitated those of the learner.

Kozma (1991) proposed a theoretical framework for media research characterized as "mediated information" (p. 180) in which the learner actively collaborated with the medium to construct knowledge. According to this view, learning was an active, constructive process and the learner strategically managed the available cognitive resources to create new knowledge by extracting information from the environment and integrating it with information already stored in memory. Kozma concluded that the processing capabilities of computers influenced the mental representations and cognitive processes of learners.

The essence of the media research debate and its application to ILS technology was in the distinction between medium and method or what Clark (1983) described as research *with* media as opposed to research *on* media. Kozma (1991) argued that both medium and method are components of the instructional design and that within a particular design the medium enabled and constrained the method while the method drew on the capabilities of the medium. Therefore, when learning was influenced by a method or design, it was in part because of the medium's capability to complement a learner's prior skills and knowledge.

The implication of this debate for ILS technology rests in the fact that the processing capabilities of the computer can influence the mental representations and cognitive processes of learners. In the past research on media was concerned with how best to teach a lesson. However, the emphasis of media research shifted from teaching to learning. Media research was better applied when the research methodology identified the particular design features of a particular medium or identified the possible instructional variables that facilitated learning. A medium was distinguished from other media by its characteristic symbol system, but some media such as computers were distinguished by their capability to process symbols. Therefore, it was this transformation capability of the computer rather than its symbol systems that distinguished learning with computers.

Grabowski (1989) profiled the underlying dilemma of media research in her statement that implicit in the fact that a particular medium may have the potential for delivering effective instruction is the fact that a medium can deliver quite ineffective instruction. The same dilemma holds true for innovations such as ILS technology that have the potential for effective instruction when the implementation follows the developers' design parameters, but may provide ineffective instruction when the implementation does not follow the design parameters for the innovation. In the next section the dilemma of appropriately implementing ILS technology and other innovations is discussed at length.

Implementation of Innovations--Fidelity or Adaptation

In order to understand educational change and innovation it is important to distinguish how implementation contributes to the process. Implementation is the placement of an innovation in the instructional process and is distinctive from adoption because many innovations are adopted but never implemented (Bond, 1988). Since the literature on implementation of educational innovations was extensive, it was the source of several propositions about the change process. One persistent theme in the literature was the inadequacy of computer technology implementations (Bond, 1988).

Good implementation was the most critical factor in maximizing positive learning outcomes with ILSs according to Shore and Johnson (1992). Mageau (1992) declared that the single biggest problem with ILSs was poor implementation. Although ILSs have promising possibilities for education, schools cannot reasonably expect to experience gains in learner achievement and motivation from ILS technology if ILSs are not properly implemented. Furthermore, schools cannot expect to receive the best return on their investment in ILS technology without adequate implementation.

Since the implementation of ILSs into the instructional process in a school is a highly complex process, most ILS companies developed some form of implementation model for use by schools adopting their system (Van Dusen & Worthen, 1992). These models outlined what the developers believed to be essential components of successful implementation. Frequently the practices described in the implementation models were general and non-prescriptive and administrators and teachers implementing ILSs were not aware that these models existed.

Assessing the effectiveness of an innovation without examining how the innovation was implemented may lead to distorted results. Hall and Loucks (1978) concluded that extensive study of innovations from the perspective of dissemination and adoption has been conducted while much less is known about innovations from the implementation perspective. The notion that once an innovation is adopted and initial training takes place, the users will put the innovation into practice, is inadequate and short-sighted. Hord and Huling-Austin (1986) cautioned that implementation does not equal delivery of an innovation. Furthermore, to suppose that the users of an innovation will implement an innovation in the way it is intended to be used is an ambitious assumption.

Hall and Loucks (1977) charged that many experimental and evaluation studies were based on an implicit assumption that the treatment was present and its effects were accounted for by testing whether there were statistically significant differences between two groups or by pre- and posttesting the same sample. They concluded that information about the actual use and degree of implementation of an innovation might better explain some nonsignificant findings reported in evaluation and empirical studies.

Implementation Models

Several models or strategies have been employed to provide a systematic approach to the evaluation of the extent to which an innovation is implemented. Alkin

(1969) proposed that before learner performance was measured it was necessary to facilitate full implementation of an innovation. Stallings (1977) required developers to identify key elements or characteristics of an innovation and then limit an evaluation only to classrooms that demonstrated the specified characteristics of the innovation. Hall and Loucks (1977) proposed that the implementation of innovations was more than a dichotomy of use and nonuse and operationally defined eight "levels of use" of an innovation (p. 265).

Researchers at the Apple Classroom of Tomorrow (ACOT) project observed distinguishable changes in classrooms in technology-rich schools (Dwyer, Ringstaff, & Sandholtz, 1991). These instructional changes in ACOT classrooms were viewed as an evolutionary process in which teachers moved from concerns about technology to the development of powerful learning experiences for their students. According to Dwyer et al. the following stages of implementation were observed in different schools over several years:

(1) Entry phase. Teachers attempted to establish order in "radically transformed physical environments" (p.47).

(2) Adoption phase. The technology was integrated into the traditional classroom, student attitude levels about the computers were high, teachers reported individual student effects, but overall student achievement was generally unchanged.

(3) Adaptation phase. Traditional teaching methods were supported with computer activities and productivity and efficiency were the salient changes reported by teachers.

(4) Appropriation phase. More innovative instructional strategies were employed by teachers because of increasing confidence in the technology.

(5) Invention phase. The use of the technology became a mindset in which there was a willingness to experiment and change.

Most models of change viewed change as a developmental or evolutionary process. The early phases of accommodation and assimilation of a particular innovation were replaced with dynamic processes of restructuring and re-engineering.

Factors Facilitating Implementation

Several factors that facilitated (or inhibited) the implementation of an innovation accounted for considerable discussion in the change literature. These implementation factors may be classified according to the following three categories:

1. the concerns or attitudes of users of an innovation or new technology;
2. the patterns of usage in implementing an innovation;
3. the interventions used by change agents to facilitate implementation of an innovation.

The attitudes and perceptions of the potential users of an innovation were an essential element in the success and subsequent effectiveness of an innovation. Hughes and Keith (1980) examined teachers' perceptions of an innovation based on the various attributes of an innovation as postulated by Rogers and Shoemaker (1971).

These attributes were relative advantage, compatibility, complexity, trialability, and observability. Teachers' perceptions of the innovation were found to correlate positively and significantly with the degree of implementation of the innovation on all the Rogers and Shoemaker attributes except complexity. The findings of the study supported the hypothesis that potential adopters' perceptions of an innovation in terms of the attributes defined by Rogers and Shoemaker were related to the successful implementation of educational innovations.

The practices of teachers in using an educational innovation were another dimension of the implementation process. While many teachers considered an ILS to be a powerful tool that can help them improve the quality of their instruction, other teachers were less impressed with the usefulness of ILSs (Cook, 1994). Simply placing ILS technology in schools did not necessarily improve the quality of instruction. Any benefit that learners received from an ILS was largely influenced by the way in which teachers utilized the ILS for instruction (Cook, 1993).

According to Churchman (1979) teacher practices using an innovation ranged from non-use to over-use and teachers often adapted and created several variations of an innovation based on their perception of the needs of their students. Hativa (1988) noted that differences in learning gains attributed to CBI were due to variations in the ways in which teachers implemented CBI. Cook (1993) suggested that the benefits students received from ILS instruction "are in large part determined by the ways that teachers utilize the ILS teaching tool" (p. 14). Hall and Loucks (1978) recognized that an innovation often exhibited little resemblance to the theoretical model on which it was based and, therefore, was seldom operationalized in the same way in different classrooms and schools.

Teachers and other innovation users did not act in isolation from the influence of school and classroom context (Hord & Hall, 1982). The way a teacher used an innovation for instruction was, in part, influenced by interactions with the principal, technology coordinator, other teachers, and technical and sales consultants. A number of studies were devoted to examining and understanding the variables that facilitated or inhibited the implementation of ILSs and other innovations (Albers, 1994; Cook, 1993, 1994; Hord & Huling-Austin, 1986; Van Dusen & Worthen, 1992). Cook (1993) suggested that school climate factors including the communication of goals, teacher participation in decision-making, interaction among teachers, risk-taking, and the presence of a change facilitator were closely related to successful ILS implementation. Van Dusen and Worthen (1992) identified several essential factors that provided for a successful implementation of an ILS including learner time on the ILS, teacher involvement with the ILS, integration of ILS courseware into the curriculum, and staff development.

Resolving the Fidelity-Adaptation Issue

Fullan and Pomfret (1977) described implementation as a "phenomenon in its own right" (p. 336) and suggested implementation studies should determine the extent to which actual use of an innovation corresponded to the planned or intended use of the innovation. This assimilation of planned use with actual use was referred to as "fidelity of implementation" (p. 340). Implementation was described as an interval or developmental process where certain patterns of usage of an innovation reflected higher or lower levels of proficiency, and consequently the effectiveness of the innovation (Cook, 1993). Therefore, unless an innovation was properly or adequately implemented, it may not be possible to explicitly determine innovation effectiveness.

Implementation studies were usually conducted according to one of two orientations (Fullan & Pomfret, 1977). The predominant category of implementation study was one in which the purpose of the study is to determine fidelity of implementation. The other category of implementation study considered how innovations were changed or adapted by users during the implementation process. Although research tended to separate the issue of fidelity from adaptation, Hall and Loucks (1978) argued that most developers reached a "point of drastic mutation" (p. 18) beyond which adaptations made to an innovation were not acceptable.

The debate of *fidelity* versus *adaptation* has been an unresolved issue of implementation research for many years. On one hand it seemed plausible that if an innovation were wholly implemented then there would be no degree of adaptation. However, the reality of implementation existed in the fact that "teachers will adapt the innovation to their perception of the needs of their students, omitting some materials, rearranging the rest to varying degrees, and departing increasingly from the designer's intentions as time passes" (Churchman, 1979, p. 25). Although implementation research tended to separate implementation from adaptation, this separation appeared to be an artificial one imposed by the researchers and did not reflect real world circumstances (Pensabene, Smith, & Azzarrello, 1993). To evaluate fidelity of implementation and disregard the eventuality that an innovation will be adapted, neglected the potential for program improvements by the innovation users and design enhancements by the innovation developers.

Pensabene et al. (1993) proposed that a valid fidelity of implementation model should have measures that are developed specific to the program design under investigation and that the problem with the fidelity position is the overemphasis on adoption over adaptation. Pensabene et al. concluded that one solution to the problem is to build adaptation of the innovation into the instructional design of the innovation. Another possible solution that was described as a second tier in the Pensabene et al. model was to allow for adaptation in the implementation model by considering the appropriateness of adaptations relative to the theoretical basis or rationale of the design of the innovation (Fitz-Gibbon & Morris, 1975). In other words, implementation research was better served when it acknowledged that users will choose different levels at which they will implement the various elements of an innovation and that this adaptation was a critical component of implementation.

Since the phenomenon of change is extremely complex, change models often attempted to assess and explain various dimensions of the change process. A model that accommodated both sides of the fidelity-adaptation issue and that was the conceptual basis for this investigation was the Concerns-Based Adoption Model (Hall, Wallace, & Dossett, 1973). The Concerns-Based Adoption Model (CBAM) emphasized change as a developmental process that was experienced by individuals who were implementing innovations with an organizational context. CBAM and its accompanying diagnostic tools provided a theoretical framework for understanding and describing the process of change in educational institutions. This model described the complex process of change as it occured through the adoption of innovations by individuals within formal organizations (Hall, George, & Rutherford, 1986).

CBAM was based on several assumptions about change and the adoption of innovations:

1. *Change is a process, not an event.* . . . We now know that change is a process occurring over time, usually a period of several years. Recognition of this is an essential prerequisite of successful implementation of change.
2. *Change is accomplished by individuals.* . . . Only when each (or almost each) individual in the school has absorbed the improved practice can we say that the school has changed.
3. *Change is a highly personal experience.* What we mean here is that individuals are different; people do not behave collectively. Each individual reacts differently to a change, and sufficient account of these differences must be taken. . . .
4. *Change involves developmental growth.* We have discovered from studies of change that the individuals involved appear to express or demonstrate growth in terms of their feelings and skills. These feelings and skills tend

to shift with respect to the new program or practice as individuals pass through an ever-greater degree of experience. . . .

5. *Change is best understood in operational terms.* Teachers, and others, will naturally relate to change or improvement in terms of what it will mean to them or how it will affect their current classroom practice. . . .

6. *The focus of facilitation should be on individuals, innovations, and the context.* We tend to see school improvement in terms of a new curriculum, a new program or package—something concrete that we can hold onto. But in doing so, we forget that books and materials and equipment along do not make change; only people can make change by altering their behavior. The real meaning of any change lies in its human, not its material component. Furthermore, effective change facilitators work with people in an adaptive and systemic way, designing interventions for clients' needs, realizing that those needs exist in particular contexts and settings. . . . (Hord, Rutherford, Huling-Austin & Hall, 1987, p. 5-7).

CBAM emphasized the interval nature of the change process and recognized that implementation should have measures that were developed specifically to the design of the innovation being evaluated (Pensabene et al., 1993). The client-centered, context-sensitive approach of the CBAM model provided an appropriate methodology to address the research questions posed by this study. Particularly, this model provided a set of tools to examine the practices and behaviors employed by teachers in the delivery of ILS instruction in view of the critical design features of an ILS (Hord et al, 1987).

Computer-Based Instruction--Delivering Instruction or Managing Classrooms

Two research themes were apparent in the literature related to computer-based instruction. One theme focused on the capabilities of the computer in the delivery of instruction. This approach was generally labeled computer-assisted instruction (CAI) and featured the use of the computer for the delivery of instruction including drill-and-practice, problem-solving, educational games, and simulations. The other research theme was designated as computer-managed instruction (CMI) and featured the computer in the role of managing instruction. CMI maximizes the computer's capabilities to provide individualized tracking and adaptation of instruction across an entire course of study. ILSs represented consolidation of these two approaches to CBI.

This section reviews the background and advancement of CBI that led to the development of ILSs and presents a survey of CBI literature with particular emphasis on studies using ILSs. For purposes of this study, research on CBI and ILSs is categorized according to two methodologies: evaluative studies and quasi-experimental designs.

Background of CBI and ILSs

In the 1950s educational researchers attempted to solve learning problems by applying the techniques of behavioral analysis as theorized by B.F. Skinner through programmed instruction (PI). The concepts PI of were then applied to crude teaching machines that first appeared in the late 1950s and early 1960s. PI and teaching machines were used throughout the 1960s by colleges, public schools, and the military. Price (1989) concluded that PI was effective but never achieved a high degree of popularity because it was tedious, dull, and did not fit well with group-oriented, fixed-schedule school settings.

Early efforts to use computers in instruction emerged from the guiding principles of PI. CAI was one of the earliest applications of computer technology to education (Burns & Bozeman, 1981). The computer industry itself was among the first to use CAI in the late 1950's when CAI was used to train industry personnel (Suppes & Macken, 1978). At a time when PI was the focus of educators for individualizing instruction, CAI emerged as a natural integration of computer technology and the PI movement (Schoen & Hunt, 1977).

Among the original CAI models to emerge was a project under the direction of Patrick Suppes at Stanford University. The Stanford Project was begun in 1963 and its purpose was the development of a tutorial system to provide instruction in elementary mathematics, language arts, and reading. By the end of the second year of operation approximately 400 students received daily computer-assisted instruction in either reading or mathematics (Suppes, Jerman, & Brian, 1968). As a direct consequence of the Stanford Project and the need for curriculum-relevant CAI courseware, Suppes formed a company, Computer Curriculum Corporation (CCC), that marketed CBI for minicomputer systems. Suppes and Morningstar (1972) validated the use of computers as effective teachers and argued that the creation of many articulated programs instead of isolated topical lessons was required for computers to be used effectively to deliver instruction.

A project originated at the University of Illinois in 1960, the PLATO (Programmed Logic for Automatic Teaching Operations) project, took a different approach to CBI. In the PLATO project computer hardware and software were specifically designed to deliver instruction in a wide variety of subjects to a large base of learners simultaneously. PLATO researchers pioneered the use of color graphics, touch-sensitive screens, a variety of delivery modes, a high level of interaction between the computer and the learner, and learner control (Price, 1989). PLATO became a registered trademark of Control Data Corporation and served as a model for many CBI delivery systems. In 1967 the University of Illinois established a research laboratory for the PLATO project and PLATO expanded into a large-scale computer-based educational system called PLATO IV (Lyman, 1972).

More recently several companies have migrated to microcomputer-based platforms. These ILSs consisted of computer hardware and software configured as a local area network (see Figure 1). The ILS included a comprehensive package of software called courseware that provided CBI on a network of computers. The courseware included a management system that tracked individual learner progress and adjusted instruction accordingly.

CBI is having a profound impact on both the field of education and our society. ILSs experienced enormous popularity and sales for most of the major systems grew at a near phenomenal rate (Sherry, 1992). Large textbook publishing companies

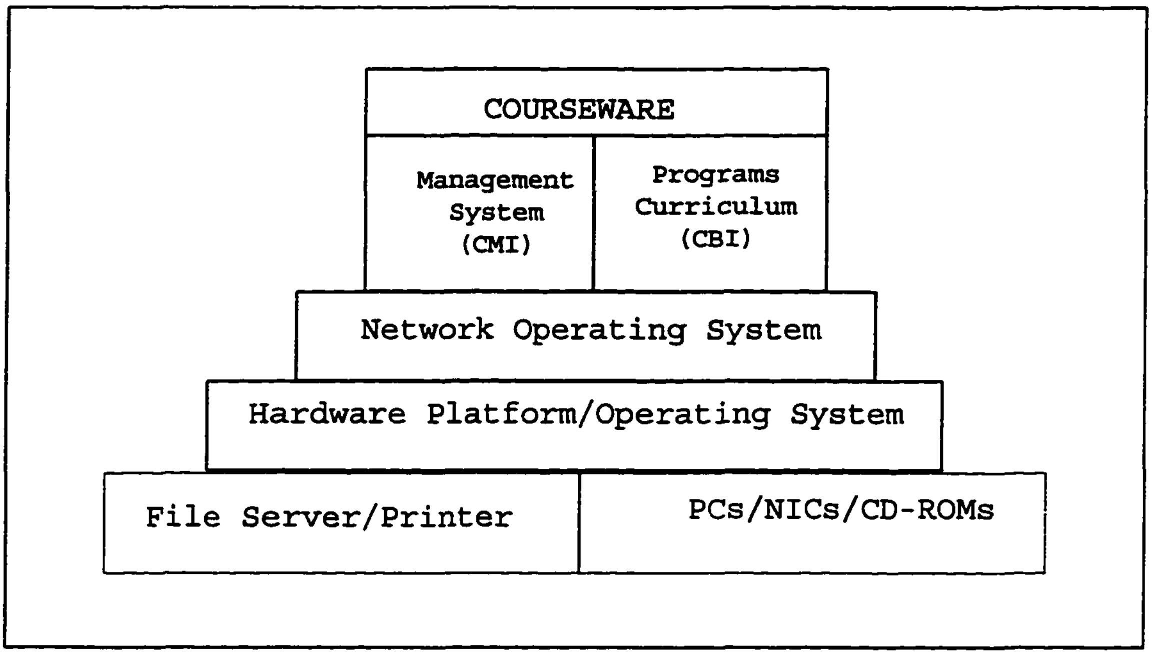

Figure 1. A Conceptual Model of an Integrated Learning System

purchased ILS companies and invested heavily in reshaping them for the future. ILSs accounted for a large portion of the computer-based instructional systems used in public schools and many educators believed that these systems will continue to become more common in public schools (Sherry, 1990a).

CBI and ILSs provided certain advantages for learning that teachers or textbooks could not provide. Although opinions differed about this issue, one may argue that the primary advantage of CBI was the potential to provide individualized instruction. Since CBI was a dynamic medium, it was capable of varying the lesson content, the instructional sequence, and the level of difficulty for each lesson as well as revising the types of feedback (Ross, 1984). Usually these revisions were accomplished while the learner was completing a lesson. For example, the computer selected and presented math problems at varying levels of difficulty in response to an initial diagnosis of each learner's mathematics ability. Once an assessment is made, the control processes of the computer-based instructional system utilized feedback from the learner to continuously refine the estimate of the learner's progress.

As the costs of computing technology steadily declined, the use of CBI became increasingly feasible for classroom applications. Research findings that examined the effectiveness of CBI in terms of learner achievement and time required to learn material to a mastery level often were supportive (Bangert-Drowns, Kulik, & Kulik, 1985; Kulik, Bangert, & Williams, 1983; Burns & Bozeman, 1981; Kulik & Kulik, 1987; Kulik, Kulik, & Cohen, 1980, Niemiec & Walberg, 1985). For example, Kulik et al. (1980) analyzed results from over 50 studies related to the effectiveness of CBI at the college level and determined that in most cases CBI raised test scores by about .25 of a standard deviation and in a few cases CBI dramatically increased test scores by 15 to 70 percentage points. Kulik et al. observed in every study that CBI was substituted for conventional instruction, CBI accomplished the instructional objectives in about two-thirds of the time required by conventional teaching methods.

Although CBI was considerably appealing, there still remained some question about the design features and delivery capabilities that account for this instructional effectiveness. Research indicated that CBI was not intrinsically good or bad, effective or ineffective (Hannafin & Peck, 1988) and several researchers turned their attention away from the comparative effectiveness question and focused on the learning environment, instructional design, and learner variables that maximized CBI

(Goetzfried & Hannafin, 1985; Ross, 1984; Ross & Rakow, 1981; Ross, Rakow, & Bush, 1980; Skinner, 1990; Tennyson, 1980; Tobias, 1989).

Evaluative Studies CBI and ILSs

Evaluative studies of CBI attempted to answer questions about CBI and its effects on learner achievement and the conditions and extent to which CBI was most effective. Evaluations made comparisons between related forms of CBI or CBI and classroom instruction. Evaluations also examined variables that facilitated or inhibited the use of CBI in classrooms.

The research comparing the effectiveness of CBI to other methods of instruction provided inconclusive results. For instance, in a multi-year study of several ILSs Resta and Rost (1986) determined that ILSs were under-utilized and inappropriately used. May (1991) compared three different ILSs and determined that test scores did not indicate significant differences in achievement as a result of the ILS after one year of testing. However, surveys completed by the faculty, principals, and parents in May's study indicated they perceived the ILSs to have a positive impact on learning and the interest level of learners.

ILS evaluative research often assumed the form of comparative studies of specific products. For instance, Taylor (1990) evaluated the Jostens Learning System in rural school districts in Alaska and reported that learners enjoyed CBI and that teachers needed to be actively involved in CBI sessions and proficient in the use of the ILS. The Educational Products Information Exchange (EPIE) Institute conducted a fourteen month independent evaluation of eight ILSs (Sherry, 1990). Hands-on evaluations of the courseware and management systems of Jostens Learning Corporation, WICAT Systems, Wasatch Education Systems, New Century Education, Ideal Learning, Computer Curriculum Corporation, Computer Networking Specialists, and Computer Systems Research were evaluated by EPIE analysts. The two major findings of the EPIE study were that ILSs were viewed positively by a majority of learners and educators and that most schools did not make effective use of ILSs.

Other evaluative research overviewed the companies that were marketing the most widely-used ILSs. These evaluations provided information about instructional strategies, curriculum areas, and future trends of the software packages. Other evaluations developed guidelines to be considered when purchasing an ILS including a list of vendors offering ILSs and related products (Curlette, Howard, & Bray, 1991; Lehrer, 1988; Sherry, 1992; Smith & Sclafani, 1989; Wiberg, 1993; Wilson, 1990).

ILS vendors often published evaluation summaries that appeared to back up claims of the effectiveness of their ILS in increasing learner achievement. Trotter (1990) reviewed this research and indicated that hundreds of studies existed that attributed gains in standardized test scores and other improvements to the use of ILSs. Trotter concluded that many of these studies, which were handed out freely by ILS vendors and proud school systems, did not stand up to methodological analysis and the research had such serious flaws that no definitive conclusions could be drawn from the evaluation studies.

Several prominent reviews of CBI and ILSs used meta-analytic procedures to calculate the effects of computer use on elementary, secondary, and post-secondary students (Bangert-Drowns, 1985; Bangert-Drowns, Kulik & Kulik, 1985; Kulik & Kulik, 1987). These meta-analyses generally provided favorable results about the effectiveness of CBI. Kulik and Kulik (1987) concluded that CBI had positive effects for all categories of programs across all educational levels, effects varied as a function of the research design used to measure the effectiveness of CBI, and outcomes varied as a function of the type of publication in which the results were found.

Becker (1992a) analyzed results reported in thirty evaluations of ILSs and adjusted, as necessary, for deficiencies in the original designs and reports. Becker concluded that most studies substantially overstated ILS effectiveness. On average ILSs demonstrated only a moderately positive effect on learner achievement because ILSs did not help learners at all levels of the achievement distribution. Becker suggested that these modest positive effect sizes indicated that results are also affected by the conditions of the study as much as by the quality of the software packages in use. He concluded that the use of ILSs did not consistently increase learner achievement in reading, mathematics, and language arts as might be expected from learners using high-quality software regularly throughout the year and that ILSs had not achieved their potential in American education.

Several case studies and evaluations revealed valuable insights into the attitudes and patterns of usage of teachers and schools incorporating computer-based technology into education. Van Dusen and Worthen (1992) described four components of implementation essential for an ILS to impact learners: (1) engaged learning time on the ILS; (2) teacher involvement with the ILS; (3) integration into the curriculum;

(4) staff training. They reported factors that hindered ILS implementation as differences between scheduled time and engaged time of learners using an ILS, little active monitoring of learner progress by teachers, limited use of system-generated reports for tracking learner performance, inadequate training of teachers in using the ILS and ILS reports, and no understanding of the individualization features of the ILS. Most teachers believed the ILS should be used mainly as a supplement to the curriculum and did not utilize learner performance data on the ILS for reporting learner progress.

Cook (1993, 1994) examined four sets of variables that influenced teachers' level of ILS implementation in all of the schools in the Chicago metropolitan area in which an ILS had been used for more than three years. The findings of this study revealed that school climate factors were closely related to high levels of ILS use. These factors included clearly communicated goals, teacher participation in the decision-making process, interaction among teachers regarding ILS use, and the presence of a local hero who spearheaded efforts to make the ILS a success.

Bond (1988) determined that implementations of computer technology varied notably in the type and extent of facilities, instructional context, and participation. He concluded that the role of microcomputers in education was not well defined due to the diversity of applications and that the process of implementing microcomputers differed from the implementation of other innovations because of the presence of this diversity. Bond summarized his findings as follows:

> Assessment of microcomputer implementations should be based on local criteria specific to the intent of a particular implementation. Pertinent evaluative criteria should include emphasis on the educational context of the implementation; the use of formative techniques will probably yield more success than summative techniques. Sweeping statements regarding the success or failure of microcomputers in education should be viewed with great suspicion. (p. 329)

In a nationwide study researchers at the Bank Street College of Education surveyed teachers experienced at integrating computers into their teaching (Hadley & Sheingold, 1993). The purpose of this study was to see what teachers who were recognized for their efforts using technology were doing, how they used educational technology, what they perceived to be the value of technology, and how they believed their teaching and instructional had changed as a result of computer technology. The integration of computer technology into the curriculum was based on the notion "that teachers readily and flexibly incorporate technologies into their everyday teaching practice in relation to the subject matter they teach" (p. 265). Hadley and Sheingold found that teachers who advanced beyond just knowing how to use computers to incorporating technology into their teaching practices believed that they now teach differently and more effectively.

Becker (1994) used national survey data from third through twelfth grade teachers of academic subjects to identify "exemplary computer-using teachers" (p. 261). Becker found several distinctions that favored exemplary teachers:

- Exemplary computer-using teachers taught in an environment that helped them to be better computer-using teachers.
- Exemplary computer-using teachers were better prepared to use computers well in their teaching.
- Exemplary computer-using teachers allowed computers to have a much greater impact on how and what they teach.
- Exemplary computer-using teachers made greater demands on available resources and faced problems that other computer-using teachers were less likely to face.
- Exemplary computer-using teachers taught in a representative range of communities, schools, and classrooms, but schools and districts used resources to nurture and support the kind of teaching practices considered exemplary.
- Exemplary computer-using teachers had more well-rounded educational experiences than other teachers, usually a liberal arts background and a commitment to lifelong learning.
- Exemplary computer-using teachers had a strong personal interest in computing activities and were disproportionately male (possibly due to the fact that in our culture interest in computing activities is highly correlated with gender).

A growing body of largely qualitative research indicated that computer technology was of more educational benefit when its use was incorporated into the classroom practices of teachers and integrated with and essential to the curriculum.

Other factors that enhanced the effects of computers and ILS technology in schools and classrooms were teacher training, engaged learning time, teacher involvement with the ILS and computer technology, clearly communicated goals for the technology, and teacher participation in the decision-making process of selecting technology.

Experimental/Quasi-Experimental Studies of CBI and ILSs

Empirical research regarding CBI and ILSs was somewhat limited and the methodologies employed for this category of research were best described as quasi-experimental since the designs often resembled experimental designs without full control over the scheduling of the experimental treatments (Campbell & Stanley, 1963). A sampling of the quasi-experimental research based on the work of five researchers (Alifrangis, 1990; Becker, 1992b; Gilman, Emhuff, Bender, Gower, & Miller, 1991; Norton & Resta, 1986; Seaman & McCallister, 1988) is presented in this section. The research design, the sample, the experimental treatment, and the findings are described for each of these studies.

A study to describe the implementation of an ILS (Education Systems Corporation, ESC, now Jostens Learning Corporation) was conducted in a large elementary school near a metropolitan area (Alifrangis, 1990). Alifrangis employed a pretest/posttest control group design and random assignment to examine changes in learners' achievement in either mathematics or reading. Pretest/posttest data were supplemented by observations, interviews, document reviews, and teacher and learner questionnaires. The evaluation of the ILS focused on the curricular scope and sequence and its relation to the school district curriculum, how the management system was used by the teachers to assess learner weaknesses and plan appropriate follow-up, general learner and teacher reactions to using the ILS, and educational outcomes.

Results of the achievement tests indicated that learners' test scores improved, but significant differences in the reading and mathematics components were limited to homogeneous groupings by race or race by sex. Implementation factors that contributed to the few statistically significant results were the one year time span of the study, the differences among teachers both in the way they integrated lab instruction with classroom work, and the lack of or inconsistent monitoring of the learners by some teachers and of some teachers by the administration.

Seaman and McCallister (1988) evaluated the use of several ILSs (CCC, Comprehensive Competencies Program, IBM PALS, and Control Data Corporation's PLATO) in adult education. Participants were categorized as upper-level (7th through 12th grade) or lower-level (0 through 6th grade). Learner progress was measured through the use of a test/retest design using the Test of Adult Basic Education as the pretest and posttest to identify increases in reading, mathematics, and language. Attitude surveys were administered and teachers and administrators were interviewed. Among the findings were the following:

- Overall increases were demonstrated in all three skill areas (reading, mathematics, and language).

- ILSs were most effective in supporting reading and math instruction.
- The most effective ILSs for lower-level learners were those that were integrated with conventional whole-class instruction.
- The PLATO/CCC configuration was clearly the most effective system for providing mathematics instruction.
- Lower-level groups benefited less from ILS instruction than upper-level learners.
- Learner and staff attitudes were generally positive toward ILS instruction.

Norton and Resta (1986) conducted a study on third, fourth, fifth, and sixth grade learners enrolled in computer reading classes in a six-week summer school session. One of three integrated learning systems (CCC, WICAT, Dolphin) was in operation for each reading class. Learners were divided into three treatment groups. One group spent half of its time using an ILS for reading instruction while the other half of the group's time was used for traditional reading skills instruction. In the other two groups, half of the time was spent using an ILS for reading instruction and the other half of the time was spent using either problem-solving software or simulation software.

In all areas tested Norton and Resta (1986) discovered that learners entering the fourth, fifth, or sixth grade achieved more from instruction supplemented by problem-solving and simulation software than from instruction supplemented by more traditional skills instruction. In the case of learners entering the third grade, all three treatments affected achievement positively but statistical analysis indicated there was no significant difference among treatments. The researchers concluded that the nature of problem-solving and simulation software demanded abilities for abstraction that exceeded the developmental abilities of younger learners. The researchers concluded that computers had the potential to play an important role in support of the reading curriculum if educators pursued new uses of this new technology as opposed to using the technology as a new medium for accomplishing the traditional curricular goals associated with reading instruction.

A study to investigate the effects of an ILS on the learning and attitudes of learners was conducted in four elementary schools in the Metropolitan School District of Mount Vernon, Indiana, using the Wasatch Educational System ILS (Gilman et al., 1991). A total of 1179 learners in the elementary grades and 120 teachers participated in the study with scores in previous years from an additional 2426 learners. Learners were pretested on several criteria, including days absent from school, reading achievement, language arts achievement, mathematics achievement, total achievement for the test battery, and cognitive skills index. Among the attitudes tested were self-concept, attitude toward school, attitude toward computers, and skills learners could do with computers. Results were analyzed by a repeated measures analysis of variance. Almost all the learner achievement and attitude variables showed significant gains after the introduction of the ILS. The study confirmed that the ILS increased learners' computer skills and improved attitudes.

Gilman et al. (1991) analyzed teachers according to their attitudes toward instructional technology, instruction using an ILS, and their perceptions of their own skills using instructional technology. Almost all of the achievement and attitudinal variables for learners indicated significant gains after the introduction of an ILS. The study also confirmed that the ILS was well received by teachers and learners. An unexpected finding of the study was that standardized test score means of the school system were lowered during the initial year of the project. The researchers postulated this decrease resulted from devoting instructional time to keyboarding and computer literacy rather than learning basic academic skills, incongruencies in the learning objectives of the standardized tests and the ILS, and a reduction in teacher contact with individual learners.

Becker (1992b) observed that the weakest component of ILS instruction is one instructional quality and that this weakness was largely a consequence of overemphasizing the individualization of instruction. The evidence for this observation was based on a study conducted in sixteen second through fifth grade classes at two elementary schools in Baltimore, Maryland. A randomized experimental design was employed in which one-half of each teacher's class used an ILS for mathematics activities while the other half used the ILS only for reading and language arts exercises. Learners were randomly assigned to the two treatments in each class creating balanced treatment groups. Outcomes were assessed using both the California Achievement Tests and a criterion-referenced test constructed to cover topics directly from ILS and non-ILS tasks not covered on the standardized test. Learners were divided into three groups according to their CAT pretest scores. The low group was comprised of the lower 30% pretested at each school, the middle group the middle 40%, and the high group the upper 30%.

In Becker's (1992b) study ILSs appeared to work best for learners in the upper group, often raising their test scores substantially. Additionally, well-designed ILSs seemed to help learners in the lower part of the class distribution. However, ILSs were less likely to help learners in the middle of the class distribution. Becker suggested that learners in the middle of the distribution were less likely to need a different level or pace of instruction compared to what they may receive in conventional whole-class instruction.

In summary, the quasi-experimental research regarding ILSs revealed several findings that were pertinent to the present study:

- Learners appeared to benefit most from math and reading instruction.
- Both learners and teachers had positive attitudes about using ILSs for instruction.
- The overall effectiveness of ILSs was often positive but modest in magnitude because ILSs helped some learners more than others. ILS instruction seemed to be more effective for higher aptitude learners than for lower aptitude learners.
- Instructional quality appeared to be the greatest weakness of ILSs and this was largely a consequence of overemphasizing the individualization of instruction.

While the debate about the impact of ILSs on learner achievement will likely continue, Bailey and Lumley (1991) recommended that the potential impact of ILSs should be calculated using the existing research on effective instruction. They maintained that ILSs had addressed many of the problems found in older forms of individualized instruction and computer-assisted instruction. Although the current evidence from existing empirical research and evaluations indicated that ILSs had not achieved their potential contribution to education, the same findings predicted that ILS instruction had the potential to provide teachers with sophisticated technology that adhered to and enhanced the principles of effective instruction.

Summary of the Literature Review

The literature review examined the use of CBI/ILS technology in classrooms from the perspectives of media research, educational change and the implementation of innovations, and the current and past use of CBI and ILSs in schools and classroom. Several propositions can be formulated from the preceding discussion. These propositions provide a theoretical and practical basis for the analytical strategies used by this study and define alternative explanations for the research questions that are examined by this study:

- *Media research about computers was beneficial when the research was directed toward the transformation capabilities of the computer to process symbol systems.* The present study primarily examined the instructional strategies and practices of teachers implementing an ILS rather than the delivery of instruction by a particular medium.
- *Evaluations of new technologies such as ILSs were worthwhile when they identified and/or explored operational variables, designs, or processes that facilitated learning and improved instruction.* The present study examined the

actual use of ILS technology by teachers within the context of the original design parameters of the technology.

- *The implementation of innovations was a developmental process and users chose different levels of usage at which they implemented the various features of an innovation. Furthermore, users adapted the various features of an innovation to meet their specific needs.* The present study was designed to examine and analyze the operational patterns of use of ILS technology by individual teachers at intervals along an implementation continuum.
- *Teachers were the primary users of educational innovations such as ILSs. Teachers' usage of an innovation provided a true picture of how the innovation was implemented in the classroom and was the key factor in determining what the ideal use of an innovation will be.* Teachers were the unit of analysis for the present study.
- *The concerns and attitudes that teachers possessed concerning an innovation impacted the way in which the innovation was implemented and used in practice.* The present study was designed to examine and analyze concerns of individual teachers about an innovation at an interval along the implementation continuum.
- *Although the effects of CBI on learning and achievement were not conclusive, learners were motivated by CBI and teachers generally had positive attitudes about CBI.* The present study collected and analyzed teachers' attitudes and instructional strategies in implementing of ILS technology.

- *CBI and ILS implementation were influenced by the interventions of teachers and other change facilitators. These interventions were often external to the instructional control of the teacher and often attempted to influence the instructional practices of the teacher.* The present study examined the computer-using instructional practices of teachers with the intent of exploring the relationship of these practices to the way in which teachers implemented an ILS.
- *Computer technology was more valuable to teaching and learning when it was integrated into the everyday classroom practices of teachers.* The present study examined variations in the computer-using practices among teachers.
- *Evaluations of CBI should be based on local criteria specific to the intent of a particular implementation, should emphasize the educational context of the implementation, and should use formative techniques.* The present study employed a design that examined ILS implementation data within the educational context for which these data existed.
- *ILSs have addressed many of the problems associated with other forms of CBI and individualized instruction. However, the full potential of ILSs for classroom instruction was often not realized because ILSs were not properly implemented.* The present study examined the implementation of ILS technology and considered instructional strategies that reinforced the implementation of ILS technology.

CHAPTER 3

RESEARCH METHODOLOGY AND PROCEDURES

The research indicated that the impact of computer technology on education often depended more on the educational context of the innovation than on any other variable. To understand the impact of ILS technology in classrooms, it becomes necessary to shift the focus of an evaluation from the technology to the people who use it. Paramount to accomplishing the research objectives of this study is the underlying assumption that an understanding of a technological innovation such as an ILS requires going beyond the classroom (Sheingold, Kane, & Endreweit, 1988). Multiple contexts provide a more comprehensive explanation of the impact of an innovation on teaching and learning. Principally, the benefits of certain educational innovations such as CBI and ILSs cannot be understood without comparing the actual use of the innovation with its planned use.

The research goals for this study provided a mandate for examining the intended and actual use of ILS technology and what impact ILS technology had on learners in attaining the competencies this technology assumed to be advancing. These phenomena were analyzed by examining *innovation configurations*, the operational patterns that resulted from implementation of an ILS by different individuals in different contexts. Other contextual data collected by this study included an examination of the concerns and attitudes of teachers using an ILS for instruction, learner achievement using the ILS, and the collection of data from several school sites.

The research questions for this study were designed to answer questions about the components of ILS implementation and its intended use, how ILS technology was implemented by teachers, and the impact of variations in the implementation practices of teachers on the achievement of learners using an ILS. This study identified associations among these phenomena and examined the relative merits of these associations as well as the educational benefits to learners of ILS technology. The research questions guiding this study took into consideration the expected impact of ILS technology based on a review of the literature.

Research Questions

The primary purpose of this study was to detect variations in certain patterns of ILS use among individuals implementing ILS technology that reflected higher or lower levels of proficiency and, consequently, impacted ILS effectiveness. The following research questions provided an operational basis for the research tasks undertaken by this study:

1. What are the concerns of individuals implementing ILS technology?
2. What patterns of use occur among teachers implementing an ILS? How do these patterns differ from one another?
3. How do the implementation practices of teachers impact learner achievement using an ILS?

This chapter describes the participants and sampling procedures used in this study, the research design, procedures, and protocols that were followed to acquire data about teacher attitudes, innovation configurations, and learner achievement. Additionally, this chapter provides descriptions of the instruments used to measure these phenomena and the methods of analyses used to examine these data.

Research Design

This study used several quantitative data collection strategies to obtain information about the implementation of ILSs. The primary unit of analysis for this study was individual teachers in elementary schools implementing an ILS, although some comparisons and contrasts were drawn among schools. This study relied on written self-report questionnaires, interviews with teachers and other key personnel involved in ILS use, and computer-generated learner performance data. This study was designed to provide a *snapshot* of the conditions at a particular point in time and to provide a context for understanding and interpreting the data collected in this study.

The issues of validity and reliability were addressed through the research design by various strategies that enhanced the credibility of the data collection and analysis within the context of the research questions posed by this study. These strategies included the use of multiple sources of data, data collection from multiple sites, and the development of a study database that maintains a chain of evidence (LeCompte & Goetz, 1982). The following sections include discussions of how each of these strategies were implemented.

Content validity for the variables in this study was increased through pre-study field tests and revisions of the instruments used in the study. Additionally, a focus group of ILS experts was convened to review the audio tapes and ratings of the researcher for all interviews and a variety of statistical methods was applied to the data in order to describe different dimensions of the data and provide multiple views of the phenomena that occur when teachers used computers to provide instruction to learners.

Participants and Sampling Procedures

The school district selected for this study was a midwestern urban school district that had made a substantial investment in ILS technology. ILS technology was used at all elementary school campuses in the district. The school district initially implemented ILS technology in six elementary schools and during the previous school year expanded the program to include almost all kindergarten through eighth grade students in the school district. All eighteen of the district's elementary schools were equipped with ILS labs.

The sample selected for this study consisted of elementary school teachers at four schools whose students interacted with an ILS. Fictional school names were used to report the data collection in order to maintain the anonymity of the participants. These schools used the Computer Curriculum Corporation (CCC) *Successmaker* courseware for instruction (see Appendix D). The researcher attempted to collect responses from all of the ILS-using teachers in each school.

A lab configuration was employed at each campus with a number of workstations distributed to each on classroom on one campus. Each campus had a lab coordinator or media specialist to coordinate the computer lab activities and to assist the classroom teacher in the management and coordination responsibilities of the computer lab and in facilitating ILS instruction. The principal developed a lab schedule in which all students at each school were provided daily interaction with the ILS to supplement regular classroom instruction. The schools selected for this study had employed ILS technology for different periods of time thus allowing for comparisons to be made among the various schools.

Data Collection Protocol and Procedures

Data for this study were collected through published district information, interviews with technology coordinators and vendor representatives, written surveys with teachers, a focused interview with teachers, and learner achievement data generated by the ILS. Although written questionnaires and interviews were completed anonymously, each instrument was coded with a unique identification number based on the social security number of the teacher to provide a thread among the various instruments completed for each teacher.

The instrumentation used to collect data for this study included the Stages of Concern Questionnaire (SoCQ), the Innovation Configuration Matrix (ICM), and the Cumulative Gains Report. A brief overview of these instruments is provided below while a comprehensive discussion with field test results is reported in the Data Collection Instruments section of this chapter. Samples of the ICM and SoCQ are provided in Appendix A and Appendix B respectively.

An assumption of this study was that the way teachers used an ILS was in part determined by an individual teacher's concerns about using an ILS for instruction and in part by the instructional strategies used to facilitate implementation of the ILS (Albers, 1994; Cook, 1993, 1994; Gilman, Emhuff, Bender, Gower, & Miller, 1991; Hall, George, & Rutherford, 1986; Hord & Hall, 1982; Hord & Huling-Austin, 1986; Seaman & McCallister, 1988; Van Dusen & Worthen, 1992). The Stages of Concern Questionnaire (SoCQ) was used to examine the attitudes or concerns of teachers who were implementing ILS technology and the Innovation Configuration Matrix (ICM) was used to examine the instructional strategies used by teachers implementing an ILS.

This study attempted to describe how an ILS looked in actual practice in schools and classrooms in clear, operational terms (Hord, Rutherford, Huling-Austin, & Hall, 1987). An ICM was developed to represent the patterns of ILS use that result when different teachers in different schools put an ILS into operation as a part of instruction. The ICM described the acceptable and ideal use of ILS technology by teachers (Heck, Stiegelbauer, Hall, & Loucks, 1981), identified the operational components of an ILS and the variations in the use of each component, and benchmarked teachers' patterns of actual use of an ILS.

One of the most important features of an ILS is a comprehensive management system that accumulates data in various forms about learner progress. One form of data collection provided by the management system was the Cumulative Gains Report. The Gains Report provided a running account of each learner's gain and amount of time to achieve this gain. These data were tracked by the management system for each course in which the learner was enrolled.

Data Collection Tasks

Data for this study were obtained through several data collection tasks. Preparation and planning for data collection began with interviews with technology consultants, district administrators, and other change agents as well as by conducting field tests and pilot studies for the instruments developed for this study. Meetings with school staff familiarized the researcher with the district goals and implementation plan for ILS technology and provided an orientation to district administrators about the data collection procedures and protocol.

Prior to the first data collection task the researcher met with the principal from each selected school and provided an overview of the research project. This overview consisted of explaining the purpose of the research project and the procedures and instrumentation to be used for data collection. The researcher provided the principal with a written statement of the goals of the research project and the data collection activities employed. The principal was requested to provide this information about the research project to each of the teachers in his or her school. In addition to the principal interview, interviews were conducted with various change facilitators and implementers including (but not limited to) district administrators, technology coordinators and consultants, and teachers in order to gather information for final development of the ICM.

For the first data collection task all classroom teachers were requested to complete the SoCQ. The results of the SoCQ were summarized and returned to district administrators and principals. Respondents to the SoCQ were grouped according to each of the stages of concern and a random sampling from each of the stages from each school was selected for conducting ICM interviews.

For the second data collection task ICM interviews were conducted with selected teachers. An expert group consisting of the researcher, an experienced lab coordinator, and a vendor representative was assembled to score the actual use by each teacher for each implementation component. The expert group used transcribed interview recordings of the interviews to score the ICM.

ICM interviews were approximately 20-30 minutes in length and were tape recorded with teacher permission. The interview was a focused interview that followed a structure imposed by an interview guide and the ICM itself. The interview examined the use and implementation of the ILS by teachers. The interview techniques employed by this study were non-threatening and encouraged teachers to speak openly to provide a greater depth of information than would be allowed by surveys or observations only. A one-on-one methodology was employed to allow the interviewer to establish rapport with the teacher.

Teacher interviews were scheduled to take place during a time when each class was in the computer lab. The researcher returned for a second round of interviews for teachers that were absent during the first round. The researcher was able to interview all teachers in the sample except one. Teacher interviews were recorded on audio tape, transcribed to written form, and then reviewed by the group of ILS experts.

The tendency of subjects to exaggerate the positive aspects of a program, often called the halo effect, was controlled during the interview process to increase the likelihood that teaching practices accurately represented true patterns of use. The ICM interview probed several components of ILS use and major inconsistencies across ICM components would have indicated inaccuracies. Furthermore, the ICM interview allowed the interviewer the flexibility to probe questionable or unconvincing statements by the teacher.

The third data collection task consisted of obtaining computer-generated data on learners using the ILS. The assistance of the media or lab coordinator at each school was enlisted for collecting learner achievement data of ILS use and all student reports that were requested were obtained. These data were collected from the cumulative gains report for each of the teachers selected for ICM interviews and used for purposes of comparing implementation data from the ICM with learner achievement data.

Table 1 provides a summary of the data collection protocol used for this study. All data from this investigation were recorded in the study database. The data recorded in the database included the results of all instrumentation. The database was organized by participant and data collection results or notes were linked to a participant (teacher) in the study. The main purpose of this database was to establish a chain of evidence linking the content of the data analysis to the research questions of this study, thereby increasing construct validity and reliability of the design.

Table 1

Data Collection Protocol

Data	Instrumentation	Who Collected From	Data Collection Task	Data Collection Method
Components of Innovation Configuration Matrix	Interviews and field tests	Lab coordinators, vendor representatives, teacher users	Prior to first data collection	Checklists, interviews, and review of published materials
Attitudes and Concerns about ILS	Stages of Concern Questionnaire	All teachers using ILS	First task	Self-report questionnaire
Patterns of ILS Usage by Teachers	Innovation Configuration Matrix Checklist	Selected teachers using ILS	Second task	Interviews and observation using ILS with class
Learner Time/ Achievement Data Using ILS	Learner Gains Report	Students of selected teachers using ILS	Third task	ILS-generated reports

Data Collection Instruments

According to Lecompte and Goetz (1982) the value of scientific research is, in part, dependent upon the ability of individual researchers to demonstrate the credibility of their findings. The research questions investigated by this study were addressed through the collection of data using several data collection instruments, some of which were developed by the researcher. These instruments were used to collect data regarding teacher attitudes about using an ILS, teacher practices in implementing an ILS, and learner achievement using the ILS. The instruments used to collect these data are described in this section.

Teacher attitudes were assessed using the Stages of Concern Questionnaire (SoCQ). The SoCQ is a standardized, thirty-five item instrument designed to measure the attitudes or concerns of teachers implementing a particular innovation, which in this case, is ILS technology. The Innovation Configuration Matrix (ICM) is an instrument used to measure the operational patterns and variations of usage among teachers implementing an innovation. The ICM was developed by the researcher based on teacher practices and instructional strategies using ILS technology.

Innovation Configuration Matrix

Hall and Loucks (1978) explained that a particular innovation can have several different operational patterns resulting from selection and use of different innovation component variations. They labeled these operational patterns as "innovation configurations" (p. 9). These patterns resulted when different teachers put innovations into operation in their classrooms. Hord et al. (1987) noted that individual teachers used different components of an innovation in different ways and when these components were put together a number of patterns emerged that characterized different uses of the innovation.

Heck, Steigelbauer, Hall, and Loucks (1981) developed a tool to use in identifying the essential components of an innovation and the variations for each of these components. Although this instrument does not specifically measure fidelity, it does provide an understanding about how teachers are using an innovation and allows the evaluators or the facilitators of the innovation to make judgments about appropriate practices and how much variation in practices is acceptable (Hord et al., 1987). Heck et al. developed a five-step process for determining innovation configurations:

1. Interview innovation developers and facilitators to determine the essential components of the innovation.
2. Interview and observe a small sample of users of the innovation to determine variations for each component.
3. Develop interview questions and conduct interviews.
4. Construct a component checklist consisting of innovation components and a set of variations within each component.
5. Determine prevalent innovation configuration patterns.

ICM Development. Following this procedure an Innovation Configuration Matrix (ICM) consisting of a component checklist and a set of variations within each component was constructed and field tested. The construction of the ICM was based on a review of the research and documentation for the courseware, telephone interviews with the developers of the courseware, and interviews with vendor training facilitators, lab managers, and teachers who use the CCC courseware.

The ICM was devised as an instrument to be completed by the researcher based on responses supplied by the teacher during an audio-taped interview. The components and variations of these components selected for inclusion in the ICM presumed to reflect actual and ideal practices of teachers involved with ILS implementation. Although many variations of ILS use by teachers may exist, this study made the assumption that the ICM as developed and revised represented a true and accurate gradient of ILS use from least acceptable to ideal.

For this study an ICM checklist was provided to a focus group of teachers who use CCC courseware in order to collect benchmarking data about the implementation as understood by the teachers using the ILS and to develop an interview guide for conducting teacher interviews. Heck et al. (1981) reported that "user completed checklists are useful as descriptive measures that capture the overall gestalt of what an innovation is like in a school or larger context" (p. 51).

The construct measured by the ICM was the degree and pattern of use of the ILS. The framework for the ICM was based upon many of the components in the *Training Workbook* (1993), ILS research, and interviews with vendor representatives and lab managers (see Table 2). Five variations were constructed for each ICM component with each successive variation indicating a level of use representing a closer approximation of ideal use.

The interview guide was devised to elicit responses from teachers that allowed the interviewer or a qualified scorer to complete an ICM checklist for each interviewee. The guide consisted of a set of questions worded and arranged so that all respondents were interviewed in the same way while allowing the interviewer to probe the respondents. The interview guide was rehearsed with two teachers before submitting the ICM to the field test.

Table 2

Components of Original ILS Innovation Configuration Matrix

No.	Component Description
1.	Participation in ILS Selection
2.	Training in Use of ILS
3.	Clearly Designed Roles of Teachers, Lab Managers, and Principals
4.	On-Going Support System and Communication Among Staff
5.	Evaluation of ILS Instruction
6.	Clearly Stated Goals
7.	Integration of Courseware with Classroom Instruction
8.	Appropriate Selection of Courses, Enrollment Levels, and Options
9.	Effective Use of Motivational Strategies and Activities
10.	Regular Use and Analysis of Teacher Reports
11.	Effective Scheduling
12.	Clear Rules for Daily Procedures, Behavior, and Discipline
13.	Sufficient Time on Task for Each Learner
14.	Teacher Intervention as Learner Need Arises
15.	Positive, Up-to-Date and Comfortable Lab Environment
16.	Teacher Knowledge and Skills to Use the Routines and Equipment

ICM Field Test. A field test of the ICM was performed in order to establish instrument reliability, enhance construct validity, revise matrix components, and refine the interview guide to elicit appropriate responses to the matrix elements. Albers (1994) noted that the process of revision is critical in determining the desired or ideal use of an ILS because the ICM does not necessarily reflect the planned use prescribed by the developer, but rather the ICM describes what the school and teachers who use the ILS are doing.

The ICM was subjected to a two-phase field test. In the first phase interviews were conducted with a sample of ten teachers who regularly used the CCC courseware for instruction. The purpose of this administration of the ICM was to make revisions to matrix components and to make revisions to the interview guide. The scorers for the field test consisted of the researcher and a lab manager who had facilitated an ILS for five years. Low interscorer correlations as well as the context of each component were taken into consideration in revising the ICM.

Total scores for each subject were determined by totaling the points recorded by the scorers corresponding to the variation in pattern of usage along the scale for each matrix component. The ICM allowed for a total score 80. Descriptive statistics and interscorer reliability coefficients were computed for the ICM (see Table 3). The standard error of measurement for the ICM was 2.75 for Scorer 1 and 2.67 for Scorer 2. This administration of the ICM yielded a coefficient alpha of .71 for Scorer 1 and .72 for Scorer 2. An interscorer reliability coefficient of .86 for all items was obtained for this administration of the instrument.

Table 3

Interscorer Reliability Coefficients for ICM in Field Test, n=10

Variable	Standard Deviation	Standard Error of Measurement	r	Coefficient Alpha	p
Scorer 1	4.85	2.70		.69	<.05
Scorer 2	5.12	2.67		.73	<.02
All Items			.86		<.01

Interscorer reliability coefficients were computed for each ICM component and were recorded in Table 4. All interscorer reliability coefficients except for Component 4 were significant at the .10 level or better. Component 4—On-Going Support System yielded low reliability coefficients possibly because of small sample size resulting in small variances among the responses.

Table 4

Interscorer Reliability Coefficients for ICM Components in Field Test, n=10

Component	r	p
1. Participation in ILS Selection	NV*	NA
2. Training in Use of ILS	1.00	NA
3. Clearly Designed Roles	.66	<.05
4. On-Going Support System	.50	
5. ILS Evaluation	.93	<.01
6. Clearly Stated Goals	.73	<.02
7. Integration of Courseware	.58	<.10
8. Appropriate Enrollment	.61	<.10
9. Effective Use of Motivational Strategies	.90	<.01
10. Regular Use of Reports	.61	<.10
11. Effective Scheduling	NV*	NA
12. Clear Rules for Daily Lab Procedures	.72	<.02
13. Sufficient Time on Task	NV*	NA
14. Teacher Intervention	.82	<.01
15. Lab Environment	.72	<.02
16. Teacher Knowledge of ILS	1.00	NA

*No Variance among item responses.

The scorers indicated no variance in teacher use for Component 1—Participation in ILS Selection, Component 11—Effective Scheduling, and Component 13—Sufficient Time on Task. The small variances on some components among the respondents were primarily attributable to the homogeneity of instructional strategies among the field test sample due to a highly structured educational environment regulating ILS use. However, Components 11 and 13 were determined to be critical to the ILS implementation process and, therefore, were retained in the ICM with modifications to better distinguish among the variations for these components.

As a result of the field test interviews Component 1, Component 3 (Clear Roles of Teachers, Lab Managers, Principals) and Component 15 (Positive, Up-to-Date, and Comfortable Lab Environment) were discarded from the ICM since these components did not represent actual use of the innovation by the teacher but were part of the preparation or support structure for ILS use (Heck et al., 1981). Additionally, Component 5 (ILS Evaluation) was modified to represent teacher evaluation of learners using the ILS and renamed ILS Use in Learner Evaluation. Two other components, Integration with Curriculum and ILS Design of Instruction, were added to the ICM to better represent ILS implementation activities and instructional strategies performed by teachers.

After modifications to the ICM were made, the second phase of the field test was conducted to establish reliability and validity for the final version of the ICM. A sample of nineteen teachers who regularly use the CCC courseware completed an ICM checklist using the modified form of the ICM and then five of the subjects completing the checklist were selected for interviews. Descriptive statistics were computed for total instrument reliability (see Table 5). The 15-item checklist allowed for a range of total scores from 0 to 75. The standard error of measurement for this administration of the questionnaire was 3.68.

High interscorer reliability coefficients were computed for the modified ICM. An interscorer reliability coefficient of .96 for all items was obtained from this administration of the instrument. This administration of the ICM checklist yielded a coefficient alpha of .61 ($p < .01$) for the total scale. The final version of the ICM checklist and interview guide are provided in Appendix A.

Table 5

Descriptive Statistics for Modified ICM Checklist in Field Test

n	Mean	Standard Deviation	Standard Error of Measurement	Interscorer r	Coefficient Alpha
19	37.53	5.87	3.68	.96	.61

Stages of Concern

Several researchers had postulated that the way in which users of an innovation perceived the innovation was fundamental to their level of use of the innovation (Fullan & Pomfret, 1977; Hughes & Keith, 1980; Kimpston, 1985). Hughes and Keith reported that an innovation as perceived by the potential user of the innovation and not the innovation itself was the critical variable in explaining the degree of implementation of an innovation. Kimpston reported that "teachers' beliefs and practices about the importance of and participation and involvement in curriculum implementation tasks were more pronounced for teachers who were most closely attending to the curriculum prescribed by the district" (p. 195). In other words, those teachers who closely followed the prespecified curriculum attached greater importance to implementation tasks and their involvement with them.

The SoCQ grew out of the research of Frances Fuller (1969) on teacher concerns. Fuller, a counseling psychologist, pursued a series of in-depth studies of concerns of teachers based on group counseling sessions and longitudinal in-depth interviews of student teachers. Fuller (1969) proposed a developmental model of the concerns of teachers consisting of three phases of concern: a pre-teaching, non-concern phase, an early teaching, concern with self phase, and a late teaching, concern with students phase. Fuller's pioneering work on the concerns of teachers was the basis for development of the SoCQ.

Hall, Wallace, and Dossett (1973) postulated that the concerns or attitudes individuals had about a change was an important dimension in the change process. Hall, George, and Rutherford (1986) described the concept of concerns about innovations as an aroused state of personal feelings and thought about a particular issue or task. Hall et al. (1973) determined that certain demands of an innovation were perceived as being more important than others, and therefore, the type of concern about an innovation as well as the degree of intensity of a concern will vary. The degree of arousal of different types of concerns varied depending on the amount of one's knowledge about and experience with the innovation and a pattern to the movement of intensity of concern across types was predictable (Hall et al., 1986).

Stages of concern described how users perceived an innovation from the time they first became aware of it until they gained mastery of the innovation (Hall & Loucks, 1978). Users were initially concerned about how an innovation affected them personally and later users became concerned with how the innovation impacted their work environment.

The SoCQ was developed from the original conceptualizations provided by Hall et al. (1973). Seven stages of concerns that users or potential users of an innovation had were identified (see Table 6). These stages of concern were distinctive but were not necessarily mutually exclusive (Hord, Rutherford, Huling-Austin, & Hall, 1987). The seven stages varied in intensity and, consequently, characterized the developmental nature of individual concerns.

Table 6

Stages of Concern About an Innovation

S	0	AWARENESS	Little concern about or involvement with the innovation
E	1	INFORMATIONAL	A general awareness of the innovation and interest in learning more detail about it is indicated.
L			
F	2	PERSONAL	The user is uncertain about the demands of the innovation, inadequacy in meeting those demands, and his or her role with the innovation.
T			
A	3	MANAGEMENT	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources.
S			
K			
I	4	CONSEQUENCE	Attention focuses on the impact of the of the innovation on students in his or her immediate sphere of influence.
M			
P	5	COLLABORATION	The focus is on coordination and cooperation with others regarding use of the innovation.
A			
C	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.
T			

The developmental nature of concerns was reflected by grouping the stages into three dimensions: Self, Task, and Impact (Hord et al., 1987). In the early stages of a change effort individuals were more likely to have personal concerns with the change while in the latter stages of usage of an innovation concerns about the task and the impact of the innovation on users became more intense.

The SoCQ was developed to provide a quick-scoring measure of stages of concern and was validated over a three-year period. Construct validity was the primary concern with this instrument and was not easily demonstrated since no other instrument with which the SoCQ could easily be compared existed that directly measured concerns. However, an attempt was made to demonstrate that the scores on the questionnaire related to each other and to other variables as conceptualized by the developers of the instrument through a series of validity studies using intercorrelation matrices, judgments of concerns based on interview data, and confirmation of expected group differences and changes over time.

A prototype instrument containing 195 items and Q-sorted into six subscales (Stages 1-6) was analyzed by intercorrelation (N=359). Evidence for the validity of these stages as separate constructs was based on correlations in which 83% of the items correlated more highly to the assigned stage than the total instrument score and 72% correlated more highly to the assigned stage that to any other stage. A correlation matrix was computed with intercorrelation coefficients near the diagonal ranging from .60 to .82 and depicting a pattern where those correlations near the diagonal were higher than those more removed from the diagonal. Thus, the scales on the pilot questionnaire indicated an order consistent with the hypothesized order of the stages of concern (Hall et al., 1986).

Hall et al. (1986) next subjected these data to a principal components factor analysis with varimax rotation. Seven factors were extracted although six were hypothesized. The seventh factor proved to be representative of Stage 0 and was thus classified. The hypothesized scales with the obtained factor structure revealed high congruence and, therefore, the developers of the instrument inferred that the seven scales identified seven independent constructs that were consistent with the seven stages of concern (Hall et al.).

The current 35-item questionnaire was prepared by selecting items from each of the factors of the 195-item questionnaire and reliability was established primarily through two studies. In a one-week test-retest study (N=132), stage score correlations ranged from .65 to .86 with four of the seven correlations being above .80. Estimates of internal consistency (N=830) ranged from .64 to .83 with six of the seven alpha coefficients being above .70. The 35-item questionnaire was used in cross-sectional and longitudinal studies of eleven different educational innovations in which several different validity studies were explored. The SoCQ was compared with expert ratings of open-ended concerns statements and taped respondent interviews of concerns. The general conclusion was that the SoCQ accurately measured stages of concern about an innovation and appeared to do a better job than other measures or clinical judgments (Hall et al., 1986).

In a longitudinal study (Hord & Huling-Austin, 1986) based on the actions of nine elementary school principals in three school districts where new curricula were being implemented, the SoCQ was used with other instruments to measure implementation progress. Teachers in the first school district were judged to be satisfactory implementers of a writing program since their early concerns in Stages 0, 1, and 2 had decreased and management concerns (Stage 3) had become primary. In the second school district management concerns (Stage 3) about a new mathematics program decreased, but consequence concerns (Stage 4) also remained low possibly due to the fact the teachers did not implement all the program components. In the third school district teachers were well-established in implementing a new science curriculum due to the fact that management concerns (Stage 3) had decreased and consequence concerns (Stage 4) emerged.

In another longitudinal study of team teaching at a single school, the teachers moved from not teaming through establishing teaming as a routine over a two-year period (Hall et al., 1986). The data were consistent with the theoretical framework of stages of concern as demonstrated by their concerns shifting from being high on the lower stages (Stages 0,1, and 2) to high on management concerns (Stage 3) and finally to relatively low intensity on all stages of concern.

The SoCQ focuses on the concerns of individuals involved in change. In an educational setting teachers are often the focus of change and innovation and so this instrument is generally used by teachers. The instrument consists of 35 items that teachers rate using an eight point Likert scale (see Appendix B). There are five items for each of the seven measures. The questionnaire items are applicable to any educational innovation.

Percentile tables were established for converting raw scale scores. The standardization sample for the SoCQ consisted of 646 teachers and administrators in educational institutions from kindergarten through higher education who completed the questionnaire in 1975 (Hall, et al., 1986). Percentile scores reflected the relative intensity of concerns by the user of an innovation in a particular stage. Interpretation of the SoCQ is performed by the examination of percentile scores for peak stages, second highest stage, and high stage for groups or individuals (Hall, et al.).

To substantiate the internal consistency and reliability of this instrument for this study, a sample of 33 elementary school teachers from five elementary schools implementing an ILS completed the SoCQ in a pilot study. Descriptive statistics were computed for total test reliability (see Table 7) and item-total reliabilities were computed for each of the seven stages of concern scales (see Table 8). The 35-item questionnaire allowed for a range of total scores from 35 to 245. The standard error of

Table 7

Descriptive Statistics and Total Test Reliability for SoCQ in Pilot Study

n	Mean	Standard Deviation	Standard Error of Measurement	Coefficient Alpha
33	114.09	33.36	10.81	.90

Table 8

Coefficients of Internal Reliability for SoCQ in Pilot Study, n=33

Stage	Item-Total Correlation	p
STAGE 0	.38	<.05
STAGE 1	.75	<.01
STAGE 2	.89	<.01
STAGE 3	.69	<.01
STAGE 4	.54	<.01
STAGE 5	.72	<.01
STAGE 6	.67	<.01

measurement for the questionnaire was 10.81. This administration of the scale yielded a coefficient alpha of .90 for the total scale. The item-total reliability coefficients for Stages 1-6 were high ($p < .01$) while Stage 0 yielded a lower item-total reliability coefficient ($p < .05$).

Cumulative Gains Reports

The gains reports for courses were controlled by the system manager and are used to track learner gains over periods of time that (*Reports Guide*, 1993). The reports provided a running account of learner gains including the amount of time and gain between specified beginning and ending dates. Gains reports were generated by course and provided engaged learning time and gains data for each learner enrolled in a particular course (see Figure 2).The Gains Report showed each learner's average

Gains report for class 100

READER'S WORKSHOP Gains Report

SESSIONS	GAIN IN PARTIAL PERIOD	SESS IN PARTIAL PERIOD	GAIN LAST PERIOD	TIME LAST PERIOD	GAIN SINCE IPM	TIME SINCE IPM	COURSE AVERAGE
100 Aikens, Edward							
41	0.25	11.00	0.52	7:37	0.77	11:52	5.89
110 Butler, Kyle							
46	0.44	16.00	0.45	6:46	0.89	13:26	6.40
SAMPLE SIZE							
2	N/A	--	2	2	2	2	2
MEANS							
43.5	N/A	N/A	0.49		0.83		
STANDARD DEVIATIONS							

Number of students = 2

Figure 2. Sample Gains Report (from *Instructional Management Handbook*, 1993, Sunnyvale, CA: Computer Curriculum Corporation).

gain across strands as measured from the end of initial placement motion, the most recent twenty sessions, and the current partial period of fewer than twenty sessions.

Data Analysis

An explanation of the phenomena associated with the implementation of an ILS in an educational setting required the researcher to examine relationships including self-report questionnaires, structured interviews, and computer-generated learner performance reports. Data from the SoCQ, ICM, and the learner gains reports provided valuable descriptive and analytical data about ILS implementation and provided support for the data analysis and subsequent interpretation. Depending on the data source, a number of different strategies for analyzing and interpreting the data were employed. The following list describes the analysis strategy devised for each of the research questions:

- *Question 1: What are the concerns of individuals implementing ILS technology?*

The starting point for exploring ILS implementation was to examine the attitudes and concerns of teachers about ILS implementation. The SoCQ hypothesizes that as subjects move from unawareness and nonuse of an innovation into a more highly sophisticated use, the intensity of these concerns is initially high in Stages 0, 1, and 2 and ultimately high in Stages 4, 5, and 6 (Hall, et al., 1986). The goal of interpreting the SoCQ was to evaluate the relative intensity of respondents' concerns in order to provide a concerns-based characterization of the degree of implementation about the innovation (Hall et al.). Thus, the SoCQ primarily profiled the types of concerns that were most intense and least intense among the respondents.

To analyze the SoCQ data, item responses were grouped by stages of concern and then summed for each stage. A Pearson correlation was computed for each stage of the SoCQ that considered the intercorrelations of all items and variables in the questionnaire in order to determine the reliability of the SoCQ stage data. A two-tailed test of significance was employed to determine the significance levels of differences in both directions. Raw scores were converted to percentile scores for each of the seven stages to provide a profile of concerns at the school level. The high, second high, and low stage scores were identified in the profile and an interpretation of the profile pattern was formulated.

A random sampling procedure was used to select subjects for ICM interviews from all respondents completing the SoCQ. An independent variable labeled SoCQ level of use was formed by classifying each subject's corresponding high and second high stages of concern into a Self, Task, or Impact group.

- *Question 2: What patterns of use occur among individuals implementing an ILS? How do these patterns of use differ from one another?*

An Innovation Configuration Matrix consisting of a component list and a set of variations within each component was constructed and field tested following a procedure defined by Heck, et al. (1981) and Hord, et al. (1987). Five variations were defined for each component ranging from 1 (non-use or limited use of component) to 5 (ideal use of component). An ICM interview (see Appendix A) was conducted and recorded by the researcher with each of the teachers selected for the sample. The interviews were transcribed and an expert group consisting of the researcher, an experienced lab manager (not from the school system under study), and a vendor representative independently rated the interviews based on the content and structure of the ICM checklist.

Analysis of patterns of use by teachers implementing an ILS was conducted for ICM interviews through the computation of individual component frequencies of the ICM using a procedure described by Heck et al. (1981). The procedure consisted of determining the frequency for each variation within each component on the ICM and then calculating the proportion for each variation within each component. The proportions for each variation were tallied across respondents to provide a profile of ICM level of use for all cases. An independent variable labeled ICM level of use was formed by assigning a level of use classification for the composite score of the ICM to each case using the same scale as was used for the component variations on the ICM.

The next step in the analysis of the ICM was to conduct pattern analysis of the interview data to determine dominant configuration patterns or variations. The general patterns that emerged from this analysis were analyzed by a cluster analysis that identified relatively homogenous groups of cases based on selected characteristics. The center was computed for each dominant configuration pattern or cluster that emerged from the data and then each case was assigned to the cluster with the nearest center until no cases changed cluster membership (*SPSS Professional Statistics*, 1995).

One-way analysis of variance was used to examine differences among the configuration patterns for each of the components measured by the ICM. One-way analysis of variance tests the null hypothesis that the population mean of a variable is the same in several groups of cases (*SPSS 6.1*, 1995). A nonparametric Kruskal-Wallis test was performed to validate the results of the ANOVA against discrepancies that existed in the assumptions due to differences in group sizes and normality (Minium, 1978; Norusis, 1995). A Kruskal-Wallis test is a nonparametric alternative to one-way analysis of variance that eliminates the assumption that the samples are from populations with the same shape (Norusis).

Post-hoc tests were performed to compare differences between pairs of configuration patterns' means for each ICM component using the Bonferroni procedure. The Bonferroni procedure uses *t* tests to perform comparisons between pairs of group means and adjusts the observed significance level for these comparisons by dividing by the total number of tests.

A linear regression analysis was used to examine the relationship between each significant ICM component (from the ANOVA) and the degree of ILS implementation. Linear regression estimates the coefficients derived from the linear equation involving the independent variables that best predict the value of the dependent variable. A stepwise multiple regression was performed to determine which components were the best predictors of ILS implementation. Stepwise variable selection was used to enter each ICM component into the regression model by order of importance and remove components from the model whose importance was diminished as additional predictors were added.

- *Question 3: How do the implementation practices of teachers impact learner achievement using an ILS?*

Gain scores and time on task data were collected for all students of teachers who completed ICM interviews. To analyze gain scores relative to the implementation practices of teachers, a procedure resembling one used by George and Hord (1980) was performed. Since a linear relationship between gain scores and time on task on the ILS existed (see *Instructional Management*, p. 26), an analysis of covariance was performed using the ILS math gain scores as the dependent variable, the three ICM implementation groups as the independent variable, and time on task using the ILS-generated gain score for math instruction as the covariate. Analysis of covariance was used to test the implementation group differences against the ILS math gain score while controlling for differences that existed among the groups due to time on task.

Correlational analyses were used to explore the relationship between the degree of implementation as indicated by the ICM composite score and learner achievement as indicated by the ILS gain score. For the correlational analysis random samples were drawn from the population of learners and correlation coefficients were computed between the ICM composite scores, ILS gain scores, and time on task. Random samples were selected from the population of learners for each of the ICM implementation patterns and correlation coefficients were computed between ICM composite scores, ILS gain scores, and time on task for each implementation pattern.

Limitations of the Study

Several factors contributed to the limitations imposed upon this study and several problems with the research design called for resolution in order to increase the validity and generalizability of the findings. Some of the more methodological problems included statistical independence, unit of analysis, accuracy of self-reporting, halo effect, non-response, and direction of causality. Several limitations of the study that remained unresolved included the following:

1. This study incorporated several research techniques to ensure the reliability and validity of the research design including written documentation of study protocol, study database, structured interviews, key informant reviews, and multiple sources of data. However, a single researcher collected all interview data and so the articulation of these data was limited to a single perspective.
2. Interviews with teachers were based on the teaching schedule of the teacher and the amount of time allowed for each teacher was limited and often varied. Teacher comments that digressed from the questioning protocols were, therefore, somewhat minimized. Although questionnaires, interviews, and reviews of documentation and hard copy data were used, extensive classroom observation of ILS use would have contributed to the validity of the data collection and would have added another dimension to the perspective of the researcher.

3. This study attempted to evaluate the impact of ILS technology at a certain point in time and did not evaluate the progressive impact of ILS technology over a period of years. Furthermore, many of the variables in this study were not stable traits and probably changed over time. This study attempted to be descriptive, explanatory, and correlational, but not necessarily experimental. Although this study provided no longitudinal perspective, continuing collection of data following the protocols in this study could be used in future years to assess the trends and impact of ILS technology over time.
4. Although the concern of this study was ILS technology, there were many instructional strategies embedded into the total schooling process. The statistical methods used in this study assumed that variables influenced learner achievement cumulatively. Exploring every possible interaction was well beyond the scope of this study.
5. Gain scores generated by the ILS were used to evaluate learner achievement. Several difficulties exist in using gain scores in experimental designs such as a ceiling effect, regression toward the mean, assumption of equal intervals, and reliability (Borg & Gall, 1989). Gain scores as used in this study were not necessarily the difference in posttest and pretest scores. ILS-generated gain scores were the increase in learner grade level from initial placement on the ILS to the current average. Some of the difficulties associated with conventional gain scores may be overcome by ILS-generated gain scores. Since ILS gain scores were based on an initial placement algorithm that was the result of patterns of

responses over time and not a single test score, these scores, therefore, provided a more accurate (or at least comprehensive) indicator of a learner's initial achievement.

6. Although educational change research often involves multiple levels of data, the size of the sample of schools in this study (four schools) was not conducive to using the school as a unit of analysis except for purposes of descriptive statistics.

7. The problem of non-response is an issue in any study using self-reporting methods. Unless there is a reasonable response rate results cannot be considered representative. The intent of this study was to obtain near one-hundred percent response rates on samples selected for all measures. Several techniques were used to ensure as large a response rate as possible. First, each principal was provided a written procedure for the data collection. The support of the principal for the data collection was enlisted and in all cases the principals supplied the researcher with access to teachers and information concerning teachers' schedules. The researcher provided a second round of Stages of Concern Questionnaires and was therefore able to obtain a relatively high return rate.

CHAPTER 4

DATA ANALYSIS

The research questions for this study required the researcher to analyze relationships and associations from several sources of data including self-report questionnaires (the Stages of Concern Questionnaire—SoCQ), structured interviews (the Innovation Configuration Matrix—ICM), and computer-generated learner performance reports (gains reports). Several strategies for analyzing and interpreting these data were employed.

The research questions for this study allowed for a view of implementation of an ILS from several vantage points: individual teacher use of the ILS, individual teacher concerns with the ILS, learner achievement, and between-school comparisons of teacher concerns. Data were also analyzed at increasingly complex levels to obtain a comprehensive evaluation based on several attributes of these data. The data analysis presented in this chapter is arranged by instrumentation (or data source) used for the collection of ILS implementation data and the corresponding research question.

Stages of Concern Questionnaire

To collect data for the first research question regarding the concerns of individuals implementing ILS technology, the Stages of Concern Questionnaire (SoCQ) was administered to all ILS-using teachers in four elementary schools. Stages of Concern focus on the concerns of individuals involved in a change process. For purposes of analysis these concerns are organized into seven stages that are distinctive but not necessarily mutually exclusive. An individual is likely to have some degree of concern at all stages. These seven stages are grouped into three dimensions: Self, Task, and Impact. In the early stages of a change effort individuals are more likely to have personal concerns with the change while in the latter stages of usage of an innovation concerns about the task and the impact of the innovation become more intense.

According to Hall, George, and Rutherford (1986) subjects moved from unawareness and nonuse of an innovation into a more highly sophisticated use. Therefore, the intensity of concern was initially high in Stages 0, 1, and 2 and ultimately high in Stages 4, 5, and 6. To interpret the SoCQ, an overall view of the relative intensity of different stages of concern about a particular innovation was developed to profile the intensity of the types of concerns among the respondents.

The Stages of Concern Questionnaire was administered to all teachers in the four elementary schools selected for this study. Of the 93 teachers in the four elementary schools who were handed a questionnaire, 65 completed and returned the SoCQ for an overall return rate of 71% (see Table 9). Reliability coefficients were computed for

Table 9

Frequency and Proportion of Teachers Returning SoCQ

School	Teachers	Respondents	Return Rate	Sample Percent
West	18	11	61%	17%
North	24	16	67%	25%
South	22	17	77%	26%
East	29	21	72%	32%
Totals	93	65	70%	100%

each of the seven stages of the SoCQ employing a two-tailed test (see Table 10). The 35-item questionnaire yielded high reliability coefficients for all stages (p < .01).

Table 10

Coefficients of Internal Reliability for SoCQ, n=65

		Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	TOTAL
Pearson Correlation	Stage 0		.424**	.349**	.465**	.170	.014	.048	.470**
	Stage 1			.785**	.556**	.431**	.388**	.319**	.799**
	Stage 2				.695**	.476**	.527**	.481**	.884**
	Stage 3					.411**	.322**	.537**	.806**
	Stage 4						.414**	.625**	.704**
	Stage 5							.407**	.622**
	Stage 6								.678**
Sig. (2-tailed)	Stage 0		.000	.004	.000	.176	.909	.705	.000
	Stage 1			.000	.000	.000	.001	.010	.000
	Stage 2				.000	.000	.000	.000	.000
	Stage 3					.001	.009	.000	.000
	Stage 4						.001	.000	.000
	Stage 5							.001	.000
	Stage 6								.000

Table Caption

**. Correlation is significant at the 0.01 level (2-tailed).

To analyze the SoCQ, data item responses were grouped and summed according to each of the seven stages of concern. Raw scores were converted to percentile scores for each of the stages and response patterns were examined as high and second high stages of concern. By examining both the second high stage score and the peak stage score, additional insights into the dynamics of concerns were evaluated (Hall et al.,1986). Tables 11 and 12 provide matrices of the frequency and proportion of the high and second high stages of concern scores.

Table 11

Frequency of Highest and Second Highest Stages of Concern, n=65

STAGE	0 Awareness	1 Informational	2 Personal	3 Management	4 Consequence	5 Collaboration	6 Refocusing	High Stage Total
0 Awareness		12	9	9	1	1	3	35
1 Informational	5		3	0	1	1	0	10
2 Personal	0	4		0	0	0	0	4
3 Management	2	4	3		0	1	0	10
4 Consequence	1	0	0	0		0	2	3
5 Collaboration	1	0	0	0	0		0	1
6 Refocusing	1	0	1	0	0	0		2
2nd High Stage Total	10	20	16	9	2	3	5	65

Select Highest Stage of Concern from left column and read across for Second Highest Stage of Concern.

Table 12

Proportion of Highest and Second Highest Stages of Concern, n=65

STAGE	0 Awareness	1 Informational	2 Personal	3 Management	4 Consequence	5 Collaboration	6 Refocusing	High Stage Total
0 Awareness		18.5%	13.8%	13.8%	1.5%	1.5%	4.6%	53.8%
1 Informational	7.7%		4.6%	0.0%	1.5%	1.5%	0.0%	15.4%
2 Personal	0.0%	6.2%		0.0%	0.0%	0.0%	0.0%	6.2%
3 Management	3.1%	6.2%	4.6%		0.0%	1.5%	0.0%	15.4%
4 Consequence	1.5%	0.0%	0.0%	0.0%		0.0%	3.1%	4.6%
5 Collaboration	1.5%	0.0%	0.0%	0.0%	0.0%		0.0%	1.5%
6 Refocusing	1.56%	0.0%	1.5%	0.0%	0.0%	0.0		3.1%
2nd High Stage Total	15.4%	30.8%	24.6%	13.8	3.1%	4.6%	7.7%	100.0%

Select Highest Stage of Concern from left column and read across for Second Highest Stage of Concern.

Overall, highest levels were at Stage 0 and second highest at Stage 1. According to Hall et al. a high Stage 0 score indicated either an unconcern about the innovation or users who were more concerned about things not related to the innovation. In this case a high Stage 0 may indicate concern about things not related to the innovation since there was an overall high response tendency among the stage scores.

Table 13 provides another view of these data by showing the cumulative percentile scores for teachers completing the SoCQ for each school and the mean overall trends. The table is annotated with the high stage score, second high stage score, and scores representing peaks in the data trends. Peaks occurred when a stage score was higher than the stage scores on either side or when a Stage 6 score was higher than a Stage 5 score.

Table 13

Stages of Concern Cumulative Percentile Scores by School, n=65

School	Stages of Concern						
	0	**1**	**2**	**3**	**4**	**5**	**6**
West	84[1]	54	45	56[2,3]	21	14	38[3]
North	84[1]	69[2]	59	52	27	22	22
South	84[1]	69[3]	67	69[2,3]	30	31	42[3]
East	77[1]	51	52[2,3]	43	43	22	38[3]
Mean	81[1]	60[2]	57	56	30	22	34[3]

[1]High Stage Score [2]Second High Stage Score [3]Peak Stage Score

When all these scores were considered and viewed by each school, the trends were more obvious and easily interpreted. Therefore, a profile for each school was provided in the following section of the data analysis. These profiles include a demographic summary of the teachers completing the SoCQ, a chart showing a graphical representation of the SoCQ cumulative scores compared to the mean overall trend, and an analysis and interpretation of the SoCQ data.

Stages of Concern Questionnaire Profiles

West Elementary. West Elementary was near the end of the second year of implementation of the ILS at the time these data were collected. West Elementary had 18 classroom teachers who used the ILS. Of the 18 teachers, 11 or 61% of teachers at West Elementary completed a Stages of Concern Questionnaire, which represented 17% of all teachers at the four schools who completed a SoCQ. All teachers completing the SoCQ at West Elementary were female with an average of 13 years of teaching experience and 1 year of experience using the ILS. Five teachers had a Masters degree and 6 teachers had a Bachelors degree. Among the teachers completing the SoCQ at West Elementary, 5 were in the age groups of 20-29, 2 were 30-39, 2 were 40-49, and 2 were 50-59. Eight teachers rated themselves as a Novice while 3 teachers considered themselves Intermediate level users of the ILS.

A SoCQ profile for West Elementary was plotted using the mean percentile scores for each of the seven stages for all respondents from that school (see Figure 3). The profile depicted a multiple peak profile with highest levels at the Stage 0-Awareness and then peaking a second time at Stage 3—Management and then tailing-up at Stage 6—Refocusing. Overall, the concerns pattern for West Elementary was generally consistent with the overall pattern of concerns for all four schools.

Figure 4 depicts individual plots for all respondents to the SoCQ questionnaire from West Elementary School. A general trend of peaking at Stage 3 and a tailing-up at Stage 6 that was consistent with the school means profile in Figure 3 is fairly distinguishable from the individual profiles chart.

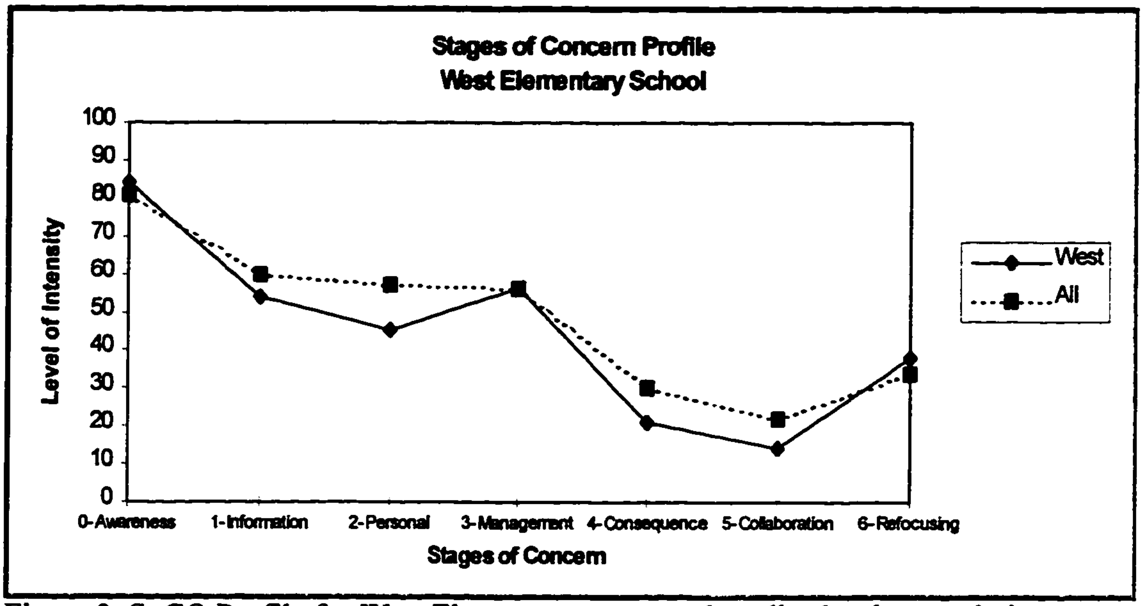

Figure 3. SoCQ Profile for West Elementary compared to all schools cumulative.

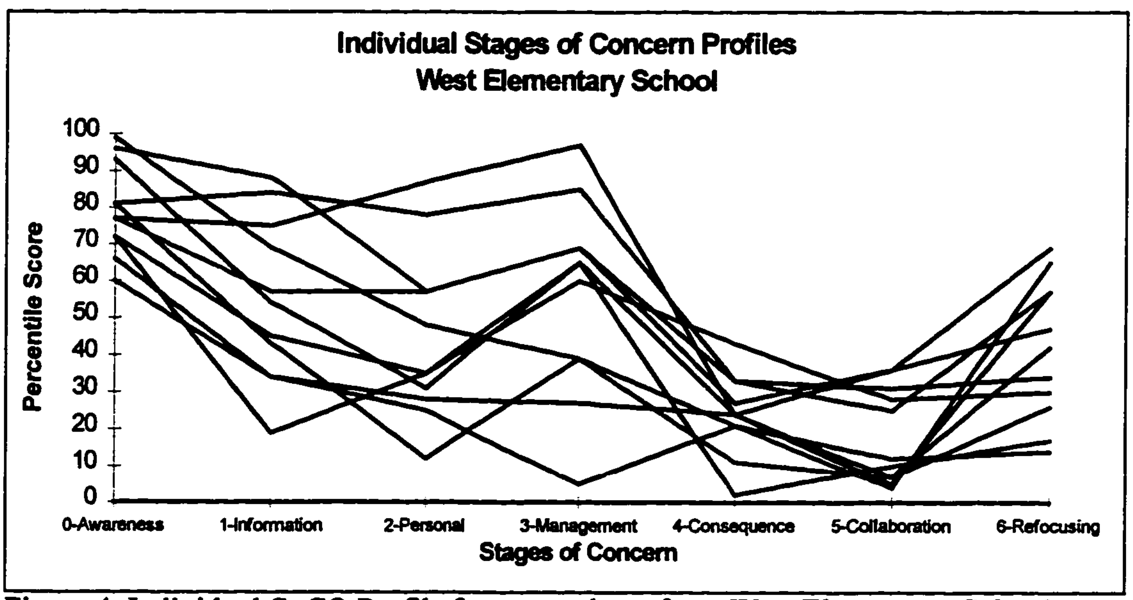

Figure 4. Individual SoCQ Profile for respondents from West Elementary School.

North Elementary. North Elementary was near the end of the second year of implementation of the ILS at the time these data were collected. North Elementary had 24 classroom teachers who used the ILS. Of the 24 teachers, 16 or 67% of teachers at

North Elementary completed a Stages of Concern Questionnaire, which represented 25% of all teachers at the four schools who completed a SoCQ. Fifteen of the teachers completing the SoCQ at North Elementary were female and 1 teacher was male. These teachers had an average of 16 years of teaching experience and 1.38 years of experience using the ILS. Seven teachers had a Masters degree and 9 teachers had a Bachelors degree. Among the teachers completing the SoCQ at North Elementary, 2 were between the ages of 20-29, 1 was 30-39, 9 were 40-49, and 4 were 50-59. Nine teachers rated themselves as a Novice while 7 teachers considered themselves Intermediate level users of the ILS.

A SoCQ profile for North Elementary was plotted using the mean percentile scores for each of the seven stages for all respondents from that school (see Figure 5). There was an absence of peaking on the SoCQ profile for North Elementary. This lack of peaking provided no clear evidence of progression from one dimension of concerns (self, task, impact) to another. Except for the slight peaking of Stage 3—Management and the absence of peaking at Stage 6—Refocusing, the concerns pattern for North Elementary was generally consistent with the overall pattern for all four schools.

Figure 6 depicts individual plots for all respondents to the SoCQ questionnaire from North Elementary School. Although the Stage 3 peaking and tailing-up at Stage 6 was not as distinguishable as for West Elementary, upon close examination of the chart there was evidence of this trend with 5 of the 12 respondents.

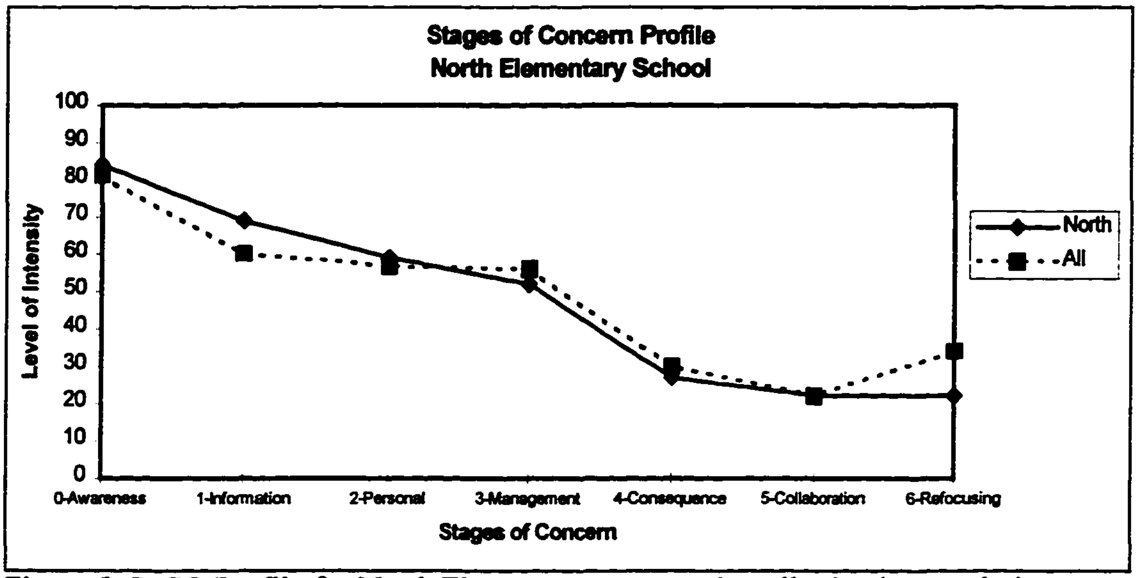

Figure 5. SoCQ Profile for North Elementary compared to all schools cumulative.

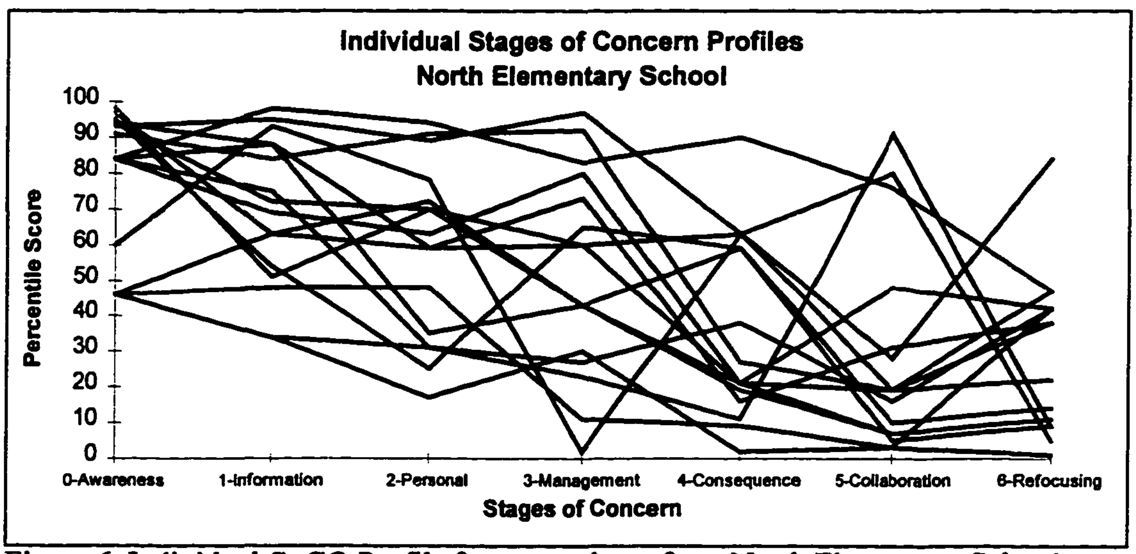

Figure 6. Individual SoCQ Profile for respondents from North Elementary School.

South Elementary. South Elementary was near the end of the second year of implementation of the ILS at the time these data were collected. South Elementary had 22 classroom teachers who used the ILS. Of the 23 teachers, 17 or 77% of the teachers at South Elementary completed a Stages of Concern Questionnaire, which represented 26% of all teachers at the four schools who completed a SoCQ. Sixteen of the teachers completing the SoCQ at South Elementary were female and 1 teacher was male. These teachers had an average of 11 years of teaching experience and 1.06 years of experience using the ILS. Two teachers had a Masters degree and 15 teachers had a Bachelors degree. Among the teachers completing the SoCQ at South Elementary, 9 were in the age group of 20-29, 1 was 30-39, 4 were 40-49, 2 were 50-59, and 1 was 60-69. Two teachers rated themselves as Nonusers of the ILS, 9 teachers rated themselves as a Novice using the ILS, 5 teachers considered themselves Intermediate level users of the ILS, and 1 teacher considered himself an Experienced user of the ILS.

A SoCQ profile for South Elementary was plotted using the mean percentile scores for each of the seven stages for all respondents from that school (see Figure 7). The profile depicted a multiple peak profile with highest levels at the Stage 0—Awareness and then peaking a second time at Stage 3—Management and then tailing-up at Stage 6—Refocusing. The concerns pattern for South Elementary was similar to the trends for West Elementary except for operating at a higher level. The concerns pattern for South Elementary was generally consistent with the overall pattern of concerns for all four schools.

Figure 8 depicts individual plots for all respondents to the SoCQ questionnaire from South Elementary School. Evidence of Stage 3 peaking pattern was detectable in the individual profiles chart with a majority of the respondents from South Elementary.

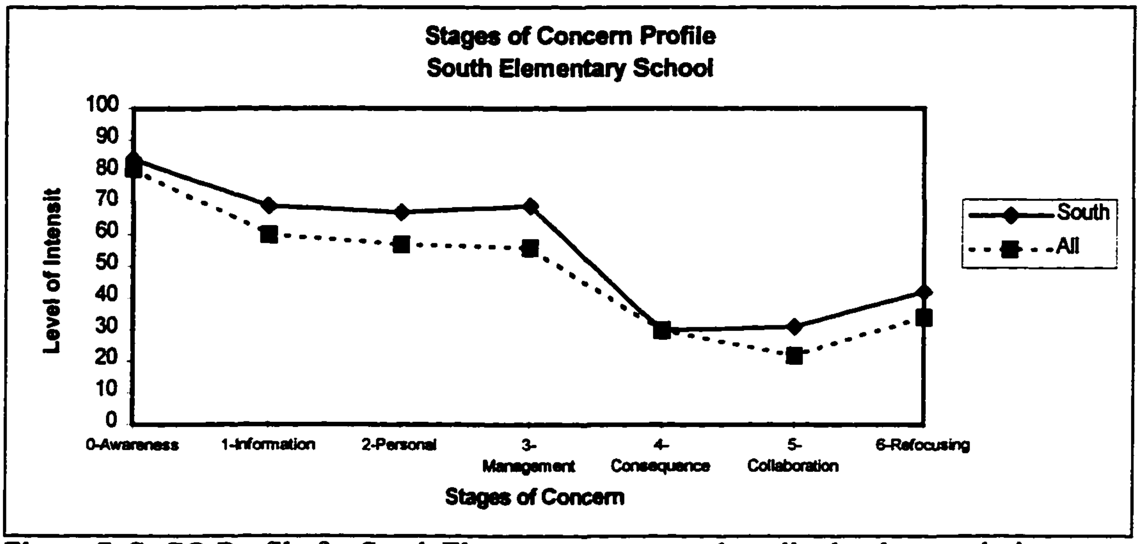

Figure 7. SoCQ Profile for South Elementary compared to all schools cumulative.

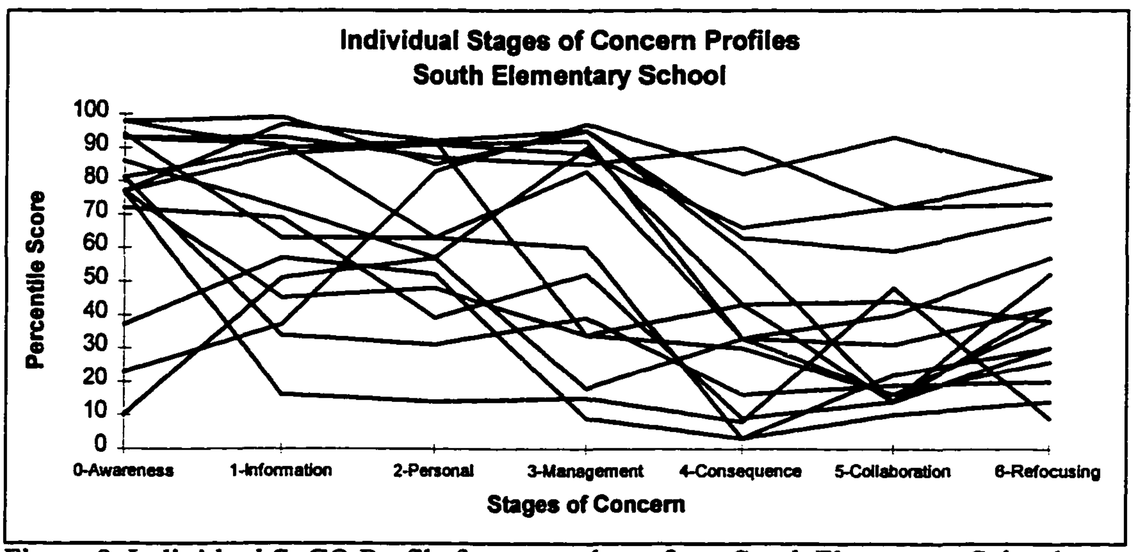

Figure 8. Individual SoCQ Profile for respondents from South Elementary School.

East Elementary. East Elementary was near the end of the third year of implementation of the ILS at the time these data were collected. East Elementary had 29 classroom teachers who used the ILS. Of the 28 teachers, 21 or 72% of teachers at

East Elementary completed a Stages of Concern Questionnaire, which represented 32% of all teachers at the four schools who completed a SoCQ. Twenty of the teachers completing the SoCQ at East Elementary were female and 1 teacher was male. These teachers had an average of 9 years of teaching experience and 1.57 years of experience using the ILS. Six teachers had a Masters degree and 15 teachers had a Bachelors degree. Among the teachers completing the SoCQ at East Elementary, 8 were between the ages of 20-29, 4 were 30-39, 6 were 40-49, and 3 were 50-59. Fourteen teachers rated themselves as a Novice using the ILS while 7 teachers considered themselves Intermediate level users of the ILS.

A SoCQ profile for East Elementary was plotted using the mean percentile scores for each of the seven stages for all respondents from that school (see Figure 9). The SoCQ profile for East Elementary indicated a slightly different trend than that of the other schools. In contrast to the Stage 3—Management concerns peaking evident in the profiles of the other schools, multiple peaking for East Elementary was evident at both Stage 2—Personal and Stage 4—Consequence. However, the peaking at Stage 6—Refocusing was consistent with the trend of the total group.

Figure 10 depicts individual plots for all respondents to the SoCQ questionnaire from East Elementary School. The Stage 4 peaking pattern along with the tailing-up at Stage 6 was evident in the individual profiles chart for East Elementary.

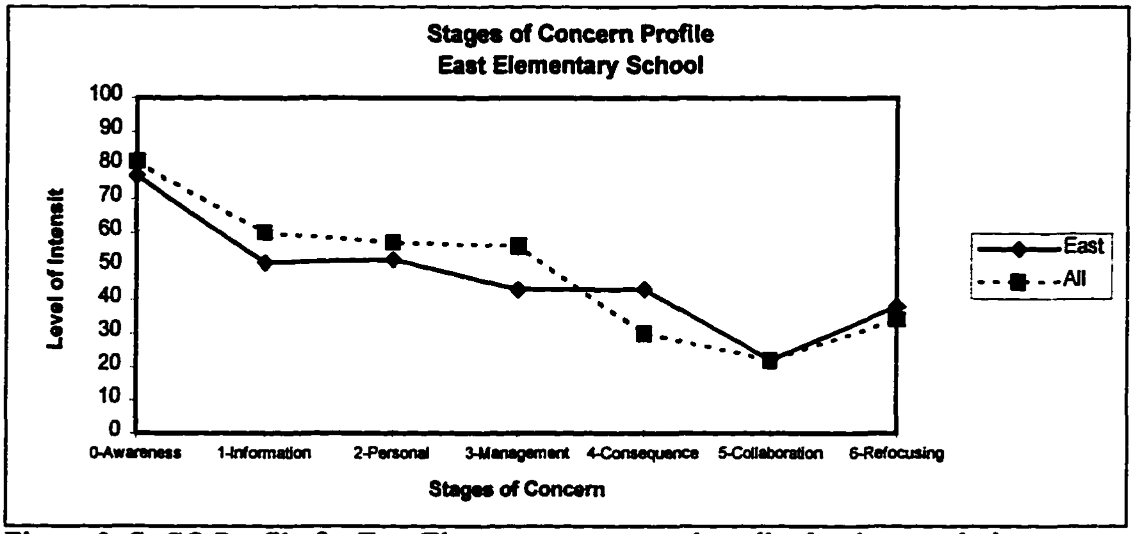

Figure 9. SoCQ Profile for East Elementary compared to all schools cumulative.

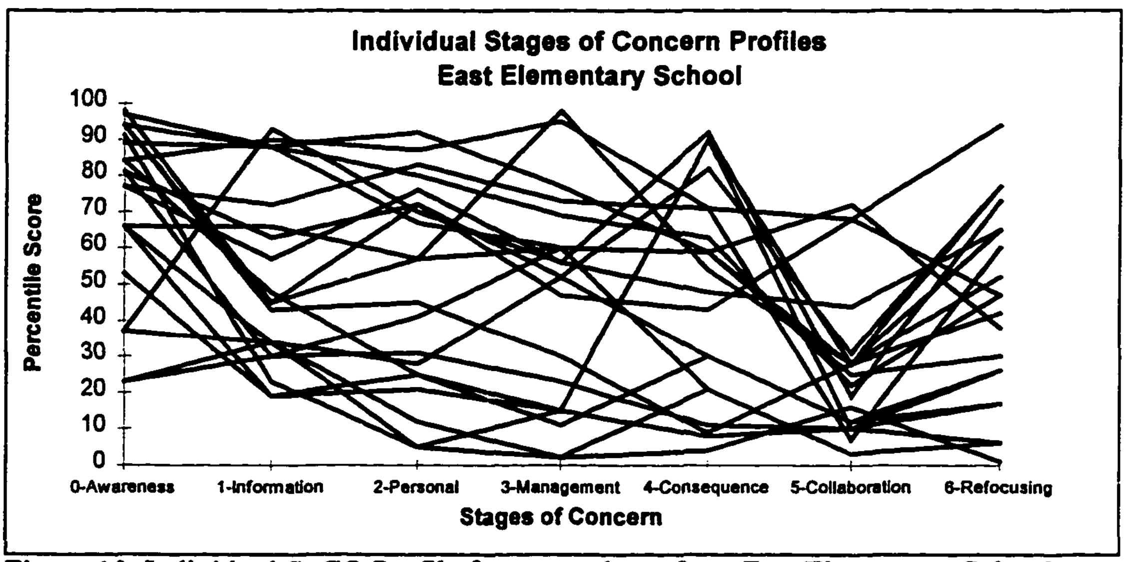

Figure 10. Individual SoCQ Profile for respondents from East Elementary School.

Sampling Procedure

Results of the SoCQ were used to select a stratified sample of teachers for ICM interviews. In order to provide a representative sample with varying degrees of concern about ILS technology, respondents to the SoCQ were identified by their corresponding high and second high stage of concern to form an independent variable labeled SoCQ level of use. Three SoCQ level of use groups or dimensions were identified as Self, Task, or Impact concerns. Cases with high and second high scores in Stages 0, 1, and 2 were combined to form a Self concerns group. Cases with high or second high scores in Stage 3 formed a Task concerns group and cases with a high or second high score in Stages 4, 5 or 6 were combined to form an Impact concerns group.

A random sampling procedure was used to select thirty subjects for ICM interviews from those completing the SoCQ. A preliminary power test to determine an appropriate sample size for an analysis of variance (ANOVA) design indicated that for a sample size of thirty the power was .7 for an effect size of .75. Power was examined for each dependent variable in the ANOVA. Tables 14 and 15 compare the proportions of respondents in the sample with all SoCQ respondents by school and by level or dimension of concern respectively. The tables indicate that the distribution of the sample by school, level, or dimension of concerns was fairly representative of all respondents.

Table 14

Random Selection of SoCQ Respondents by School

School	No. Respondents	Proportion Respondents	No. Selected	Proportion Selected
West	11	17%	5	17%
North	16	25%	6	20%
South	17	26%	10	33%
East	21	32%	9	30%
TOTAL	65	100%	30	100%

Table 15

Random Selection of SoCQ Respondents by Level of Concern

Dimension	No. Respondents	Proportion Respondents	No. Selected	Proportion Selected
Self	33	51%	15	50%
Task	18	32%	8	27%
Impact	14	17%	7	23%
TOTAL	65	100%	30	100%

Innovation Configuration Matrix

To collect data for the second research question regarding patterns of use occurring among individuals implementing an ILS and differences among these patterns of use, an ICM interview (see Appendix A) was conducted and recorded by the researcher with each of the teachers selected for the random sample. One interview in the original selection was not completed making N=29 for the ICM.

An expert group consisting of the researcher, an experienced lab manager (not from the school system under study), and a vendor representative was assembled to rate the interviews for the ICM checklist. The ICM component scores for each case in the sample were based on the collective ratings of the expert group. The expert group reviewed transcribed audio tapes of teachers' interviews and independently scored each respondent based on the content and structure of the ICM checklist and the following two guidelines:

1. Any information stated by the respondent during the interview may be used to rate any component. Since ICM interviews consisted of open-ended questioning and probing, respondents were likely to provide responses that answered previous or subsequent questions.
2. Rate to the highest level of use described by the respondent for any component. Higher levels of use primarily describe behaviors or practices that indicate a more sophisticated implementation of the innovation but are not necessarily inclusive of lower levels of use in actual practice.

Reliability statistics were computed to determine both the internal consistency in the ratings determined by each scorer as well as the external consistency in ratings among the scorers. Inspection of Table 16 indicated a high level in the external consistency of the ratings among the three scorers for all items on the scale (r = .9926 for AB; r = .9974 for AC; r = .9935 for BC). Additionally, a high level of internal consistency was indicated by a significant coefficient alpha ($p < .01$) for each scorer and for all scorers combined (see Table 17).

Table 16

InterScorer Reliability Coefficients for ICM

Scorer	A	B	C
A	--		
B	.9926	--	
C	.9974	.9935	--

Table 17

Interltem Reliability Coefficients for Each Scorer on ICM

Scorer	Mean	Variance	Std. Dev.	Alpha
A	48.3448	22.1626	4.7077	.5386*
B	48.5517	34.1133	5.8407	.7800*
C	46.6897	20.3645	4.5127	.5614*
All	47.8621	25.6552	5.0651	.6503*

*Significant at the .01 level

The first step in determining the patterns of usage that occured among teachers implementing an ILS and how these patterns differed was to compute individual component frequencies for the ICM using a procedure similar to Heck et al. (1981). The procedure consisted of determining the cumulative frequency of ratings for each variation within each component on the ICM awarded by the three scorers (1305 possible ratings for all variations of all components by three scorers) and then calculating the average and proportion for each variation for all components on the ICM (see Table 18). An ICM level of use factor was formulated for each case by classifying the composite score on the ICM according to the same scale used for the ICM component variations. The frequency profile levels of use totals represented a relatively normal distribution with 75% of ratings in the middle three levels of use categories.

The next step in the analysis of the ICM was to conduct pattern analysis of the interview data to determine dominant configuration patterns or variations. This procedure identified relatively homogenous groups of cases by computing the centroid

Table 18

Frequency of Level of Use as Rated by Expert Group

	Level of ILS Use					
Component	**1**	**2**	**3**	**4**	**5**	**Total**
Understands Instructional Design of ILS Courseware		13	51	23		87
Received Training in Use of ILS	1	27	24	24	11	87
On-Going Support System Is Provided	3	50	25	4	5	87
Sets Instructional Goals for Use of ILS	26	54	2	3	2	87
Integrates ILS Courseware with Classroom Instruction	16	32	21	15	3	87
Integrates ILS Courseware with District Curriculum	4	4	8	70	1	87
Individualizes Enrollment Options on ILS	5	9	69	3	1	87
Effective Scheduling of ILS				33	54	87
Sets Clear Rules for ILS Use		2	6	1	78	87
Provides Sufficient Time on Task for ILS Use			29	58		87
Facilitates ILS Instruction			27	47	13	87
Uses Reinforcement and Motivational Strategies	20	13		49	5	87
Uses Reports Generated by ILS Management System		4	60	16	7	87
Uses ILS Achievement in Learner Evaluation	63	12	6	6		87
Understands and Uses ILS Routines and Equipment			63	15	9	87
TOTAL	138	220	391	367	189	1305
MEAN	9	15	26	24	13	87
PROPORTION	11%	17%	30%	28%	14%	100%

for each dominant configuration pattern that emerged from the data and then assigning each case to the cluster with the nearest centroid until no cases changed cluster membership.

Since the initial cluster centers and the number of dominant patterns were unknown, this procedure consisted of selecting all fifteen components of the ICM for use in the cluster analysis and incrementing the number of clusters until a reasonable model was obtained. The number of clusters started with two and was incremented by one until convergence of cluster centers reached a distance of zero and the number of cases in each cluster was similar. The cluster analysis was run for two, three, and four clusters before a reasonable model was selected.

At two clusters convergence was achieved with a maximum distance of center change of .3205 while at three and four clusters convergence was achieved with a maximum distance of center change of .0000. At two clusters the distance between final clusters centers was 7.1883 with 18 cases in one cluster and 11 cases in the other while at four clusters the distances between final cluster centers ranged from 7.6997 to 17.1270 and the number of cases in each cluster ranged from 1 to 16.

The best model occurred with the number of clusters set at three. When the number of clusters was set at three, convergence of cluster centers was achieved after four iterations and the maximum distance by which any cluster center changed was zero. When the number of clusters was set at three, the number of cases in each cluster ranged from 8 to 12 (see Table 19). Table 20 provides the final cluster center for each cluster for each ICM component

Table 19

Number of Cases in Each Implementation Cluster

Cluster	Number of Cases
1	9
2	8
3	12
Total Valid Cases	29

Table 20

Final Cluster Centers for ICM Components in Cluster Analysis

ICM Component	Cluster 1	Cluster 2	Cluster 3
1. Understands Instructional Design of ILS Courseware	6.1111	10.1250	8.8333
2. Received Training in Use of ILS	9.2222	12.5000	7.9167
3. On-Going Support System Is Provided	7.1111	9.5000	6.5833
4. Sets Instructional Goals for Use of ILS	5.4444	6.7500	4.9167
5. Integrates ILS Courseware with Classroom Instruction	6.1111	10.3750	6.6667
6. Integrates ILS Courseware with District Curriculum	11.0000	12.0000	10.5000
7. Individualizes Enrollment Options on ILS	8.1111	8.8750	8.5833
8. Effective Scheduling of ILS	13.5556	13.8750	14.0833
9. Sets Clear Rules for ILS Use	13.5556	15.0000	14.5000
10. Provides Sufficient Time on Task for ILS Use	10.4444	11.1250	11.3333
11. Facilitates ILS Instruction	11.1111	12.8750	11.7500
12. Uses Reinforcement and Motivational Strategies	4.1111	11.7500	11.3333
13. Uses Reports Generated by ILS Management System	9.2222	10.7500	9.8333
14. Uses ILS Achievement in Learner Evaluation	3.8889	4.8750	4.5833
15. Understands and Uses ILS Routines and Equipment	9.8889	10.7500	9.9167

In order to assess the adequacy of the classification of implementation pattern groups by the cluster analysis, a Discriminant Analysis (DA) was performed. A DA determines the linear combination of predictor variables that best classifies cases into one of several known groups (*SPSS Professional Statistics*, 1995). The fifteen ICM components were used to separate the groups into the discriminant functions. As a result of this procedure all grouped cases were correctly classified.

Table 21 lists each ICM component by $F(2,26)$ and the corresponding discriminant function coefficients and Figure 11 provides a plot of the discriminant functions for each of the ICM patterns. The discriminant function coefficients reflected the importance attached to each ICM component in distinguishing the discriminant functions. The multivariate analysis of variance performed by the DA produced significant differences among the Implementation Patterns on ICM components 1, 2, 3, 4, 5, 11, and 12 ($p < .05$).

Table 21

Discriminant Function Weights for ICM Components

ICM Component	F	Sig.	Fn 1	Fn 2
12. Uses Reinforcement/Motivational Strategies	67.8826	.0000	1.25823	-.30846
2. Received Training in Use of ILS	10.2191	.0005	.13897	.29295
5. Integrates with Classroom Instruction	9.2215	.0009	-.27445	1.74723
3. On-Going Support is Provided	7.6386	.0025	.60909	.18948
11. Facilitates ILS Instruction	6.5705	.0049	.33663	.14500
1. Understands ILS Instructional Design	3.4095	.0484	-.16839	.28902
4. Sets Instructional Goals for ILS	2.8557	.0757	-.23317	.61968
13. Uses ILS Management Reports	2.5546	.0971	-.36072	-.09096
10. Provides Sufficient Time on Task	2.1375	.1382	1.48069	-.53613
9. Sets Clear Rules of ILS Use	1.7029	.2019	-.15515	.10001
6. Integrates with District Curriculum	1.5184	.2379	.35935	-.59012
15. Understands/Uses ILS Routines and Equipment	.9081	.4157	-.07324	.08089
7. Individualizes Enrollment Options on ILS	.6088	.5516	.25277	-.42373
8. Effective Scheduling of ILS	.4905	.6179	-1.07805	-.77891
14. Uses ILS Achievement in Learner Evaluation	.3634	.6988	.14913	-.58905

Based on both functions of the DA, Pattern 2 was indicative of a high degree of implementation characterized by high training and support, integration into classroom and curriculum, and use of reinforcement and motivational strategies. Implementation patterns were further examined by additional analyses.

To examine differences among the ICM configuration patterns a one-way analysis of variance (ANOVA) was performed. One-way analysis of variance determined significant differences among the implementation patterns groups for each of the ICM components (see Table 22).

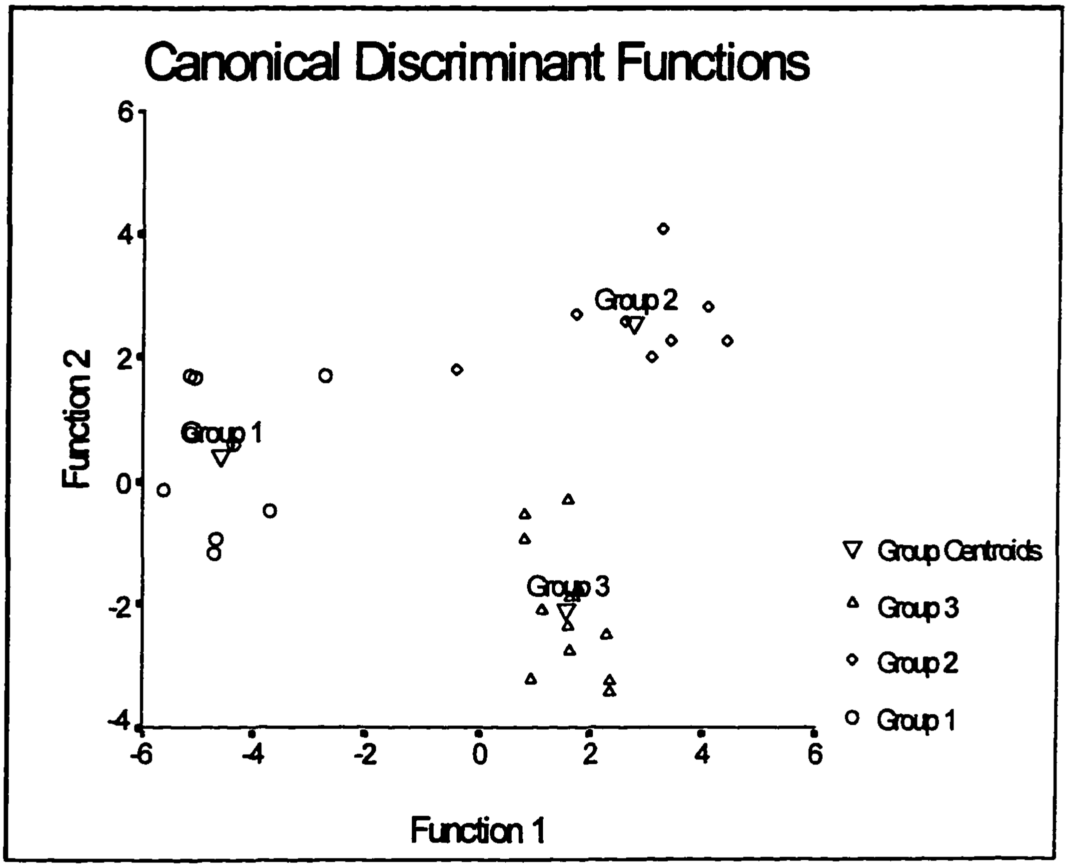

Figure 11. Plot of Discriminant Functions for Each ICM Implementation Pattern.

To validate assumptions required by the ANOVA, a test of homogeneity of variance was performed to determine whether the variance of the dependent variables was significantly different among the implementation pattern groups (see Table 23). For the most part, the assumption of equality of variances was satisfied. However, the Levene statistic produced by the homogeneity of variance test was significant ($p < .05$) for two ICM components: Component 7—Individualizes Enrollment Options on the ILS and Component 9—Sets Clear Rules of ILS Use.

Table 22

Descriptive Statistics for ICM Grouped by Implementation Pattern

Dependent Variable	Implementation Pattern	N	Mean	Std. Deviation	Std. Error
1. Understands ILS Instructional Design	1	9	9.33	.71	.24
	2	8	10.13	1.13	.40
	3	12	8.83	1.27	.37
	Total	29	9.34	1.17	.22
2. Received Training in Use of ILS	1	9	9.22	2.28	.76
	2	8	12.50	1.93	.68
	3	12	7.92	2.39	.69
	Total	29	9.59	2.88	.54
3. On-Going Support Is Provided	1	9	7.11	1.90	.63
	2	8	9.50	2.07	.73
	3	12	6.58	1.16	.34
	Total	29	7.55	2.05	.38
4. Sets Instructional Goals for ILS	1	9	5.44	1.67	.56
	2	8	6.75	2.55	.90
	3	12	4.92	.79	.23
	Total	29	5.59	1.80	.33
5. Integrates with Classroom Instruction	1	9	6.11	2.42	.81
	2	8	10.38	2.26	.80
	3	12	6.67	2.06	.59
	Total	29	7.52	2.81	.52
6. Integrates with District Curriculum	1	9	11.00	2.00	.67
	2	8	12.00	.53	.19
	3	12	10.50	2.32	.67
	Total	29	11.07	1.93	.36
7. Individualizes Enrollment Options on ILS	1	9	8.11	2.47	.82
	2	8	8.88	.35	.13
	3	12	8.58	.67	.19
	Total	29	8.52	1.43	.27
8. Effective of ILS	1	9	13.56	1.24	.41
	2	8	13.88	1.36	.48
	3	12	14.08	1.08	.31
	Total	29	13.86	1.19	.22
9. Sets Clear Rules of ILS Use	1	9	13.56	2.60	.87
	2	8	15.00	.00	.00
	3	12	14.50	1.24	.36
	Total	29	14.34	1.70	.31
10. Provides Time on Task	1	9	10.44	1.13	.38
	2	8	11.13	1.13	.40
	3	12	11.33	.78	.22
	Total	29	11.00	1.04	.19
11. Facilitates ILS Instruction	1	9	11.11	1.76	.59
	2	8	12.88	1.13	.40
	3	12	10.92	.79	.23
	Total	29	11.52	1.48	.27
12. Uses Reinforcement/ Motivational Strategies	1	9	4.11	.60	.20
	2	8	11.75	2.55	.90
	3	12	11.33	1.23	.36
	Total	29	9.21	3.80	.71

Dependent Variable	Implementation Pattern	N	Mean	Std. Deviation	Std. Error
13. Uses ILS Reports	1	9	9.22	1.20	.40
	2	8	10.75	1.98	.70
	3	12	9.83	1.03	.30
	Total	29	9.90	1.47	.27
14. Uses ILS in Learner Evaluation	1	9	3.89	2.32	.77
	2	8	4.88	2.64	.93
	3	12	4.58	2.50	.72
	Total	29	4.45	2.43	.45
15. Understands/Uses ILS Routines and Equipment	1	9	9.89	1.36	.45
	2	8	10.75	1.67	.59
	3	12	9.92	1.51	.43
	Total	29	10.14	1.51	.28

A plot of these two variables revealed that the homogeneity of variance assumption was violated by four outlier cases for Component 7 and three outlier cases on Component 9. Several attempts to transform these variables yielded no success in obtaining a nonsignificant Levene statistic and satisfying the assumption of equality of variances and so these variables were discarded from further analysis.

The ANOVA examined the differences among the implementation patterns for each of the components measured by the ICM (see Table 24). The ANOVA indicated significant differences for six of the ICM components: Component 1—Understands ILS Instructional Design, $F(2,26)=.048$, Component 2—Received Training in Use of ILS, $F(2,26)=.001$, Component 3—On-Going Support is Provided, $F(2,26)=.002$, Component 5—Integrates with Classroom Instruction, $F(2,26)=.001$, Component 11—Facilitates ILS Instruction, $F(2,26)=.005$, and Component 12—Uses Reinforcement/ Motivational Strategies, $F(2,26)=.000$.The observed power was calculated for the F test ($p<.05$). The observed power indicated the probablility that the F test was greater than the critical value under the alternative hypothesis (*SPSS Advanced Statistics 7.0*

Update, 1996). These results of the ANOVA were consistent with the multivariate analysis of variance performed by the discriminant analysis.

Table 23

Homogeneity of ICM Component Variances

DependentVariable	Levene Statistic	df1	df2	Sig.
1. Understands ILS Instructional Design	1.950	2	26	.162
2. Received Training in Use of ILS	.431	2	26	.655
3. On-Going Support is Provided	1.467	2	26	.249
4. Sets Instructional Goals for ILS	3.338	2	26	.051
5. Integrates with Classroom Instruction	.136	2	26	.874
6. Integrates with District Curriculum	2.529	2	26	.099
7. Individualizes Enrollment Options on ILS	8.111	2	26	.002
8. Effective Scheduling of ILS	.480	2	26	.624
9. Sets Clear Rules of ILS Use	8.883	2	26	.001
10. Provides Sufficient Time on Task	.872	2	26	.430
11. Facilitates ILS Instruction	2.370	2	26	.113
12. Uses Reinforcement/Motivational Strategies	1.851	2	26	.177
13. Uses ILS Management Reports	1.890	2	26	.171
14. Uses ILS Achievement in Learner Evaluation	.605	2	26	.554
15. Understands/Uses ILS Routines and Equipment	.162	2	26	.851

To validate the results of the ANOVA in regard to violations of assumptions about differences in group sizes and normality, a Kruskal-Wallis nonparametric analysis of variance was performed (see Table 25). The Kruskal-Wallis test is a nonparametric alternative to one-way analysis of variance that eliminates the assumption that the samples are from populations with the same shape. The Kruskal-Wallis test confirmed the results of the ANOVA for five of the six significant ICM components. Only Component 1—Understands ILS Instructional Design yielded a significant difference on the ANOVA but did not yield a significant difference from the nonparametric test.

Table 24

ANOVA of ICM Interview Data Grouped by Implementation Pattern

Dependent Variable		df	F	Sig.	Observed Power
1. Understands ILS Instructional Design	Between Groups	2	3.409	.048	.589
	Within Groups	26			
	Total	28			
2. Received Training in Use of ILS	Between Groups	2	10.219	.001	.975
	Within Groups	26			
	Total	28			
3. On-Going Support Is Provided	Between Groups	2	7.639	.002	.920
	Within Groups	26			
	Total	28			
4. Sets Instructional Goals for ILS	Between Groups	2	2.856	.076	.511
	Within Groups	26			
	Total	28			
5. Integrates with Classroom Instruction	Between Groups	2	9.221	.001	.961
	Within Groups	26			
	Total	28			
6. Integrates with District Curriculum	Between Groups	2	1.518	.238	.293
	Within Groups	26			
	Total	28			
8. Effective Scheduling of ILS	Between Groups	2	.491	.618	.122
	Within Groups	26			
	Total	28			
10. Provides Sufficient Time on Task	Between Groups	2	2.137	.138	.398
	Within Groups	26			
	Total	28			
11. Facilitates ILS Instruction	Between Groups	2	6.570	.005	.874
	Within Groups	26			
	Total	28			
12. Uses Reinforcement/ Motivational Strategies	Between Groups	2	67.883	.000	1.000
	Within Groups	26			
	Total	28			
13. Uses ILS Management Reports	Between Groups	2	2.555	.097	.465
	Within Groups	26			
	Total	28			
14. Uses ILSAchievement in Learner Evaluation	Between Groups	2	.363	.699	.102
	Within Groups	26			
	Total	28			
15. Understands/Uses ILS Routines and Equipment	Between Groups	2	.908	.416	.190
	Within Groups	26			
	Total	28			

Post-hoc Bonferroni tests were used to compare differences between pairs of configuration patterns' means for ICM components yielding a significant difference on

Table 25

Kruskal-Wallis Test of ICM Interview Data Grouped by Implementation Pattern

DependentVariable	Chi-Square	df	Asymp. Significance
1. Understands ILS Instructional Design	4.102	2	.129
2. Received Training in Use of ILS	11.895	2	.003
3. On-Going Support is Provided	9.998	2	.007
4. Sets Instructional Goals for ILS	4.606	2	.100
5. Integrates with Classroom Instruction	10.946	2	.004
6. Integrates with District Curriculum	4.493	2	.106
8. Effective Scheduling of ILS	1.218	2	.544
10. Provides Sufficient Time on Task	3.572	2	.168
11. Facilitates ILS Instruction	11.953	2	.003
12. Uses Reinforcement/Motivational Strategies	20.105	2	.000
13. Uses ILS Management Reports	4.507	2	.105
14. Uses ILS Achievement in Learner Evaluation	2.039	2	.361
15. Understands/Uses ILS Routines and Equipment	2.535	2	.282

both the ANOVA and the Kruskal-Wallis (see Table 26). The Bonferroni procedure performed *t* test comparisons between pairs of group means and adjusted the observed significance level for these comparisons by dividing by the total number of tests. The Bonferroni comparisons indicated that mean differences were significant ($p < .05$) for all five of the ICM components for configuration Pattern 2 when compared to Patterns 1 and 3 with the exception of Component 12. On Component 12 the means between Patterns 2 and 3 were not noticeably different. However, mean differences were significant ($p < .05$) when comparing configuration Patterns 1 and 3 for Component 12—Uses Reinforcement/ Motivation Strategies.

Table 26

ICM Components Significant at 95% Confidence Interval in Post Hoc Comparisons

Dependent Variable	Implementation Pattern	Implementation Pattern	Mean Difference	Std. Error	Sig.
2. Received Training in Use of ILS	1	2	-3.28*	1.089	.017
		3	1.31	.988	.593
	2	1	3.28*	1.089	.017
		3	4.58*	1.022	.000
	3	1	-1.31	.988	.593
		2	-4.58*	1.022	.000
3. On-Going Support Is Provided	1	2	-2.39*	.819	.022
		3	.53	.743	1.000
	2	1	2.39*	.819	.022
		3	2.92*	.769	.002
	3	1	-.53	.743	1.000
		2	-2.92*	.769	.002
5. Integrates with Classroom Instruction	1	2	-4.26*	1.084	.002
		3	-.56	.984	1.000
	2	1	4.26*	1.084	.002
		3	3.71*	1.018	.004
	3	1	.56	.984	1.000
		2	-3.71*	1.018	.004
11. Facilitates ILS Instruction	1	2	-1.76*	.608	.022
		3	.19	.552	1.000
	2	1	1.76*	.608	.022
		3	1.96*	.571	.006
	3	1	-.19	.552	1.000
		2	-1.96*	.571	.006
12. Uses Reinforcement/ Motivational Strategies	1	2	-7.64*	.769	.000
		3	-7.22*	.698	.000
	2	1	7.64*	.769	.000
		3	.42	.722	1.000
	3	1	7.22*	.698	.000
		2	-.42	.722	1.000

*The mean difference is significant at the .05 level.

These post-hoc findings indicated that differences among the configuration patterns revealed by analysis of variance were primarily based on differences between Pattern 2 and the other two patterns. Figures 11 and 12 clearly illustrated that the means for Pattern 2 were substantially higher than the means for the other two patterns on almost all ICM components. Post-hoc testing validated that these differences were significant for Components 2, 3, 5, 11, and 12. Thus, teachers who implemented the ILS according to Pattern 2 were statistically better implementers than teachers who implemented the ILS according to Patterns 1 or 3.

A stepwise multiple regression was performed to determine significant ICM components or combinations of components that were the best predictors of the degree of ILS implementation (see Table 27). Linear regression is used to estimate the coefficients derived from the linear equation involving the independent variables that best predict the value of the dependent variable. Stepwise variable selection entered each ICM component into the regression model by order of importance and removed components with diminished importance as additional predictors were added.

Table 27

Stepwise Multiple Regression of Influence Variables on Degree of ILS Implementation

Influence Variable	Beta	r	R	R^2	Adjusted R^2
5. Integrates with Classroom Instruction	.425	.748*	.748	.560	.544
2. Received Training in Use of ILS	.249	.615*	.855	.732	.711
12. Uses Reinforcement/Motivation Strategies	.368	.595*	.933	.871	.856
11. Facilitates ILS Instruction	.196	.624*	.898	.880	.880
3. On-Going Support is Provided	.184	.556*	.915	.897	.897

*The Pearson Correlation is significant at the .01 level.

Only the five significant components from the analysis of variance were entered into the regression model as predictor variables due to the relatively small number of replicates and the degree of ILS implementation as measured by ICM composite score was entered into the regression model as the criterion variable. Significant correlations ($p < .01$) were obtained among all the variables. Component 5—Integrates with Classroom Instruction explained 56% of the variability in the degree of ILS implementation for this model and 54% for other data sets from the same population. Component 5, Component 2—Received Training in Use of ILS, and Component 12—Uses Reinforcement/Motivation Strategies explained 87% of the variability of the degree of ILS implementation for this model while almost 90% of the variability of the degree of ILS implementation was explained by these five ICM components for both this model and other data sets from the same population.

Gain Scores

To explore the relationship between implementation practices and learner achievement using an ILS, reading and math ILS gain scores were collected from all learners whose teachers were selected for ICM interviews (N=608). Since the same math course was used by all learners in the population while reading scores were collected from two different ILS courses, only data collected from the math courseware were used for learner achievement analysis purposes. Gain scores generated by the ILS from the math courseware were used because these data were directly associated with the implementation variables in this study.

To initiate the analysis of gain scores, a procedure similar to one used by George and Hord (1980) was applied. An analysis of covariance was performed using the ILS math courseware gain scores as the dependent variable, the three ICM implementation groups as the independent variable, and time on task using the ILS-generated score for math instruction as the covariate due to the linear relationship between the gain scores and time on task. Analysis of covariance was used because this procedure provided for the implementation group differences to be tested against the math gain scores while controlling for differences that existed among the groups due to time on task.

A significant interaction among configuration patterns from the ANCOVA (see Table 28) was indicated, $F(2,606)=.004$. Pattern 1 teachers had a higher mean score for math gain but when the gain scores were adjusted for time on task, higher gains were obtained in classrooms with teachers in Pattern 3 than in classrooms with teachers in Patterns 1 or 2.

Table 28

ANCOVA of Math Gain by Implementation Pattern with Time on Task

Implementation Pattern	N	Unadjusted Mean	Adjusted Mean	*F*	Sig.
Pattern 1	175	.5663	.5167	5.526	.004
Pattern 2	179	.5160	.5013		
Pattern 3	254	.5286	.5731		

Figure 12 illustrates the nature of this interaction among the configuration patterns. A plot of the time on task by ICM composite score indicated negative trending in the relationship between these two variables. These data disclosed implementation behaviors that seemed to diminish ILS math achievement more than facilitate achievement. It appeared that the higher the degree of implementation (ICM composite score) the less time on task was spent by the implementer, and consequently, the lower the ILS math achievement that was attained. However, the explanation for this phenomenon was not obvious and so further analysis was conducted to detect trends in these data.

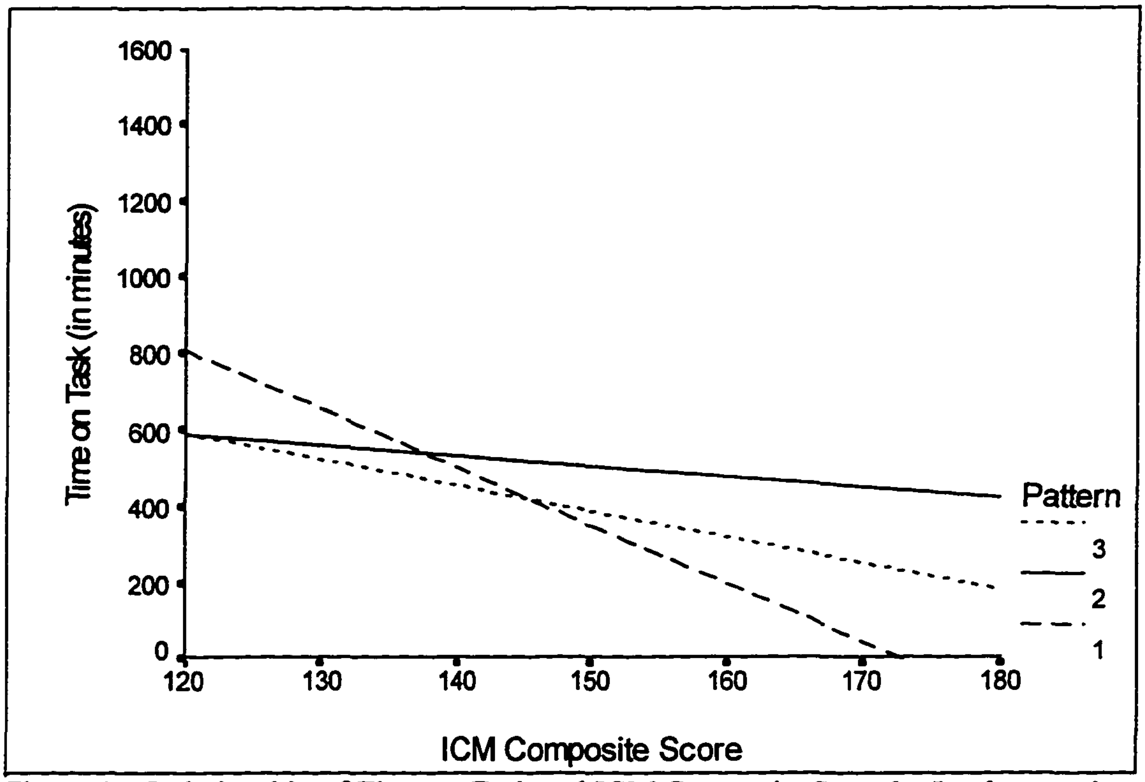

Figure 12. Relationship of Time on Task and ICM Composite Score by Implemenation Pattern.

A correlational analysis was used to explore the relationship between the ICM composite scores, math gain scores, and time on task. To perform this analysis, a random sample (N=204) was drawn from the population of learners and descriptive statistics were computed for each variable (see Table 29). Pearson correlations were computed among all three variables (see Table 30).

Table 29

Descriptive Statistics for Gain Scores Correlations

Variable	Mean	Std. Deviation	N
ICM Composite Score	145.19	13.89	204
Time on Task (in minutes)	499.62	222.39	204
Math Gain Score	.4936	.2827	204

Table 30

Correlations among ICM Composite Scores, Time on Task, and ILS Math Gain, N=204

		ICM Composite Score	Time on Task (in minutes)	Math Gain
Pearson Correlation	ICM Composite Score	1.000	-.276**	-.353**
	Time on Task (in minutes)	-.276**	1.000	.665**
	Math Gain	-.353**	.665**	1.000
Sig. (2-tailed)	ICM Composite Score	.	.000	.000
	Time on Task (in minutes)	.000	.	.000
	Math Gain	.000	.000	.

**. Correlation is significant at the 0.01 level (2-tailed).

As expected, much of the math gain achieved by learners using the ILS was explainable by the high correlation between math gain and time on task. (r = .665, p <.01). In other words, math gain increased when time on task increased and decreased when time on task decreased. However, further inspection of Table 30 revealed that there were statistically significant negative correlation coefficients between ICM composite scores and time on task (r = -.276, p < .01) and math gain (r = -.353, p < .01).

Another perspective of this phenomenon was obtained by testing the relationship between implementation patterns and learner achievement. To test this relationship, random selections (N=75) were drawn from the population of learners for each of the three implementation patterns and the ICM composite score was correlated with time on task and math gain for each implementation pattern. Descriptive statistics were computed for each variable for each implementation pattern (see Table 31).

Table 31

Descriptive Statistics of Correlation Variables by Implementation Pattern

Variable		Mean	Std. Deviation	N
ICM Composite Score	Pattern 1	133.12	8.33	75
	Pattern 2	161.28	9.20	75
	Pattern 3	140.05	5.50	75
Time on Task (in minutes)	Pattern 1	557.92	233.18	75
	Pattern 2	536.72	224.50	75
	Pattern 3	484.29	174.52	75
Math Gain Score	Pattern 1	.5401	.2828	75
	Pattern 2	.5364	.3387	75
	Pattern 3	.5764	.3076	75

Correlations between each ICM implementation pattern and math gain and time on task were performed (see Table 32). Patterns 1 and 3 both indicated significant negative correlations between ICM composite scores and time on task (r = -.284, $p < .05$ and r = -.484, $p < .01$, respectively) and ILS math gain (r = -.287, $p < .05$ and r = -.356, $p < .01$, respectively). However, ICM composite scores did not correlate with time on task (r = .000) and did not correlate significantly with math gain (r = -.126).

The statistics for Pattern 2 indicated that although the Pattern 2 behaviors did not clearly facilitate ILS math achievement, Pattern 2 behaviors did not seem to diminish ILS math achievement as much, perhaps, as did Patterns 1 and 3. The next chapter of this study will elaborate on this phenomenon, provide some possible explanations for its occurrence, and provide recommendations for further study to investigate the association of implementation pattern with leaner achievement.

Table 32

Correlations between ICM Composite Scores, Time on Task, and Math Gain by Implementation Pattern

	ICM Composite Score	Time on Task (in minutes)	Math Gain
Pearson Correlation	Pattern 1	-.284*	-.287*
	Pattern 2	.000	-.126
	Pattern 3	-.484**	-.356**
Significance (2-tailed)	Pattern 1	.014	.013
	Pattern 2	.999	.282
	Pattern 3	.000	.002

**Correlation is significant at the .01 level (2-tailed)

*Correlation is significant at the .05 level (2-tailed)

CHAPTER 5

CONCLUSIONS AND DISCUSSION

Integrated learning systems are but one in a series of technologies and innovations embraced by education in the last several decades. Although the problem of implementing an integrated learning system is relatively new, the issue of properly or adequately assimilating technology into the classroom and promoting its effective use has long been a matter of research and debate. The question of the instructional effectiveness of an ILS or any other innovation may be as much an implementation issue as a matter of instructional design and the potential of ILSs may be unfulfilled when the technology is ineffectively or improperly implemented. Therefore, the data analysis for this study was conducted within the context of research on change and innovation.

The primary research assumption for this study was that ILS implementation is best understood by examining contextual phenomena of the implementation. The intent of the data analysis was to examine the change process as it was experienced within schools and classrooms by teachers who were implementing an ILS. The data analysis was accomplished by collecting process data that revealed several contextual variables of the implementation including teacher attitudes about ILS technology, the operational patterns of teachers using ILS technology, and learner achievement using ILS technology. Then the measured differences in the operational patterns of ILS implementation were determined and these measured differences were related to learner achievement.

Summary of the Data Analysis

The theoretical basis for this study was a model that viewed change as a process that is experienced and accomplished by individuals. Applying this model, this study attempted to define and measure the implementation of ILS technology and understand what happens to this technology as it is implemented at both the school and classroom level in terms of three research questions:

1. What are the concerns of individuals implementing ILS technology?
2. What patterns of use occur among teachers implementing an ILS? How do these patterns differ from one another?
3. How do the implementation practices of teachers impact learner achievement using an ILS?

Three sources of data collection were used to provide the data for the data analysis: the Stages of Concern Questionnaire (SoCQ); the Innovation Configuration Matrix (ICM); and the learner gains reports.

Stages of Concern Questionnaire

The Stages of Concern Questionnaire (SoCQ) was used to collect data about the attitudes and concerns of teachers using an ILS. The SoCQ classifies results into seven stages of concerns that users or potential users of an innovation may have in regard to a particular innovation. These stages of concern are distinctive and developmental but not necessarily mutually exclusive. The developmental nature of concerns is reflected by grouping the stages into three dimensions: self, task, impact. In the early stages of a change effort individuals are more likely to have personal concerns with the change while in the latter stages of usage of an innovation concerns about the task and the impact of the innovation on learners becomes more intense.

The SoCQ was administered to all teachers in the four elementary schools selected for this study. A return rate of 71% was obtained for the questionnaire. Reliability coefficients were computed for each of the seven stages of the SoCQ employing a two-tailed test and yielded high reliability coefficients for all seven stages ($p < .01$).

The SoCQ focused on the concerns of individuals involved in change. The logical unit of measure for this instrument was ILS-using teachers. The instrument consisted of 35 items that teachers rated using an eight point Likert scale. There were five items for each of the seven measures. Percentile tables have been established for converting raw scale scores and interpretation of the SoCQ was performed by the examination of peak stage scores, second highest stage scores, and group profiles.

To analyze the SoCQ, data item responses were grouped and summed according to each of the seven stages of concern. Raw scores were converted to percentile scores for each of the stages and response patterns were examined as high and second high stages of concern. Overall, highest levels were at Stage 0—Awareness and second highest at Stage 1—Informational. A high Stage 0 score indicated either an unconcern about the innovation or users who were more concerned about things not related to the innovation. However, there was an overall high response tendency among the various stage scores indicating that the high Stage 0—Awareness score may not have actually reflected a general unconcern about the innovation. A summary of the SoCQ profile for each school follows:

West Elementary. A high Stage 0—Awareness indicated established users who were no longer particularly concerned about the innovation (the ILS) or users who were more concerned about things not related to the innovation. However, the second peak at Stage 3—Management suggested that teachers had logistics, time, and management concerns. The tailing-up on Stage 6—Refocusing suggested that teachers had ideas about how to improve the use of the ILS. There appeared to be a progression from self concerns (Stages 0, 1, 2) to task concerns (Stage 3). Task concerns are typically more intense during the early period of use of an innovation (Hall, George, & Rutherford, 1986).

North Elementary. The SoCQ profile for North Elementary suggested a general awareness and concern about the innovation and an interest in learning more about the innovation (Stage 1 slightly higher than Stage 2). Although a high Stage 0—Awareness indicated established users who were no longer particularly concerned about the ILS or were more concerned about things not related to the innovation, a second high Stage 1 suggested that teachers wanted more information about the ILS. With the absence of peaking at Stage 3—Management there was no clear indication of progression from self to task concerns. Low Stage 4—Consequence and Stage 5—Collaboration suggested some lack of concern about consequences for learners. The tailing-off at Stage 6—Refocusing revealed no other ideas were competitive with the use of the ILS.

South Elementary. The profile for South Elementary resembled the profile of West Elementary except at higher levels of stage scores. A high Stage 0 indicated established users who were no longer particularly concerned about the ILS or users who were more concerned about things not related to the ILS. However, the second peak at Stage 3—Management suggested that teachers were transitioning to logistics, time, and management concerns and clearly indicated a progression from self concerns (Stages 0, 1, 2) to task concerns (Stage 3). The distinct tailing-up on Stage 6 indicated that teachers had ideas about how to improve the use of the ILS.

East Elementary. The SoCQ profile for East Elementary suggested a slightly different spin on the interpretation than that of the other schools due to modest differences in the response pattern. Although a high Stage 0—Awareness indicated established users who were no longer particularly concerned about the ILS or were more concerned about things not related to the innovation, Stage 2—Personal concerns were equal to or more intense than Stage 1—Informational, which suggested users were concerned more about how they were affected personally by the innovation than in learning more about the substantive nature of the innovation (Hall et al, 1986). The peaking at Stage 2—Personal also suggested that teachers had personal concerns and consequences for themselves. The distinct tailing-up on Stage 6—Refocusing clearly indicated that teachers had ideas about how to improve the use of the ILS.

There appeared to be some progression from self concerns (Stages 0, 1, 2) to concerns about the impact of the ILS on learners (Stage 4) based on the peaking that occurred at Stage 4. The difference in the concerns pattern for East Elementary compared to the overall pattern of concerns for all four schools, particularly in regard to Stage 4—Consequence concerns, were due, in part, to the fact that this school (both principal and teachers) had been implementing the ILS for a longer period of time than the other schools.

Although the frequencies of highest stage of concern levels were at Stage 0 and second highest at Stage 1, the overall trend for the SoCQ seemed to indicate a slight peaking of concerns at Stage 3—Management and then a distinct peaking at Stage 6—Refocusing. This pattern would seem to suggest an implementation where, on average, concerns for the innovation were evolving from a dimension of self concerns to a dimension of task concerns. Additionally, the tailing up at Stage 6 supported the notion that the average implementer had ideas about how to change or improve the innovation.

Innovation Configuration Matrix

The Innovation Configuration Matrix (ICM) was used to collect data regarding patterns of use occurring among individuals implementing an ILS as well as the differences among these patterns. An ICM interview was conducted using a random sample selected from those teachers completing and returning the SoCQ. The ICM component and composite scores for each case in the sample were based on the collective ratings of an expert group who reviewed transcribed audio tapes of teachers' interviews and independently rated each component on the ICM checklist for each respondent based on a scale of 1 to 5.

Frequency and proportions for each variation within each ICM component were computed. The proportions for each variation were tallied across components to provide a profile of ICM level of use for all cases. The frequency profile indicated levels of use generally tended toward the high end of the scale for most components with half of the ratings occurring at levels 3 or 4.

Pattern analysis of the ICM component scores was conducted to determine dominant configuration patterns among responses and ratings. Three prominent configuration patterns emerged from the data. The configuration patterns exhibited similar trends although Pattern 2 was significantly higher on several components and Pattern 1 was significantly lower on the reinforcement/motivation component.

To explore differences among the configuration patterns, an ANOVA and a nonparametric Kruskal-Wallis test were used to determine the differences among the implementation patterns for each ICM component that satisfied assumptions. The following ICM components yielded significant differences for both procedures:

- Received Training in Use of ILS
- On-Going Support is Provided
- Integrates with Classroom Instruction
- Facilitates ILS Instruction
- Uses Reinforcement/ Motivational Strategies

Post-hoc findings indicated that differences among the configuration patterns revealed by analysis of variance were based on differences between Pattern 2 and the other two patterns. A stepwise multiple regression of these five components revealed that Integrates with Classroom Instruction, Received Training in Use of ILS, and Uses Reinforcement/Motivation Strategies explained most of the variability of the degree of ILS implementation among the configuration patterns.

Learner Gains Reports

Learner gains reports were collected for all teachers who were selected for ICM interviews. These reports provided ILS math and reading achievement data of learners using an ILS. Only the gain scores from the math courseware were used for analysis since the same math courseware was used by all learners.

To examine the impact of patterns of implementation on achievement, an ANCOVA was performed using the ILS math gain scores as the dependent variable, the ICM implementation groups as the independent variable, and time on task using the ILS for math instruction as the covariate. A significant interaction among configuration groups was apparent, albeit that classrooms with teachers in Pattern 3 performed better than classrooms with teachers in Patterns 1 or 2.

This phenomenon was submitted to further analysis to detect distinguishable trends in the data. Pearson correlations were computed among ICM composite scores, math gain, and time on task. Much of the math gain achieved by learners using the ILS was explainable by time on task, but statistically significant negative correlation coefficients were obtained between ICM composite scores and time on task and ICM composite scores and math gain, suggesting an implementation phenomenon that seemed to diminish ILS math achievement more than facilitate achievement. It appeared that the higher the degree of implementation (ICM composite score) the less time on task was spent by the implementer, and consequently, the lower the ILS math achievement that was attained.

Additional testing of this phenomenon by implementation pattern indicated that Patterns 1 and 3 yielded significant negative correlations between ICM composite scores and time on task and ICM composite score and ILS math gain. However, the statistics for Pattern 2 indicated that Pattern 2 behaviors did not seem to diminish ILS math achievement as much, perhaps, as did Patterns 1 and 3.

Discussion of the Data Analysis

One of the first lessons learned from conducting research on change and the implementation of computer technology into classrooms was to never underestimate the difficulty of the task or the time required to significantly change the way learners learn or the way teachers teach. The reason for this difficulty is due, in part, to the fact that people, particularly the people most affected by a change or innovation, are the most important factor in any change process (Hord, Rutherford, Huling-Austin, Hall, 1987). Thus, the most important questions in studying change do not necessarily ask what the innovation does to improve the organization, but ask how the intended users of the innovation are affected.

The Stages of Concern Questionnaire (SoCQ) focused specifically on the concerns of teachers using an integrated learning system (ILS). The developmental nature of individual concerns about the ILS was apparent in both the overall profile, the school profiles, and the individual profiles of the stages of concern. Three of the schools (West, North, and South) had been implementing an ILS for a little less than two years and the fourth school (East) had been implementing an ILS for a little less than three years. This distinction in the length of the implementation period between East and the other three schools was reflected in the SoCQ by a higher level of concerns—concerns that focused more on how the ILS impacts learners.

The teachers completing the SoCQ most often expressed awareness, informational, or personal concerns. These teachers wanted to know more about the innovation—what the innovation was and how using it would affect them. These expressions of concern were typical of a nonuser or inexperienced user. However, the peaking on management concerns indicated some movement along the concerns continuum from self concerns to task concerns. According to Hord et al. (1987) management concerns become more intense during the early period of use of an innovation. The peaking at Stage 4--Consequence concerns by teachers at East Elementary who had been implementing the ILS for a year longer than the other teachers in the study indicated that these teachers were just beginning to be concerned about the impact of the ILS on learners using the ILS.

Regardless of the level of concern about the ILS, the profiles indicated that most users had refocusing concerns—ideas about improving the ILS that would make it work better. This phenomenon is more indicative of experienced users of an innovation who have used an innovation with efficiency for some and time are concerned with finding better ways to impact learners (Hord et al., Hall, George, &

Rutherford, 1986). One explanation for this phenomenon may be a lack of a basic understanding or knowledge about the ILS as suggested by the high Stage 0 and 1 scores that were the result of a lack of sufficient training (indicated during ICM interviews). Rogers (1983) suggested several reasons for re-invention of an innovation that may be applicable to this situation including the complexity of the innovation, a lack of detailed knowledge about the innovation, an innovation with many possible applications, or an innovation that is implemented to solve a wide range of users' problems.

This examination of the concerns of teachers using an ILS reaffirmed the proposition that the implementation of an ILS was a difficult and prolonged process. The concerns of users of an ILS appeared to be developmental or progressive—changing and reformulating over time to reflect a relative intensity that corresponded to the user's experience and pattern of use of the ILS.

Different patterns of use of the ILS resulted when different teachers used different components of the ILS in different ways. These patterns characterized different uses of the ILS that provided an understanding about how teachers were implementing the ILS and what variations represented distinguishable or superior implementation practices.

While three distinctive implementation configuration patterns emerged from the data, the most interesting comparisons and contrasts were revealed by differences or lack of differences in individual implementation components among the three pattern groupings. When the implementation components were grouped according to those without significant differences among the implementation patterns and those with significant differences, a dimensionality in the implementation components emerged that was not apparent when the ICM was formulated.

The level of use of implementation components seemed to vary according to two dimensions: (1) implementation components that were controlled or imposed by some external source such as school or district policy and procedure, district-wide orientation and indoctrination, or time and availability constraints; (2) implementation components that were under the control of the individual teacher.

Table 33 lists ICM components that satisfied assumptions for the ANOVA grouped by significant *F*'s and non-significant *F*'s. Most of the significant components exhibited characteristics of **internal** (teacher) control while most of the non-significant components exhibited characteristics of **external** control.

Table 33

Implementation Components Classified by Significance Level

Significant* (Internal)	**Non-Significant** (External)
1. Understands ILS Instructional Design	4. Sets Instructional Goals for ILS
2. Received Training in Use of ILS	6. Integrates with District Curriculum
3. On-Going Support is Provided	8. Effective Scheduling of ILS
5. Integrates with Classroom Instruction	10. Provides Sufficient Time on Task
11. Facilitates ILS Instruction	13. Uses ILS Management Reports
12. Uses Reinforcement/Motivation Strategies	14. Uses ILS Achievement in Learner Evaluation
	15. Understands/Uses ILS Routines and Equipment

*The F (one-way analysis of variance) is significant at the .05 level.

At first glance some components do not seem to categorically follow the internal/external classification scheme. However, when analyzing the components in relation to the interview guide, the rating matrix, and the actual responses, the table classification of the components did apply in most cases. Component 1—Understands ILS Instructional Design was logically in the internal category while Component 4—Sets Instructional Goals for ILS seemed to be internal but was in the external category. Most teachers responded to Component 1 based on their personal experience with the ILS and not based on an orientation or training activity while most teachers responded to Component 4 by describing goals related to lab schedules or curriculum objectives that were received from external sources. Variation 5 of Component 4—Accomplishment of Goals is Celebrated could be construed as teacher-controlled, but no teacher responded in a way that evoked a 5 rating on that component (with the exception of two cases where one scorer in each case awarded a rating of 5).

While Component 3—On-Going Support appeared to be controlled by external sources, the teachers were actually asked in the interview to discuss what they do or who they tell if they have a problem. Teachers generally responded in reference to a lab manager or another teacher who helped solve problems.

Component 13—Uses ILS Management Reports and Component 14—Uses ILS Achievement in Learner Evaluation were components seemingly under the control of the individual teacher. However, upon review of the interview responses and ratings of the teachers to these components, most teachers responded in terms of what was required by the school or district. In the case of management reports, most teachers were required (or requested) by the school administrator to use a parent letter to notify parents during parent/teacher conferences of the student's progress on the ILS. In the case of assigning grades to ILS achievement, the ILS grading and evaluation process was optional and most teachers chose not to grade ILS activities. For both components the influence of external sources was sufficient to limit the variance among the responses.

Component 15—Understands/Uses ILS Routines and Equipment was again a component that could be construed to be under the control of the individual teacher. However, the responses to this component were tainted by the structure of each local school in regard to the ILS computer lab. Schools did not employ a lab manager for each school to coordinate the ILS and other computer activities and so this duty was assigned to the media center coordinator (librarian) or media assistant. This structure was consistent among all elementary schools from which data were collected for this study. Therefore, since no professional staff person was completely responsible for the ILS, the expectations of teachers imposed by the school/principal were relatively high in regard to adequate knowledge of the ILS and performance of routines that allowed the teacher to function on the ILS with minimal support. The natural consequence of this structure was that teachers were rated high on this component and little variance emanated from the teacher responses to this ICM component.

Component 2—Received Training in Use of ILS was probably the only external component to exhibit significance in the data analysis. However, the fact that significance was obtained on this component suggested a wide variance in the responses and subsequent ratings. Therefore, either training was not consistently applied on a district-wide basis or teachers were allowed to make an individual choice of whether or not to avail themselves of training opportunities.

Additionally, one may conclude that the degree of consistency in the way in which the teachers implemented the ILS was due not only to the dimensionality of the ICM component, but also to the homogeneity of the sample. Similarities among the sample explained some of the consistency in implementation practices among these teachers. All teachers in the sample were elementary school teachers with classes of 20-30 students with a certain number of hours each day to accomplish similar curriculum goals.

Of those components where there were significant differences, some interesting conclusions can be formed. Principally, when the control dimension of an implementation component was considered, there were significant differences in the magnitude of the levels of use among teachers implementing an ILS. Teachers that were effective implementers were exceptional based on those components over which they had control such as integrating with classroom instruction, facilitating ILS instruction, or using motivational strategies.

The teachers who were effective implementers did not come from any particular school. However, these effective implementers were all experienced teachers. Almost all of the effective implementers were over 40 years of age with an average of 15 years of teaching experience compared to an average of 10 years of teaching experience for the sample. The lowest number of years of teaching experience among the group of effective implementers was 5 years. The effective implementers had been implementing the ILS for an average of 2 years compared with an overall average of 1 year. One might postulate that since these effective implementers were well-established in their classroom teaching skills and practices, they granted an appropriate amount of time and attention to the matter of developing effective ILS implementation practices.

What was most interesting about effective implementers was not who they were, but what they did in practice to become effective implementers. There were five ICM components that best described effective implementers. Effective implementers integrated the ILS with classroom instruction, were well-trained in the use of the ILS, provided reinforcement and motivational strategies for using the ILS, facilitated ILS instruction, and made use of existing support systems. Effective implementers were most likely effective teachers.

The implementation practice of these teachers that was the best predictor of the degree of implementation was integration with classroom instruction. This component alone explained over 50% of the variability in the degree of ILS implementation. When Component 2—Received Training in Use of ILS and Component 12—Uses Reinforcement/Motivation Strategies were included, 87% of the variability of the degree of ILS implementation was explained. Include Component 11—Facilitates ILS Instruction and Component 3—On-Going Support is Provided and almost 90% of the variability of the degree of ILS implementation was explained. These components when viewed together are essential elements of almost any instructional strategy—conventional or innovative.

The foremost conclusion that should be drawn from this study is based on Component 5—Integration of ILS with Classroom Instruction. The stepwise multiple regression selected this variable as the best predictor of effective ILS implementation. Consequently, this component explained over 50% of the variance in the degree of ILS use. When the teacher presented a lesson in the classroom that was directly related to activities performed by students using the ILS or when the teacher took the students to the computer lab to perform an activity directly related to a lesson presented in the classroom, the teacher was effectively implementing the ILS. Most assuredly, this conclusion about ILS implementation could be generalized to describe the effective implementation of almost any innovation.

The analysis of ILS gain scores data described a complex association in the impact of implementation behaviors on learner achievement. The ILS gain score data corresponded more with implementation behaviors that seemed to diminish ILS math achievement than with behaviors that facilitated achievement. In making the leap from implementation behaviors to learner achievement using the ILS, one must consider time on task since time on task was directly associated with ILS gain (see *Instructional Management*, p. 26). The trend among the implementation patterns seemed to be that the higher the degree of implementation the less time on task was allowed by the implementer, and consequently, the lower the ILS math achievement that was attained. In other words, the teachers that exhibited the highest levels of ILS use apparently allowed learners less time with the ILS and, in effect, abandoned to some degree, a practice that had a significant impact on learner achievement using the ILS.

Notwithstanding, the implementation behaviors of the effective implementers group, while not clearly facilitating ILS math achievement, did not appear to diminish

ILS math achievement as much, perhaps, as did the other configuration patterns. Ostensibly, this seeming lack of sustainability of effective implementers does not presume that overall math achievement of learners was impacted negatively. In fact, the literature review provided evidence (particularly Becker, 1994) that effective implementation of computer resources had the potential to maximize learner achievement.

Somewhat similar results to the findings of this study were obtained in a Hord and George (1980) study in which classroom achievement on an innovation for teachers in a moderate implementation group did better than a high implementation group. In a meta-analytic study Kulik and Kulik (1991; see also Kulik, Kulik, Bangert-Drowns, 1988) found that the treatment feature most strongly related to effect size was length of treatment and in studies where the treatment was continued for several months the effects were noticeably lower.

This behavior appeared to be consistent with the SoCQ in which there was an overall trend of peaking at Stage 3—Management concerns and Stage 6—Refocusing indicating that teachers were having difficulty operationalizing the ILS and that they had ideas about improvements to the ILS. If this were the case, these data supported a pro-fidelity point of view based on the fact that ILS gain scores decreased as teachers deviated from the planned use of the ILS (by decreasing time on task).

Several possible explanations provide plausible arguments for the occurrence of this phenomenon:

1. The actual association between achievement attributed to an ILS and effective implementation was not obtained with the available data or detected by the statistical procedures used in this study. There is a possibility that teachers had, in fact, allowed the ILS to have a much greater impact on how and what they taught through effective integration of the ILS with classroom activities that was not apparent with the available data. Recommendations for a study designed to more elaborately and comprehensively examine the association between achievement and implementation patterns is provided in the final section of this chapter.
2. A plateau effect had occurred. Highly experienced teachers developed high skill levels using the ILS and reached a plateau of effective use of the ILS, then fell back on their skills as classroom teachers to affect learner achievement.
3. A novelty effect had occurred. A novelty effect occurs when innovation users (learners or teachers) are stimulated to greater effort because of the newness or novelty of the innovation and as the innovation becomes familiar it losses its potency (Kulik & Kulik, 1991).
4. Homeostasis had occurred. Both internal or external organizational forces exerted pressure to return the system to its original state and teachers attempted to fit computers into their normal way of doing things. In other words, when some aspect of the system was changed, the system attempted to put that part back the way it was so the system didn't have to change (Carr, 1996).

Nevertheless, one conclusion is apparent from the ILS gains data. In order to sustain a long-term change effort such as the implementation of an integrated learning system, those responsible for the change need to understand the various kinds of resistance to change—resistance that is specific to the technology or of a general nature.

Rogers (1983) warned that one reason discontinuance of some innovations occurred was because change agents assumed that once adoption was secured it would continue. Rogers concluded that without continued effort to promote change there was no assurance against discontinuance of an innovation because negative messages about an innovation existed in most client systems.

Implications for Educational Change

Current debate in the field of educational change is concentrated on contrasting differences in reductionist and holistic orientations to scientific inquiry (see Banathy, 1995). Carr (1996) explained this debate by suggesting that integration and separation represented two fundamentally different aspects of the same reality. Integration was concerned that when a system was separated or reduced to smaller components some of its vital properties are lost while separation was concerned that the whole is too complex to be studied or understood in its entirety.

For example it was clear from the literature on computer-based instruction that the impact on education that has occurred as a result of the introduction of personal computers into schools during the last decade had been modest at best (Becker, 1991;

Hadley & Sheingold, 1993). The explanations for this low impact demonstrated reductionist thinking. At first the explanation was the limited access of students to computers since most schools had so few computers. Later, as the number of computers in schools increased, the explanation was that teachers were generally unprepared or unwilling to use computers for instruction or that when computers were used in schools it was only for enrichment or to provide variety to the classroom routine.

The problem with the approach of the first decade of computer use in schools was that it was focused on applying the computer to the existing instructional delivery system. Collins (1991) described American schools as a self-sustaining, interlocking system of institutions consisting of age-graded schools, multiple-choice testing, curriculum and materials, teacher education, and lecture and recitation that naturally resisted technology:

> If you try to introduce computers for students to do their work, the change will be sustained only to the degree that it fits the prevailing institutional structure. Since computers undermine the lecture and recitation methods of teaching and promote the student as self-directed learner, they do not fit this institutional structure and will be squeezed out by it. (p. 32)

However, for systemic change to occur the focus of change must become our view of the role of the teacher in implementing technology. Many researchers in the field of educational change are applying the principles of holistic thinking to the creation of new systems of human learning through methodologies that focus less on end goals and outcomes and more on helping individuals change their perceptions of themselves (Carr, 1996). The methodology followed by this study—emphasizing ILS implementation factors, the perceptions of ILS users, the focus on users of ILS technology—and the subsequent data collection and findings support a systemic change process in education.

The findings of this study provided evidence that teacher perceptions about an ILS influenced the implementation of the ILS. The highest levels of concerns were based on increasing awareness and information about the ILS. The pattern of concerns was marked by a rise in management concerns that indicated that teachers were having trouble operationalizing the ILS. This fact was reinforced by teacher concerns in trying to make improvements to the ILS and actual deviations to the implementation process.

The findings of this study provided evidence for the proposition that not all ILS use is the same. Significant differences and variances in both the ILS implementation concerns and behaviors of teachers implementing an ILS were noted. The level of ILS implementation was a function of implementation practices that included integration with classroom instruction, training in the use of an ILS, and the use of motivational strategies.

Furthermore, using an ILS to improve the teaching/learning process was more complex than earlier understood. Just because a teacher was an effective implementer of an ILS was no guarantee that learners realized higher achievement using the ILS. Without the necessary organizational support the expectation for instructional technology to improve the teaching and learning process cannot be sustained.

This examination of the perceptions and practices of teachers implementing an ILS can be a highly effective guide to actions that change agents and stakeholders might follow as they assume a role in facilitating change and improvement in the implementation of ILS technology. Given the context of ILS implementation, the findings of this study substantiated the research on change and innovation. Several lessons from the change literature were revealed through this study that might assist stakeholders or change agents in promoting a successful and effective ILS implementation:

1. Implementation of an ILS is a developmental process that must be nurtured and sustained. Implementation of an ILS doesn't happen by itself. When left to their own devices, teachers will implement an ILS to whatever level is consistent with their concerns about the ILS and structurally fits into their existing teaching patterns and practices. This trend will endure as long as teachers continue to perceive technology as ancillary to the teaching/learning experience (Mecklenburger, 1990).
2. Teachers' concerns and perceptions of an ILS influence the way in which they implement an ILS. An understanding of the types (or stages) of concerns that teachers have determines the type of support or assistance that will be most useful in implementing the ILS (Hord, Rutherford, Huling-Austin, & Hall, 1987). Change agents should themselves be students of change—understanding the nature of change and realizing that resistance to technology or resistance to change in general exists in almost any organization. It is the change agent's

responsibility to combat resistance and to influence perceptions by providing support and assistance that is consistent, continuous, progressive, and corresponds to the changing concerns of the users of an innovation.

3. Teachers implement an ILS in different ways. The specific operational components of the ILS must be communicated to teachers so they understand what the program looks like when it is fully functioning. Once the implementation process is underway, the change agent must be able to identify exactly what teachers are doing in order to determine how best to provide assistance and support and to accurately report to the stakeholders how the ILS is being implemented. Most importantly, before learner achievement data can be examined to determine the effectiveness of the ILS, it must be determined to what degree the ILS has been implemented. Recalling the admonition of Smith and Ragan (1993), before drawing the line of causation from instruction to results, one must first identify the degree to which the design and intended use of the ILS actually represented what occurred during instruction. A determination of the relative merit of an ILS should be based on an examination of the degree to which an ILS is actually used in relation to the intended use of the ILS.

4. Integrate ILS instruction with classroom activities and instruction. For systemic change to occur in the teaching/learning process, the existing system has to be fundamentally replaced with an improved system. Teachers that were the most effective implementers of an ILS incorporated ILS instruction into classroom

instruction or vice versa. These teachers sent the message to learners that instruction received on the ILS was just as meaningful and just as important as whole-class instruction. Becker (1992b) argued that the main reason ILSs do not reach their potential "has to do with the ideology of autonomous tutoring by software and individualized pacing that accompanies their marketing and operational structure" (p. 6-7). Becker described ILS instruction as individualized learner assignments where learners work alone according to their placement in a hierarchy of mastered skills, where the teacher serves as an ancillary provider of assistance, and where the class functions as a convenient structure for managing time for large groups of students. Becker concluded that ILS vendors must restructure how they require teachers to use their system. Becker envisioned an ILS instructional strategy that included the blending of individualized computer-based instruction, small-group instruction in which the teacher introduces a lesson that is followed-up with computer-based instruction and student practice, and whole-class teacher-directed lessons followed-up with computer-based practice.

5. Training should be a continuous process and not a one-time event. On-going training is a key component to sustaining an ILS implementation. On-going training reaffirms fundamental practices that focus the user on the intended use of the ILS and influences the concerns a user will have about the implementation of an ILS. In interviews teachers reported the training for the ILS implementation that occurred was generally conducted by the vendor. In

contrast, teachers reported that the most help for ILS implementation in terms of training or support came from colleagues or lab managers.

6. ILS implementation must be teacher-driven. There is a perception that an ILS runs itself (Gleghorn, 1993) and by simply placing learners with computers does not ensure that they will grasp the underlying structure of important ideas and concepts. Resnick and Johnson (1988) noted that learning that occurs in isolation is not sustained in other contexts and Pea (1988) explained the necessity of teachers to assist learners in applying principles in multiple situations. Effective teaching practices accommodate effective ILS implementation. Teaching practices that have been proven effective for classroom instruction, or what Fullan and Stiegelbauer (1991) labeled as "organized common sense" (p. xi), are equally effective for ILS implementation. Teachers are the primary decision makers in determining what will be the role of technology in their classrooms (Gleghorn). Teachers that facilitate ILS instruction, use motivational strategies, and integrate ILS instruction with classroom instruction are more effective implementers.

7. An understanding of how the ILS is to be used and the expectations for learning must be clearly articulated. Jones (1990) observed that change is more manageable and occurs more easily when school districts articulate a common perception about what the change process entails. Once an ILS goes into a school building it is beyond the control of the designers and developers and it becomes the responsibility of the stakeholders in the change process to ensure that the ILS

is properly implemented and that systemic change occurs. Based on interviews with teachers, there seemed to be some ambiguity about the role of the ILS, how the ILS is designed to work, and what are the implications for teaching and learning. Stakeholders must obtain consensus on what represents appropriate ILS implementation practices and these practices must be reinforced with training and technical support.

Recommendations for Future Research

This study focused on describing the concerns and implementation practices of teachers implementing an ILS and examined any association of these practices with learner achievement using the ILS. Since the implementation of ILSs is a complex process, further studies that describe the implementation process for ILSs should be conducted. Several issues and questions were raised as a result of the present study that merit the attention of further research.

1. Use of external measures of learner achievement to investigate the complex associations between learner achievement and degree of implementation. Measures external to the ILS should be used to collect learner achievement data for examining the association between implementation patterns and learner achievement attributed to an ILS. A pretest/posttest control group design using a standardized external measure such as ITBS or CAT or criterion-referenced tests for specific content areas such as math, reading, or language would provide a reasonable basis for quantifying this association. This proposed model for

analysis of learner achievement data could use analysis of covariance in which the posttest is used as the dependent variable, the implementation groups and a control group of non-ILS using teachers as the independent variable, and the pretest, grade level, and even sex as the covariates. This design would examine which implementation practices, if any, impacted learner achievement in the context of the total instructional process.

2. Use of observational measures of teacher implementation practices and time on task. The data acquisition would be enhanced by triangulating teacher interview data with both questionnaires and observations of the actual practices of teachers using the ILS. Particularly, records, logs, or observations of actual class time spent using the ILS should be compared to computer-generated data of time on task to help describe the association between implementation practices and learner achievement. However, this approach is quite time-consuming and labor-intensive and, therefore, is often not feasible.

3. Dimensionality of the Innovation Configuration Matrix. Further research should be conducted using a multi-dimensional instrument that rates the variations for each implementation component within a range of a dimension (e.g. external control or internal control). Such an instrument would allow for a more comprehensive view of implementation as well as provide for more variance in the data.

4. Comparisons of additional contextual data. These data would be collected from change agents such as principals, technology coordinators, or lab coordinators and compared with context data collected from teachers.

5. Case studies of technology-intensive, instructionally-evolving learning environments. More qualitative studies that document the progress of innovative learning environments such as Apple Classrooms of Tomorrow (see Dwyer, Ringstaff, & Sandholtz, 1991) are needed. These case studies are particularly meaningful when a model for change is implemented that includes the two conditions that Dwyer et al. suggests are essential for reform:
   - teachers are given the opportunity to reflect and change their own beliefs about learning and instruction.
   - structural or systemic changes in the learning environment are implemented administratively as new belief systems are adapted.

6. Longitudinal studies that examine changes in the concerns and the implementation practices of teachers over time. This study provided a snapshot of conditions of change at a particular point in time. A longitudinal study that provided comparisons and contrasts of contextual variables at multiple points in time would provide a more comprehensive analysis of trends that occur in the implementation data.

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Appendix A

Innovation Configuration Matrix

Innovation Configurations Matrix
for CCC Integrated Learning System

	IDEAL USE	ACCEPTABLE USE		MINIMIMAL USE	UNACCEPTABLE USE
Component 1 **Instructional System and Design of CCC**	5. Describes individualized prescriptive strategies	4. Describes instructional presentation and mastery of skills	3. Describes enrollment levels	2. Describes different content areas only	1. Has no understanding of instructional design or no understanding is necessary
Component 2 **Training in Use of CCC**	5. Initial training, continued training, and program updates are conducted	4. Initial training and continued training is conducted	3. Initial training or orientation is conducted	2. Training is self-directed and occurs on-the-job	1. Received no training
Component 3 **On-Going Support System and Communication in Use of CCC**	5. Formal grade/ department level meetings to discuss CCC are conducted	4. Building level meetings with vendor or principal to discuss CCC are conducted	3. Technology committee meets periodically to discuss CCC instruction	2. Informal discussions with lab manager or other teachers	1. No attention is given to on-going support
Component 4 **Instructional Goals or Expectations for Use of CCC**	5. Accomplishment of goals is celebrated	4. Instructional goals for CCC are accomplished	3. A plan for accomplishing instructional goals is stated	2. Goals or expectations for CCC are stated	1. No goals or expectations for CCC instruction are set
Component 5 **Integration of CCC Courseware with Classroom Instruction**	5. CCC is used as a tool for regularly accomplishing classroom instructional objectives	4. Plans lessons that integrate CCC courseware with classroom instruction in multiple subjects (Worksheets may be used)	3. Plans lessons that integrate CCC courseware with classroom instruction in one subject (Worksheets may be used.)	2. CCC courseware supplements classroom instruction	1. CCC courseware is not integrated with classroom instruction
Component 6 **Integration of CCC Courseware with Curriculum**	5. Sequence and selection of courses/lessons are adjusted to align with or support district curriculum	4. CCC courseware supplements district curriculum in multiple subjects	3. CCC courseware supplements district curriculum in one subject	2. CCC courseware is correlated to district curriculum when possible	1. CCC courseware is not integrated with district curriculum
Component 7 **Appropriate Selection of Courses, Enrollment Levels, and Options of CCC**	5. Individualized learning sequences are designed and modified based on test scores, monitoring student progress, forecasts of learning gains	4. Learning sequences are individualized for each student based on test scores or monitoring of student progress	3. Test scores or prior CCC performance are used to enroll students in same courses at different grade levels	2. Students are enrolled in same courses at grade level	1. Students are enrolled at beginning level of course or strand
Component 8 **Effective Scheduling of CCC**	5. All students are scheduled for regular use and makeup sessions are provided	4. All students are scheduled regular use	3. Some students are scheduled for regular use	2. Some students are scheduled for occasional, remedial or specialized use	1. Students are not scheduled for either occasional or regular use
Component 9 **Clear Rules for Daily Procedures Using CCC**	5. Orientation to rules and procedures is presented	4. Rules and procedures are established and handed out to students in printed form	3. Rules and procedures are established and posted in lab or classroom	2. Some rules and procedures are established by the teacher	1. No rules and procedures are established

Rules for Rating:

(1) Any information in the interview may be used to rate any single component.

(2) Rate to the highest level of use described by the respondent for any single component.

	IDEAL USE	ACCEPTABLE USE		MINIMIMAL USE	UNACCEPTABLE USE
Component 10 **Sufficient Time on Task for Each Student Using CCC**	5. Amount of instructional time is determined by targeted gain for students	4. Students receive more than 30 minutes of CCC instruction per week and makeup sessions are provided	3. Students receive more than 30 minutes of CCC instruction per week	2. Students receive at least 30 minutes of CCC instruction per week	1. Students do not receive regular weekly instruction using CCC
Component 11 **Teacher Facilitation and Intervention Using CCC**	5. Continuously facilitates instruction;provide intervention strategies including worksheets, selected practice, tutoring, or small group instruction	4. Continuously facilitates instruction	3. Occasionally facilitates instruction or facilitate when students request assistance	2. Facilitation and intervention Is provided primarily by lab manager	1. Teacher is not present or does not facilitate CCC instruction
Component 12 **Effective Use of Reinforcement and Motivational Strategies Using CCC**	5. Recognizes individual and group achievement through use of individual and group motivational strategies of motivational strategies involving parents or community sponsors	4. Recognizes individual achievement through use of individual motivational strategies including certificates, wall charts, or individual competition	3. Recognizes group achievement through use of group motivational strategies including contests or team activities	2. Explains reasons for using CCC and encourages students to actively participate in CCC instruction	1. No motivational strategies or activities are used
Component 13 **Student Feedback and Use of Reports Generated by CCC**	5. Reports are used to provide information for determining classroom instruction or classroom activities	4. Reports are used to review student progress and modify student enrollment	3. Reports are used for progress review by lab manager, teacher, or principal	2. Reports are used infrequently or on a limited basis	1. Reports are not run or distributed
Component 14 **Instructional Assessment of CCC Courseware**	5. Evaluation or assessment of students includes mastery levels, lesson completion, or courseware content for multiple subjects	4. Students receive a letter or numeric grade for CCC achievement in multiple subjects	3. Students receive a letter or numeric grade for CCC achievement in one subject	2. CCC is optional for inclusion in the evaluation or assessment of students	1. CCC is not included in the evaluation or assessment of students
Component 15 **Teacher Knowledge and Skills Using CCC Routines and Equipment**	5. Familiar with course content for multiple courses, can modify instructional levels or other student enrollment information, and can use custom reports or forecasting reports to make instructional decisions	4. Familiar with course content for multiple courses and can modify instructional levels or other student enrollment information	3. Familiar with course content and student resources for multiple courses	2. Familiar with course content and student resources for one course	1. No familiarity with course content, student resources, or management system

Rules for Rating:

(1) Any information in the interview may be used to rate any single component.

(2) Rate to the highest level of use described by the respondent for any single component.

Interview Guide for CCC Integrated Learning System
Innovation Configurations Matrix

Is it OK if we use the term CCC to stand for the CCC integrated learning system including software, computers, and lab?

1. Describe in your own words the organization of CCC instruction?

2. How much formal training have you had in the use of CCC? What training have you received lately?

3. What formal or informal communication such as meetings or discussions has occurred to support you in the use of CCC? (What do you do and who do you tell if you have a problem?)

4. What goals or expectations do you set for your class for CCC instruction? How do you determine if these goals are accomplished?

5. When planning for classroom instruction, how do you integrate or coordinate CCC instruction into classroom activities?

6. Does CCC integrate with district or grade level curriculum? If so, in what ways and with what courses?

7. How do you determine the courses, level, and sequence of instruction students receive using CCC? Are modifications to student enrollment ever made? If so, how do you determine what modifications are made?

8. What students in your class receive CCC instruction? Are makeup classes provided for when students miss CCC instruction or when your class misses a scheduled lab time?

9. Have rules or procedures been established for students using CCC? If so, how do students know these rules or procedures?

10. How much time do students spend each day or week using CCC? How do you determine the amount of time students spend using CCC?

11. What do you actually do while the students are using CCC?

12. How do you keep students motivated about using CCC? (Are there organized programs in your classroom or school to recognize student achievement using CCC?)

13. How do you use the student reports generated by CCC? Is this information reported to the principal or lab manager? If so, how do they use the reports?

14. Is CCC included in your evaluation and assessment of students? If so, in what ways do you use CCC for evaluation and assessment of students?

15. What courses on the CCC are you most familiar with? What routines on CCC can your perform (student reports, custom reports, enrollment)?

Appendix B

Stages of Concern Questionnaire

Stages of Concern Questionnaire

Name (optional) ______________________ School ______________________

This questionnaire will take approximately 15 minutes to complete. Please provide the last four digits of your Social Security number for purposes of data identification:

____ ____ ____ ____

The purpose of this questionnaire is to determine what people who are using or thinking about using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various program to many years experience in using them. Therefore, a good part of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale.

For example:

This statement is very true of me at this time.	0 1 2 3 4 5 6 7
This statement is somewhat true of me now.	0 1 2 3 4 5 6 7
This statement is not at all true of me at this time.	0 1 2 3 4 5 6 7
This statement seems irrelevant to me.	0 1 2 3 4 5 6 7

Please respond to the items in terms of your present concerns, or how you feel about your involvement or potential involvement with the CCC integrated learning system. We do not hold to any one definition of this innovation, so please think of it in terms of your own perception of what it involves. Since this questionnaire is used for a variety of innovations, the name CCC integrated learning system never appears. However, phrases such as "the innovation," "this approach," and "the new system" all refer to the CCC integrated learning system. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement with the CCC integrated learning system.

Thank you for taking time to complete this task.

0	1	2	3	4	5	6	7
Irrelevant		Not true of me now		Somewhat true of me now		Very true of me now	

1.	I am concerned about students' attitudes toward this innovation.	0 1 2 3 4 5 6 7
2.	I now know of some other approaches that might work better.	0 1 2 3 4 5 6 7
3.	I do not even know what the innovation is.	0 1 2 3 4 5 6 7
4.	I am concerned about not having enough time to organize myself each day.	0 1 2 3 4 5 6 7
5.	I would like to help other faculty in their use of the innovation.	0 1 2 3 4 5 6 7
6.	I have a very limited knowledge about the innovation.	0 1 2 3 4 5 6 7
7.	I would like to know the effect of reorganization on my professional status.	0 1 2 3 4 5 6 7
8.	I am concerned about conflict between my interests and my responsibilities.	0 1 2 3 4 5 6 7
9.	I am concerned about revising my use of the innovation.	0 1 2 3 4 5 6 7
10.	I would like to develop working relationships with both our faculty and outside faculty using this innovation.	0 1 2 3 4 5 6 7
11.	I am concerned about how the innovation affects students.	0 1 2 3 4 5 6 7
12.	I am not concerned about this innovation.	0 1 2 3 4 5 6 7
13.	I would like to know who will make the decisions in the new system.	0 1 2 3 4 5 6 7
14.	I would like to discuss the possibility of using the innovation.	0 1 2 3 4 5 6 7
15.	I would like to know what resources are available if we decide to adopt this innovation.	0 1 2 3 4 5 6 7
16.	I am concerned about my inability to manage all the innovation requires.	0 1 2 3 4 5 6 7
17.	I would like to know how my teaching or administration is supposed to change.	0 1 2 3 4 5 6 7
18.	I would like to familiarize other departments or persons with the progress of this new approach.	0 1 2 3 4 5 6 7

0	1	2	3	4	5	6	7
Irrelevant		Not true of me now		Somewhat true of me now		Very true of me now	

19.	I am concerned about evaluating my impact on students.	0 1 2 3 4 5 6 7
20.	I would like to revise the innovation's instructional approach.	0 1 2 3 4 5 6 7
21.	I am completely occupied with other things.	0 1 2 3 4 5 6 7
22.	I would like to modify our use of the innovation based on the experiences of our students.	0 1 2 3 4 5 6 7
23.	Although I do not know about this innovation, I am concerned about things in the area.	0 1 2 3 4 5 6 7
24.	I would like to excite my students about their part in this approach.	0 1 2 3 4 5 6 7
25.	I am concerned about time spent working with nonacademic problems related to this innovation.	0 1 2 3 4 5 6 7
26.	I would like to know what the use of the innovation will require in the immediate future.	0 1 2 3 4 5 6 7
27.	I would like to coordinate my effort with others to maximize the innovation's effects.	0 1 2 3 4 5 6 7
28.	I would like to have more information on time and energy commitments required by this innovation.	0 1 2 3 4 5 6 7
29.	I would like to know about what other faculty are doing in this area.	0 1 2 3 4 5 6 7
30.	At this time, I am not interested in learning about this innovation.	0 1 2 3 4 5 6 7
31.	I would like to determine how to supplement, enhance, or replace the innovation.	0 1 2 3 4 5 6 7
32.	I would like to use feedback from students to change the program.	0 1 2 3 4 5 6 7
33.	I would like to know how my role will change when I am using the innovation.	0 1 2 3 4 5 6 7
34.	Coordination of tasks and people is taking too much of my time.	0 1 2 3 4 5 6 7
35.	I would like to know how this innovation is better than what we have now.	0 1 2 3 4 5 6 7

PLEASE COMPLETE THE FOLLOWING:

1. Female____ Male____

2. Age: 20-29____ 30-39____ 40-49____ 50-59____ 60-69 ____

3. Highest degree earned:

   Bachelor____ Masters____ Doctorate____

4. Total years teaching: _______

5. Number of years at present school: _______

6. How long have you been involved in using the CCC integrated learning system, not counting this year?

   Never___ 1 year___ 2 years___ 3 years___ 4 years___ 5 or more years___

7. In your use of the CCC integrated learning system, do you consider yourself to be:

   Nonuser___ Novice___ Intermediate___ Expert___

Please check to see that you have written the last four digits of your Social Security number and the name of your school on the front page of this questionnaire.

Appendix C

Instructional Design of ILS Courseware

Instructional Design of ILS Courseware

The CCC courseware covers subjects ranging from math and reading to GED preparation. CCC courseware is classified into two main types. Lessons courses mix tutorials and exercises in a lesson structure while strands courses adjust the exercise level for each student in individual skill areas called strands.

Lessons Courses

Lessons courses are classified into two categories: modular lessons and topical lessons courses.

Modular Lessons Courses

Modular lessons courses are organized into independent modules, each focusing on a specific content area. Learners are enrolled with options for control at either the lesson level, module level, both, or no learner control.

The presentation phase of a lesson consists of a series of exercises, simulations, or interactive demonstrations. The evaluation phase of a lesson tests learner understanding through a series of practice exercises. Learners achieve mastery section by section. When 80% or more of the sections of a lesson are mastered, the lesson is considered mastered. A module is considered mastered when all of the lessons in the module have been mastered. To master a section, learners master meet three criteria:

1. Exceed a minimum percentage of correct responses in the presentation phase.
2. Exceed a minimum percentage of correct responses in the evaluation phase.
3. Achieve a minimum score that is calculated by a weighted average of the

percentages from the presentation and evaluation phases.

Upon completing all the sections in a lesson, the management system takes one of the following actions based on the performance of the learner:

1. If the learner has mastered 80% or more of the sections in the lesson, then the lesson is mastered and the learner advances to the next lesson.
2. If the learner has mastered more than 50%, but less than 80% of the sections in the lesson, the learner repeats each unmastered section.
3. If the learner has mastered less than 50% of the sections in the lesson or has more than two consecutive unmastered sections, the learner repeats the entire lesson.

When a lesson is completed, the learner completes a cumulative review consisting of evaluation exercises randomly selected from completed lessons intake module.

<u>Topical Lessons Courses</u>

The contents of topical lessons courses are organized by topic and presented in independent lessons. Learners are enrolled with the option to select lessons, although lessons are generally arranged in textbook order.

Lessons consist of instructional presentations followed by exercises to test learning. The instructional presentation introduces a concept, presents examples, and engages the learning in simple activities to reinforce the concept. Exercise sets test the learner on the material presented in the instructional presentation. If a learner has completed a lesson and missed one or more exercises, the management system allows the learner to work another exercise for every exercise that was missed or end the lesson.

There are four ways to assess subject mastery in topical courses:

1. If a learner finishes all exercises in a lesson and all end-of-lesson review exercises without dropping below a 70% correct answer score, the lesson is mastered unless the learner does poorly on the cumulative review.
2. If a learner scores less the 70%, the lesson is completed without mastery.
3. A cumulative review begin when the learner has completed one lesson with mastery. Learners work a larger proportion of exercises from lessons in which they have not done as well.
4. If a learner gets more than five consecutive incorrect responses from a lesson during the cumulative review, the status of that lesson changes to unmastered.

Strands Courses

A strand is a set of exercises in one content or skill area arranged in order of increasing difficulty. Exercises within strands are grouped into equivalence classes and ordered according to their relative difficulty. Grade levels are assigned to each equivalence class according to the appearance of similar exercises in elementary textbooks and standard achievement tests. During an instructional session a learner receives a weighted mixture of examples from all the strands appropriate for that learner's grade level and the level of difficulty of exercises is adjusted to the learner's achievement level in the strand. The management system determines a weighted average of the learner's grade placement across all strands in a course

Strands courses employ a mastery learning model in which a learner's progress is determined by his or her performance according to algorithms that evaluate learner performance and determine the learner's motion through a course. Thus, it is possible that each learner progresses through the course along a unique learning path that is established by the underlying motion algorithms of the course.

The strand organization of CCC courseware accommodates mixed presentation of instruction. In any particular instructional session a variety of skills and concepts from a number of different strands are presented. Mixed presentation provides for the assessment of mastery for each strand. The adaptive algorithms employed by CCC courseware include evaluation of learner performance in each strand, weighting skill strands, and adjusting the number of examples presented for each strand accordingly. Patterns of responses for each strand are tracked and evaluated for mastery. According to the *Instructional Management Handbook* (1993) the management system tracks up to the last 40 responses for each strand. Response pattern tracking permits the effective use of automatic intervention strategies such as review, practice, and tutorial.

The management system of the ILS evaluates learner performance from a number of different strands. Weighting of skill strands is based on individual learner performance in each strand during a session. Adjustment of the number of examples is presented for each strand and patterns of responses for each strand are tracked and evaluated for mastery.

Online Student Resources

Both lessons courses and strands courses provide for a wide range of resources for the learner to use during a session to enhance the learning experience. All resources are not necessarily available during a session based on lesson content and the type of lesson being presented. These resource options include the following:

- Help. The Help resource correctly completes the current exercise for the student.
- Back and Forward. This resource allows a learner to move back and forth through the material.
- Tools. Tools supplies learners with rulers, protractors, a tape measure, and calculator.
- Report. The online student report informs learners of both session and lesson scores.
- Glossary. The Glossary tool includes illustrated definitions for all essential terms.

Appendix D

Study Database

Raw Scores for Teachers Completing SoCQ Questionnaire for CCC Innovation Field Test

	STAGE																																		
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
FS-1	2	1	1	4	1	4	0	0	3	0	1	3	0	0	0	7	0	0	3	1	0	3	0	4	1	1	3	1	0	2	1	1	0	0	0
FS-2	6	4	3	3	1	5	6	6	3	4	6	4	6	2	3	6	3	0	4	2	5	2	3	2	6	3	4	5	4	5	2	2	3	4	4
FS-3	6	1	1	2	2	2	4	2	4	2	6	2	5	0	0	2	0	2	6	5	2	4	0	5	2	4	4	0	4	1	6	6	0	2	0
FS-4	1	1	1	5	3	1	2	3	1	1	5	3	0	1	1	1	2	2	4	1	4	5	0	3	4	6	3	2	2	4	1	2	4	5	5
FS-5	2	1	1	1	3	1	0	0	0	0	7	1	4	0	0	1	0	0	0	1	0	0	0	7	0	4	0	0	4	1	0	5	0	1	0
FS-6	6	2	2	7	1	4	7	0	5	4	6	2	5	4	4	7	5	2	7	5	3	5	0	6	6	5	4	4	4	0	5	5	4	5	4
FS-7	1	4	1	3	6	1	0	1	2	3	4	1	7	7	7	1	0	4	4	4	1	4	0	5	3	3	5	5	5	1	6	5	5	2	5
FS-8	1	1	2	4	1	6	1	2	3	3	2	3	2	2	6	6	2	1	2	1	5	2	3	5	6	5	2	4	2	4	2	2	2	2	6
FS-9	2	2	2	6	2	3	1	3	1	2	6	2	5	2	5	2	2	1	2	4	3	3	0	3	4	2	3	3	4	4	3	6	0	3	0
FS-10	4	4	2	3	2	6	6	5	5	5	5	1	7	5	7	7	7	6	6	4	5	5	5	5	6	6	6	7	6	4	4	5	6	2	7
FS-11	1	1	1	3	1	2	3	3	3	2	3	2	5	4	4	4	4	1	3	2	3	3	3	4	3	5	5	5	5	2	4	2	3	3	5
FS-12	0	2	2	0	0	4	5	4	6	4	5	0	4	4	6	4	0	2	2	2	6	4	2	5	2	5	5	5	6	5	6	5	6	5	7
FS-13	1	4	1	4	1	4	0	1	3	1	4	1	1	1	3	4	0	1	0	3	1	3	1	5	2	3	3	1	4	1	4	3	3	2	3
FS-14	3	1	5	4	1	7	7	1	2	2	4	4	7	4	4	7	4	1	3	6	6	7	7	7	5	7	4	5	7	4	3	6	7	7	6
FS-15	4	1	1	4	1	5	3	3	2	6	6	2	3	3	5	4	5	2	4	2	4	7	0	0	3	6	6	4	4	2	4	4	6	0	6
FS-16	1	1	7	1	1	7	1	1	1	1	1	7	7	4	7	1	0	1	7	1	7	1	7	0	0	4	4	4	4	2	1	0	4	0	4
FS-17	7	1	5	6	1	6	0	2	5	3	6	0	1	4	6	3	1	2	1	3	5	0	7	2	4	6	2	4	5	3	6	2	1	1	5
FS-18	6	7	0	7	4	7	2	4	6	6	7	0	7	2	0	4	0	0	4	7	6	7	0	7	5	5	6	4	7	0	7	6	4	4	0
FS-19	0	4	2	0	0	2	5	2	2	6	2	0	5	7	7	4	4	3	2	6	4	4	3	5	2	4	4	4	4	1	6	5	0	3	7
FS-20	7	4	1	1	1	4	7	0	7	1	7	1	7	7	7	7	5	4	7	2	7	5	4	7	7	5	2	5	2	3	4	0	7	7	7
FS-21	4	0	1	1	4	4	0	2	3	4	6	3	6	3	5	3	3	3	5	3	1	7	4	6	2	5	5	6	6	1	3	5	6	0	6
FS-22	3	2	6	1	1	6	1	1	0	1	1	1	1	1	1	1	1	1	1	1	7	0	5	0	0	0	1	1	1	7	1	1	1	0	1
FS-23	6	4	1	3	2	3	3	3	4	5	7	2	5	4	4	4	2	2	5	2	4	5	5	5	3	4	4	4	6	2	6	6	6	3	6
FS-24	4	2	4	4	2	4	3	3	4	2	3	4	4	4	5	5	5	3	4	0	4	0	4	4	3	4	3	3	5	3	0	2	4	5	4
FS-25	3	5	1	1	1	3	1	1	2	3	4	1	4	3	0	3	0	0	4	4	0	4	4	4	2	3	5	4	6	1	6	5	2	0	6
FS-26	5	4	4	6	4	4	5	5	4	4	4	4	4	2	5	3	4	4	5	4	5	4	5	4	0	4	3	4	5	3	3	3	4	3	4
FS-27	4	1	1	7	1	1	3	4	4	3	2	7	3	2	4	6	4	2	6	4	6	3	4	3	5	6	4	5	3	3	2	1	2	3	2
FS-28	4	4	1	2	3	3	1	1	1	1	4	0	1	0	0	3	0	0	3	3	1	6	1	7	0	0	0	2	2	1	7	7	1	1	1
FS-29	0	0	1	0	1	7	7	5	6	6	7	0	7	6	6	7	1	1	0	0	3	0	0	0	3	6	0	6	6	0	6	5	0	0	7
FS-30	0	1	1	7	1	3	7	4	1	1	4	7	0	1	4	7	7	1	1	1	7	1	1	1	7	4	1	7	1	7	1	1	7	7	7
FS-31	5	1	0	3	1	6	3	1	1	1	5	3	3	3	1	6	1	1	5	1	0	4	0	4	0	1	1	4	4	0	1	0	3	0	1
FS-31	3	3	1	7	1	5	1	1	1	1	7	1	6	3	6	7	2	1	6	0	5	5	6	6	3	7	5	6	5	2	5	4	6	2	5
FS-32	4	4	4	7	4	6	6	6	2	4	7	5	4	4	6	7	6	3	5	7	4	6	5	6	2	6	6	6	6	2	6	6	5	4	7

Ratings for Teachers Responding to the Innovation Configuration Matrix Field Test

Scorer 1

	ICM ITEM NUMBER															
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
FI-1	1	1	3	2	1	3	2	3	4	1	3	5	1	4	3	2
FI-2	1	1	1	2	1	2	3	2	2	3	3	5	1	2	3	2
FI-3	1	1	1	1	1	2	1	2	2	3	3	2	1	2	3	2
FI-4	1	1	1	1	3	2	1	2	2	1	3	2	1	2	2	1
FI-5	1	1	4	2	1	1	2	3	1	2	3	2	1	2	5	2
FI-6	1	1	3	2	1	3	3	3	1	2	4	5	1	3	4	2
FI-7	1	2	3	2	1	3	3	3	2	3	3	5	1	3	4	2
FI-8	1	1	2	2	3	2	2	2	1	1	4	2	1	2	4	2

Scorer 2

	ICM ITEM NUMBER															
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
FI-1	1	1	3	2	1	4	2	3	4	1	3	5	1	4	3	2
FI-2	1	1	1	2	1	2	2	2	1	2	3	5	1	2	3	2
FI-3	1	1	3	1	1	2	2	2	2	3	3	2	1	2	3	2
FI-4	1	1	1	1	2	1	1	3	1	1	3	2	1	2	2	1
FI-5	1	1	3	1	1	1	2	3	1	2	3	4	1	2	4	2
FI-6	1	1	3	1	1	2	2	3	1	3	3	5	1	3	5	2
FI-7	1	2	3	2	1	3	3	3	2	5	3	5	1	3	3	2
FI-8	1	1	1	2	3	2	2	3	1	2	3	5	1	2	5	2

Descriptive Data for Teachers Completing SoCQ Questionnaire for CCC Innovation

ID	School	Sex	Age	Highest Degree	Years Teaching	Years Use	CCC Rate	Selected for ICM
1	East	F	40	B	11	2	NOV	
2	North	F	40	B	20	2	NOV	✓
3	South	F	30	B	10	1	NOV	
4	South	F	60	B	35	1	NOV	
5	East	F	50	B	20	3	NOV	
6	North	F	40	M	12	2	INT	✓
7	South	F	20	B	3	1	NOV	
8	North	F	50	B	26	1	INT	
9	East	F	40	B	14	1	INT	
10	North	F	40	M	20	4	INT	
11	West	F	30	M	11	1	INT	✓
12	North	F	40	M	13	1	NOV	✓
13	North	F	40	M	24	1	INT	✓
14	East	F	30	B	10	2	INT	
15	South	F	50	B	24	2	INT	
16	South	F	40	B	20	2	NOV	✓
17	North	F	40	B	20	1	NOV	
18	East	F	20	B	1	0	NOV	✓
19	South	F	50	B	22	1	INT	✓
20	East	F	40	B	10	3	INT	✓
21	South	M	20	3	3	1	NOV	
22	East	F	30	M	2	2	NOV	✓
23	North	F	30	B	10	1	INT	
24	East	F	20	B	2	1	NOV	
25	East	F	40	M	9	2	INT	
26	North	F	20	B	6	1	NOV	✓
27	North	F	20	B	1	1	NOV	
28	East	F	20	M	4	0	INT	
29	North	F	40	M	26	1	NOV	
30	North	F	40	M	26	2	INT	
31	North	F	50	M	21	1	NOV	✓
32	East	F	20	B	3	2	NOV	
33	East	F	30	M	16	2	NOV	
34	East	M	20	B	1	0	NOV	
35	North	F	40	B	3	1	NOV	
36	North	M	40	B	20	1	NOV	
37	South	F	40	B	13	1	INT	✓
38	East	F	40	B	23	2	NOV	✓
39	North	F	30	M	10	1	INT	

ID	School	Sex	Age	Highest Degree	Years Teaching	Years Use	CCC Rate	Selected for ICM
40	West	F	20	B	1	0	NOV	✓
41	East	F	30	B	4	2	NOV	
42	South	F	20	M	6	1	EXP	✓
43	East	F	50	M	15	3	NOV	✓
44	East	F	20	B	4	3	INT	✓
45	South	F	20	B	7	1	NOV	✓
46	West	F	20	B	7	2	NOV	
47	East	F	20	B	2	1	NOV	✓
48	South	F	20	B	5	1	NOV	✓
49	East	F	20	B	1	0	NOV	✓
50	North	F	50	B	16	2	NOV	✓
51	West	F	50	M	32	1	NOV	
52	South	F	20	B	3	1	NOV	✓
53	West	F	20	B	5	1	NOV	
54	South	F	40	M	7	1	INT	
55	West	F	20	B	1	0	NOV	✓
56	North	F	20	B	4	1	INT	✓
57	South	F	20	B	1	0	NON	
58	North	F	40	B	23	1	NOV	
59	East	F	40	M	14	0	NOV	✓
60	South	F	20	B	5	1	INT	✓
61	South	F	40	B	22	0	NON	
62	North	F	50	M	25	1	INT	
63	North	F	50	M	21	1	NOV	
64	South	F	20	B	5	2	NOV	✓
65	East	F	50	B	22	2	INT	

Raw Scores for Teachers Completing SoCQ Questionnaire for CCC Innovation

	STAGE																																		
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
1	1	2	1	4	3	4	1	1	1	6	6	0	6	6	0	4	6	4	6	2	4	7	4	6	3	5	7	3	5	1	4	4	4	1	2
2	0	0	0	3	0	3	0	3	0	0	1	4	0	0	0	3	0	0	0	0	0	0	0	3	0	4	3	3	0	0	0	0	0	0	0
3	7	1	0	5	4	4	4	4	5	1	5	5	5	5	5	6	4	1	4	2	6	4	4	6	6	5	4	4	4	5	5	4	5	6	6
4	3	2	0	4	0	2	4	5	4	1	6	1	6	3	6	5	6	4	5	2	2	4	4	4	5	6	5	6	6	2	3	3	6	7	7
5	4	1	1	4	1	3	0	0	4	1	3	0	4	0	0	3	0	0	3	0	0	3	0	3	0	3	3	0	3	0	0	0	3	0	0
6	5	2	1	2	2	2	2	2	2	2	3	2	1	1	1	1	1	2	7	3	0	4	1	5	1	1	3	1	2	0	4	2	2	2	2
7	1	0	1	0	0	7	0	0	1	5	0	0	6	0	0	3	0	4	0	4	2	7	0	4	0	4	0	4	4	0	0	0	3	0	4
8	1	1	1	7	1	2	0	0	1	0	7	5	7	1	1	3	1	1	2	1	5	2	3	6	1	4	1	6	3	6	1	1	5	1	5
9	3	4	1	4	4	1	2	1	2	3	2	7	4	3	3	1	2	2	2	4	7	2	0	3	1	3	3	2	3	1	3	2	1	2	0
10	3	1	1	1	0	4	1	1	5	1	2	1	7	0	0	1	0	0	1	1	1	5	0	5	1	7	1	4	0	1	3	1	0	0	1
11	2	3	3	6	1	3	0	3	0	1	4	5	3	3	5	2	0	1	2	0	7	1	2	3	0	4	2	4	4	6	3	6	5	0	4
12	7	1	1	7	1	5	1	2	1	1	7	1	1	3	2	5	1	1	4	1	7	1	3	7	1	1	1	1	1	5	1	1	1	2	3
13	1	1	1	1	7	3	3	1	1	7	1	7	1	7	7	3	1	7	1	1	1	1	1	7	1	1	7	1	3	1	1	3	1	1	3
14	7	1	1	1	1	2	1	1	1	1	7	1	1	1	1	1	1	1	7	1	7	1	1	7	1	7	1	1	4	1	7	5	1	1	1
15	1	1	7	0	1	7	1	1	1	1	1	0	3	1	1	7	7	1	1	1	4	3	1	2	4	4	2	2	3	4	1	1	4	4	4
16	1	1	0	0	0	2	0	0	1	2	6	0	7	0	3	2	0	0	4	2	0	4	0	6	3	7	6	4	3	0	6	4	4	1	1
17	7	4	1	4	4	3	4	4	2	6	7	1	6	7	7	6	7	4	6	1	2	2	6	7	7	7	7	7	6	1	7	6	6	1	7
18	7	1	0	4	1	0	0	0	5	3	7	3	0	0	7	2	3	1	3	4	4	6	0	7	5	0	4	3	7	0	7	7	0	3	0
19	6	4	1	5	5	2	3	3	3	4	6	1	7	4	7	6	6	5	6	4	5	5	2	6	6	6	6	6	6	1	6	4	6	4	6
20	5	1	1	6	1	5	5	5	1	1	5	5	5	1	0	0	0	0	5	0	4	1	0	1	4	0	0	0	1	0	1	1	0	1	0
21	2	4	3	5	2	6	5	4	4	4	6	3	4	3	6	5	3	4	3	2	3	6	3	7	5	5	3	3	5	3	2	3	2	3	6
22	1	5	6	7	4	4	4	7	4	4	5	4	7	4	0	7	0	1	7	4	5	5	2	7	5	3	4	4	2	4	2	5	0	6	0
23	6	1	1	0	1	1	0	0	3	0	7	1	3	1	1	1	0	1	0	6	0	7	1	3	0	1	1	1	1	3	3	1	1	0	3
24	1	2	1	6	2	4	4	4	4	4	6	2	4	5	0	0	1	1	6	2	5	6	0	5	4	6	6	6	6	1	6	6	6	1	0
25	5	2	1	1	1	2	0	0	1	0	5	1	2	0	0	1	1	1	1	1	1	2	1	5	1	1	5	1	2	1	5	4	1	1	0
26	2	2	0	2	1	2	0	3	1	1	3	1	1	1	1	1	0	1	3	3	7	3	0	3	2	4	2	0	1	2	2	2	0	3	2
27	6	0	0	0	3	5	0	0	0	6	7	0	3	5	5	0	5	5	7	0	0	0	6	7	0	5	7	7	7	0	3	0	7	0	7
28	2	1	1	0	0	4	0	0	0	0	3	2	0	0	0	0	0	0	1	0	0	0	0	7	0	3	3	1	0	0	3	4	0	0	0
29	5	1	0	2	0	3	1	1	4	0	5	0	4	0	0	1	1	2	4	2	7	4	0	4	2	2	4	0	0	0	4	0	0	2	2
30	1	1	1	4	1	4	0	3	3	1	3	0	7	4	0	3	1	1	0	1	4	0	3	0	4	3	1	0	4	0	3	0	0	3	0
31	1	1	1	7	1	3	4	6	6	2	6	2	7	1	3	7	3	2	3	1	3	6	2	7	4	7	6	7	6	1	2	1	5	5	7
32	4	2	0	5	0	3	5	5	5	1	7	0	5	5	5	7	6	1	7	5	5	5	4	6	7	6	2	5	2	2	2	5	5	4	6
33	5	1	2	2	1	3	5	3	3	1	6	5	6	3	6	5	0	2	4	4	4	5	3	6	4	6	4	6	5	2	3	6	6	4	6
34	6	1	1	4	4	4	5	4	4	5	6	4	7	5	5	4	7	6	4	2	6	3	4	4	4	4	5	6	6	4	4	6	4	4	6
35	6	2	4	5	1	3	1	4	2	5	6	6	5	5	6	5	2	2	4	2	0	5	5	6	2	5	4	4	0	1	5	5	4	0	5
36	6	6	1	6	1	7	4	5	5	2	7	1	6	3	6	7	5	1	5	4	3	4	6	6	6	6	5	6	6	4	6	3	6	5	6
37	2	1	1	2	1	3	2	2	3	2	2	3	2	2	3	3	2	2	7	2	3	2	0	7	3	3	3	3	3	2	3	2	3	0	0
38	7	3	0	3	1	3	1	1	4	1	4	1	3	3	1	4	4	3	4	1	3	5	3	7	6	6	6	4	4	0	4	4	3	2	5
39	1	1	1	6	1	1	3	3	1	3	6	1	7	2	6	5	5	1	2	1	6	6	3	6	5	7	1	6	6	3	5	4	7	7	7
40	4	6	3	6	1	6	3	1	1	5	5	2	4	4	6	3	2	2	4	4	6	3	4	4	4	4	1	2	5	3	4	4	4	4	4
41	3	2	1	1	1	3	0	0	0	1	1	7	0	0	0	1	0	1	1	1	5	1	1	6	3	1	4	0	1	0	0	0	0	0	0
42	1	1	1	1	7	1	1	1	1	4	1	7	1	0	0	1	0	1	1	1	1	1	0	7	1	0	7	0	1	0	1	1	0	1	1
43	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	7	7	0	4	0	0	0	0	0	0
44	7	3	0	5	1	1	4	1	1	1	7	1	7	6	7	2	1	0	7	6	1	7	0	7	7	6	6	4	4	1	5	6	3	0	7
45	7	7	5	7	4	5	3	4	6	7	7	0	6	6	6	6	6	6	7	4	2	5	6	6	3	6	6	6	3	2	2	6	5	3	4
46	4	4	1	5	3	2	3	3	4	4	4	4	3	2	2	3	3	3	3	5	1	4	2	3	4	5	4	3	3	1	4	5	3	3	4
47	6	1	3	1	2	6	3	3	2	3	6	1	3	3	5	7	3	2	4	1	3	5	4	5	2	4	2	3	5	2	3	5	6	3	6
48	6	3	3	7	0	7	7	7	7	0	7	7	7	7	7	7	7	7	7	0	4	4	4	4	7	7	2	1	1	3	1	2	3	0	7
49	6	2	1	3	1	3	0	0	5	3	6	2	0	0	0	0	0	1	7	3	4	7	0	7	2	0	4	4	6	0	6	7	0	0	0
50	1	1	1	1	3	3	3	4	4	3	5	1	6	3	4	6	0	0	4	0	0	5	0	3	3	5	5	5	5	2	4	2	2	5	2

	STAGE																																		
ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**
51	3	1	1	6	1	4	4	3	4	4	4	1	4	4	5	6	4	1	6	2	4	2	3	5	5	5	5	5	5	1	4	3	5	3	5
52	1	3	0	3	0	3	0	0	0	0	1	4	0	2	5	4	0	1	1	1	3	5	0	6	4	4	4	5	5	1	3	3	4	3	5
53	2	3	1	3	1	3	1	1	2	0	4	3	0	0	4	3	0	1	6	3	4	7	4	6	4	3	2	4	1	3	3	0	2	6	4
54	6	2	0	7	7	1	7	4	5	6	7	0	6	0	0	5	5	6	5	5	1	5	0	6	7	7	7	6	6	0	7	7	0	7	0
55	6	2	2	6	3	3	5	5	3	3	7	2	3	0	0	3	0	0	0	0	4	2	0	5	2	0	3	0	6	0	5	5	0	0	0
56	3	0	1	6	2	4	0	0	0	3	7	3	6	6	6	4	0	1	5	1	6	5	1	4	1	4	1	1	1	0	1	7	1	1	4
57	3	1	0	1	3	7	6	1	3	3	7	2	6	6	6	3	6	3	4	2	0	4	6	6	2	6	5	6	5	1	4	3	5	3	5
58	5	3	1	6	2	3	4	5	4	4	5	1	3	4	3	3	3	5	2	2	5	4	2	3	6	5	5	4	4	2	2	2	3	1	4
59	6	6	0	5	4	3	4	5	5	6	6	2	5	6	6	3	5	4	5	6	4	6	1	6	3	5	5	5	6	2	6	6	5	3	0
60	3	1	1	3	2	4	2	2	3	2	3	1	1	0	0	3	2	1	2	1	3	1	3	5	3	3	2	2	5	2	3	2	0	0	0
61	7	7	3	5	3	2	6	6	6	4	6	6	7	4	6	6	5	5	4	0	4	5	5	6	6	6	5	6	6	3	3	4	5	5	7
62	1	1	1	7	1	2	0	0	1	0	7	5	7	1	1	3	1	1	1	1	4	2	3	6	1	6	1	6	3	6	1	1	6	1	7
63	2	2	2	2	1	4	4	3	2	2	3	3	3	3	5	4	4	2	4	2	5	2	3	4	4	4	2	3	5	3	2	4	5	3	4
64	1	1	0	7	1	3	0	2	2	0	4	3	2	2	6	6	4	1	7	4	5	6	3	4	5	4	3	5	5	1	4	7	4	5	5
65	7	1	0	2	1	2	1	1	1	1	7	2	7	2	2	2	2	2	2	2	5	2	2	2	7	3	3	3	2	7	2	2	7	2	2

Stage Scores for Teachers Completing SoCQ Questionnaire for CCC Innovation

			Level of Intensity for Stages of Concern							
School	ID	Dimension	0	1	2	3	4	5	6	Total
West	11	Self	99	69	48	39	21	12	14	42
West	23	Impact	60	34	25	5	21	4	65	9
West	26	Self	81	43	12	39	11	7	26	12
West	29	Impact	66	34	28	27	24	7	42	12
West	30	Task	72	45	35	65	2	10	17	12
West	31	Task	77	75	87	97	24	36	47	77
West	40	Self	96	88	57	69	33	25	57	75
West	46	Impact	77	57	57	69	27	36	69	60
West	51	Task	81	84	78	85	33	31	34	75
West	53	Task	93	54	31	65	24	5	57	39
West	55	Task	72	19	35	60	43	28	30	30
North	2	Self	46	34	17	30	2	3	1	3
North	6	Impact	46	34	31	27	38	16	42	18
North	8	Self	98	51	70	43	21	7	11	39
North	10	Self	46	48	48	11	9	3	42	12
North	12	Task	95	54	25	65	59	5	9	33
North	13	Impact	84	75	31	23	11	91	9	39
North	17	Self	84	98	94	83	90	76	47	95
North	27	Impact	60	93	78	2	63	80	5	60
North	35	Self	94	88	59	60	63	19	47	71
North	36	Task	93	95	89	97	63	28	84	95
North	39	Task	91	84	91	92	27	19	38	77
North	50	Task	46	63	59	73	16	31	38	45
North	56	Self	84	88	35	43	59	10	14	42
North	58	Task	84	69	63	80	21	48	42	66
North	62	Self	97	63	72	43	19	7	11	42
North	63	Self	94	72	70	60	21	19	22	54
South	3	Task	98	90	78	94	59	25	52	89
South	4	Task	77	88	91	92	33	31	42	80
South	7	Self	37	57	52	9	3	22	30	12
South	15	Self	94	63	63	60	3	10	14	33
South	16	Self	10	51	57	18	33	16	38	24
South	19	Self	81	90	91	88	66	72	73	95
South	21	Self	93	91	63	83	33	40	57	80
South	37	Self	77	45	48	34	30	16	26	30
South	42	Impact	77	16	14	15	8	48	9	6

			Level of Intensity for Stages of Concern							
School	**ID**	**Dimension**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Total**
South	45	Self	93	93	87	85	90	72	81	98
South	48	Self	98	99	85	95	59	14	42	92
South	52	Self	72	69	39	52	9	14	30	30
South	54	Impact	23	37	83	97	82	93	81	86
South	57	Self	77	97	92	34	43	44	38	77
South	60	Task	81	34	31	39	16	19	20	15
South	61	Task	98	90	92	95	63	59	69	98
South	64	Task	86	72	57	90	43	14	52	66
East	64	Self	81	63	72	47	43	68	47	69
East	5	Self	23	30	31	23	11	10	17	6
East	9	Self	94	43	45	30	9	28	42	33
East	14	Impact	84	48	25	15	90	10	26	30
East	18	Impact	66	34	28	52	82	31	77	48
East	20	Task	81	30	41	60	21	3	6	12
East	22	Task	98	45	57	98	54	28	65	80
East	24	Self	77	57	76	56	48	44	65	69
East	25	Impact	53	19	25	11	30	12	26	9
East	28	Self	37	34	12	2	21	3	6	3
East	32	Task	84	90	87	95	71	7	60	83
East	33	Self	94	88	80	69	63	22	47	80
East	34	Self	97	88	92	77	59	72	38	92
East	38	Self	66	66	57	60	59	28	52	60
East	41	Self	91	23	5	15	8	10	6	6
East	43	Self	23	34	5	2	4	16	1	3
East	44	Impact	37	93	70	56	92	19	73	75
East	47	Self	89	88	67	60	59	25	30	69
East	49	Impact	66	19	21	15	90	28	77	36
East	59	Impact	77	72	83	73	71	68	94	89
East	65	Self	94	45	72	52	30	12	17	42

Ratings for Teachers Responding to the Innovation Configuration Matrix Scorer A

	ICM ITEM NUMBER															
ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOT
2	3	4	3	1	3	4	3	5	5	4	4	1	3	2	3	48
6	3	5	3	1	2	4	3	4	5	3	4	4	3	1	3	48
11	3	3	3	2	1	4	2	4	5	3	4	4	3	1	5	47
12	3	5	3	2	2	3	3	5	5	4	4	4	3	1	3	50
13	3	5	4	4	3	4	3	5	5	4	4	4	4	1	3	56
16	3	3	2	2	2	4	3	4	5	3	3	2	3	1	4	44
18	3	2	2	1	3	4	3	5	5	4	4	4	3	1	3	47
19	3	4	3	2	1	1	3	5	2	4	4	1	3	1	4	41
20	2	3	2	1	1	1	2	5	5	4	3	4	4	1	4	42
22	3	1	2	1	2	3	3	4	5	3	4	4	3	1	3	42
26	2	3	2	1	2	4	3	5	5	4	5	2	4	1	3	46
31	2	2	2	1	3	4	3	5	5	4	4	4	3	3	3	48
37	2	4	3	2	2	4	3	4	5	3	4	1	3	1	3	44
38	4	4	3	2	3	4	3	4	5	3	5	5	4	1	4	54
40	3	2	2	1	2	2	3	4	3	3	4	4	3	4	4	44
42	3	4	3	1	4	4	3	5	5	4	4	4	4	1	4	53
43	3	3	3	2	3	4	2	4	5	3	4	4	3	1	3	47
44	3	3	2	1	1	4	3	5	5	4	3	4	4	1	3	46
45	2	2	3	1	3	4	3	5	5	4	3	4	3	3	3	48
47	3	2	4	1	2	3	1	5	5	4	3	1	3	1	4	42
48	3	4	3	1	4	4	3	5	5	4	3	1	3	1	3	47
49	3	2	2	1	3	4	3	5	5	4	3	4	3	1	3	46
50	3	5	2	1	3	4	3	4	5	3	4	4	2	3	3	49
52	3	3	2	1	1	4	3	4	5	3	3	1	3	1	3	40
55	3	2	1	1	3	4	3	5	5	4	4	4	3	1	3	46
56	3	4	2	1	1	4	1	4	5	3	4	1	3	1	3	40
59	3	3	2	2	3	4	3	5	5	4	4	4	3	1	3	49
60	3	2	1	2	1	4	3	4	3	3	4	1	4	4	3	42
64	3	4	3	2	5	4	3	5	5	4	5	4	3	4	4	58

Ratings for Teachers Responding to the Innovation Configuration Matrix Scorer B

	ICM ITEM NUMBER															
ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOT
2	3	4	3	2	3	4	3	5	5	4	4	1	3	1	3	48
6	4	5	3	2	2	4	3	4	5	3	4	4	3	1	5	52
11	4	4	3	2	1	4	3	4	5	3	4	4	2	1	5	49
12	4	5	3	2	2	3	3	5	5	4	4	4	3	1	3	51
13	2	5	5	4	3	4	3	5	5	4	4	4	5	1	3	57
16	4	3	2	2	1	4	3	5	5	4	3	1	2	1	5	45
18	4	3	2	2	3	4	3	5	5	4	4	4	3	1	3	50
19	3	3	3	2	1	1	3	5	2	4	5	1	3	1	4	41
20	2	3	2	1	1	1	2	5	5	4	4	4	3	1	3	41
22	3	2	2	2	1	4	2	5	5	4	4	4	5	1	3	47
26	4	3	2	2	2	4	2	5	5	3	5	1	4	1	4	47
31	3	3	2	2	3	4	3	4	5	3	4	4	3	3	3	49
37	4	5	3	2	2	4	3	5	5	4	4	1	3	1	3	49
38	4	4	3	2	2	4	2	5	5	4	5	5	5	2	3	55
40	3	2	2	2	3	4	3	5	3	4	4	4	3	3	3	48
42	4	4	2	1	4	4	2	5	5	4	4	4	3	1	5	52
43	2	3	2	2	4	4	4	5	5	4	4	4	3	1	3	50
44	4	3	4	2	1	2	2	5	5	4	5	4	5	1	3	50
45	2	3	2	1	3	4	3	5	5	4	3	4	4	4	5	52
47	3	2	2	2	2	3	1	5	5	4	3	1	2	1	3	39
48	3	4	3	1	3	4	3	5	5	4	3	2	3	1	3	47
49	2	2	2	1	3	4	3	5	5	4	5	4	5	1	3	49
50	4	4	2	2	3	4	3	4	5	3	5	4	3	3	3	52
52	3	3	2	2	1	4	3	4	5	3	3	1	3	1	3	41
55	4	2	2	2	2	4	3	5	5	4	4	4	3	1	3	48
56	3	4	2	1	1	4	1	4	5	3	4	1	3	1	3	40
59	3	3	2	2	3	3	3	5	5	4	4	4	3	1	3	48
60	4	2	2	5	2	4	3	4	3	3	4	1	3	4	3	47
64	3	5	3	2	4	4	3	5	5	4	4	4	3	4	5	58

Ratings for Teachers Responding to the Innovation Configuration Matrix Scorer C

	ICM ITEM NUMBER															
ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOT
2	3	4	5	3	4	4	3	5	5	4	4	4	3	1	3	55
6	4	5	5	3	2	4	3	4	5	3	4	5	5	1	3	56
11	3	4	3	2	2	4	3	4	5	4	3	2	4	2	4	49
12	3	3	2	2	2	4	3	5	5	4	4	1	3	1	4	46
13	4	5	4	4	5	4	3	5	5	4	5	4	5	2	4	63
16	3	3	2	2	2	4	3	5	5	4	4	1	3	1	4	46
18	3	2	2	1	2	4	3	5	5	4	3	4	3	1	3	45
19	2	2	2	2	2	4	3	4	5	3	3	2	3	1	3	41
20	3	3	2	2	2	2	3	5	5	4	3	4	3	1	3	45
22	4	2	2	2	2	4	3	4	5	3	3	5	3	1	3	46
26	4	4	2	2	4	4	4	4	5	3	5	2	4	1	3	51
31	2	2	2	2	2	4	3	4	5	4	3	2	3	2	3	43
37	4	2	2	2	4	3	5	5	4	3	3	2	3	2	3	47
38	4	4	3	5	4	4	4	5	5	4	5	5	4	1	3	60
40	3	2	2	2	4	4	3	4	5	4	3	2	4	2	4	48
42	4	4	2	2	5	5	3	5	5	4	4	4	4	1	5	57
43	4	3	2	2	4	4	3	4	5	4	4	4	4	1	3	51
44	3	4	2	2	2	4	3	4	5	3	3	4	3	1	3	46
45	3	2	2	2	4	4	3	5	5	4	3	4	3	2	3	49
47	3	2	5	2	2	4	1	5	5	4	4	1	3	1	3	45
48	3	4	2	2	4	4	3	5	5	4	4	2	3	1	3	49
49	3	2	2	2	2	4	3	5	5	4	4	4	3	2	3	48
50	3	4	5	2	4	4	3	4	5	4	4	4	3	2	5	56
52	3	2	1	2	2	4	3	4	5	4	3	2	3	1	3	42
55	2	2	2	2	2	4	3	4	3	3	3	4	3	1	3	41
56	3	4	3	1	2	4	3	4	5	3	3	2	3	1	3	44
59	3	2	2	2	1	2	3	5	5	4	3	4	3	1	3	43
60	3	2	2	2	2	4	3	4	3	3	4	2	3	2	3	42
64	4	3	3	2	4	3	3	5	5	4	5	4	4	2	3	54

STUDENT ILS GAINS REPORT
Math Concepts and Skills

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
1	50	2	532	0.36	4.41
2	50	2	507	0.28	3.90
3	50	2	451	0.4	4.73
4	50	2	581	0.74	3.86
5	50	2	580	0.62	4.72
6	50	2	441	0.44	4.35
7	50	2	576	0.6	4.29
8	50	2	372	0.24	3.94
9	50	2	546	0.49	5.11
10	50	2	571	0.57	4.71
11	50	2	461	0.51	4.29
12	50	2	604	0.58	4.91
13	50	2	421	0.34	4.79
14	50	2	540	0.49	4.43
15	50	2	553	0.91	4.54
16	50	2	497	0.45	3.91
17	50	2	455	0.66	5.50
18	50	2	592	0.62	4.76
19	50	2	233	0.66	2.44
20	50	2	348	0.32	3.34
21	50	2	571	0.65	4.95
22	50	2	596	0.47	3.73
23	50	2	555	0.51	3.82
24	50	2	279	0.39	4.40
25	12	3	580	0.41	3.17
26	12	3	611	0.59	2.54
27	12	3	635	0.77	3.00
28	12	3	583	0.26	2.38
29	12	3	595	0.95	3.71
30	12	3	611	0.72	3.47
31	12	3	457	0.43	2.39
32	12	3	519	0.51	3.56
33	12	3	530	0.48	2.80
34	12	3	534	0.49	2.79
35	12	3	496	0.58	3.81
36	12	3	552	0.35	2.80
37	12	3	616	0.81	3.52
38	12	3	659	1.01	3.32
39	12	3	576	0.64	3.34
40	12	3	497	0.29	3.79
41	12	3	529	0.38	3.38

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
42	12	3	443	0.33	3.83
43	12	3	582	0.37	3.72
44	12	3	587	0.71	2.64
45	12	3	582	0.39	2.76
46	12	3	609	0.94	3.77
47	12	3	355	0.65	3.45
48	2	2	521	0.48	3.77
49	2	2	425	0.48	4.53
50	2	2	511	0.37	3.71
51	2	2	417	0.46	4.07
52	2	2	456	0.47	3.97
53	2	2	438	0.34	3.09
54	2	2	494	0.21	2.46
55	2	2	512	0.29	3.68
56	2	2	383	0.28	4.12
57	2	2	278	0.11	2.62
58	2	2	483	0.44	4.39
59	2	2	466	0.25	3.89
60	2	2	512	0.54	4.55
61	2	2	391	0.31	3.93
62	2	2	343	0.26	4.39
63	2	2	64	0.01	3.73
64	2	2	482	0.36	3.71
65	2	2	479	0.8	3.72
66	2	2	489	0.3	2.91
67	2	2	422	0.26	4.00
68	2	2	391	0.19	4.09
69	6	2	648	0.62	3.91
70	6	2	642	0.48	4.40
71	6	2	739	0.62	4.13
72	6	2	811	0.77	4.00
73	6	2	756	0.37	3.14
74	6	2	754	0.98	3.95
75	6	2	692	0.91	4.02
76	6	2	821	0.9	4.00
77	6	2	734	0.94	3.90
78	6	2	748	0.57	3.91
79	6	2	699	0.63	3.96
80	6	2	703	0.65	4.16
81	6	2	894	0.91	3.33
82	6	2	647	0.66	4.60
83	6	2	687	0.46	3.98
84	6	2	710	0.61	2.61
85	6	2	584	0.5	4.24
86	6	2	552	0.23	2.63

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
87	6	2	71	0.05	2.36
88	6	2	786	0.89	3.90
89	6	2	182	0.17	2.19
90	13	2	530	0.56	4.38
91	13	2	534	0.63	4.13
92	13	2	184	0.23	5.23
93	13	2	432	0.36	4.79
94	13	2	424	0.54	4.85
95	13	2	544	0.65	4.76
96	13	2	605	0.6	4.65
97	13	2	557	0.32	3.82
98	13	2	561	0.53	4.76
99	13	2	511	0.5	4.60
100	13	2	516	0.81	5.63
101	13	2	43	0.04	4.34
102	13	2	356	0.25	4.38
103	13	2	492	0.43	5.20
104	13	2	559	0.5	4.51
105	13	2	555	0.47	4.80
106	13	2	432	0.42	4.52
107	13	2	467	0.29	3.98
108	13	2	555	0.55	4.64
109	13	2	425	0.24	3.89
110	13	2	506	0.31	4.55
111	13	2	389	0.28	4.42
112	13	2	533	0.32	4.46
113	13	2	519	0.85	3.81
114	56	1	534	0.39	2.59
115	56	1	451	0.66	2.08
116	56	1	482	0.5	2.19
117	56	1	483	0.7	1.81
118	56	1	509	0.91	2.59
119	56	1	441	0.94	1.39
120	56	1	557	0.91	1.54
121	56	1	297	0.42	1.11
122	56	1	399	0.36	2.30
123	56	1	584	1.24	2.40
124	56	1	483	0.37	2.09
125	56	1	591	0.4	2.61
126	56	1	530	0.65	1.29
127	56	1	394	0.42	2.07
128	56	1	545	0.45	2.11
129	56	1	341	0.34	1.48
130	56	1	272	0.55	0.85
131	56	1	349	0.57	1.55

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
132	56	1	532	0.59	1.73
133	56	1	542	0.64	1.76
134	56	1	536	0.51	1.65
135	48	1	466	0.26	2.32
136	48	1	463	0.19	2.45
137	48	1	501	0.57	1.86
138	48	1	409	0.29	2.50
139	48	1	482	0.49	2.15
140	48	1	362	0.33	2.02
141	48	1	550	0.72	3.48
142	48	1	604	0.6	2.57
143	48	1	581	0.63	2.14
144	48	1	485	0.23	2.55
145	48	1	549	0.62	1.56
146	48	1	432	0.26	2.72
147	48	1	354	0.29	2.93
148	48	1	553	0.28	2.28
149	48	1	391	0.29	3.72
150	48	1	435	0.35	1.77
151	48	1	441	0.7	1.37
152	48	1	366	0.1	2.85
153	48	1	399	0.51	1.33
154	48	1	47	0.05	3.09
155	16	1	146	0.09	3.89
156	16	1	135	0.1	3.61
157	16	1	601	0.28	3.62
158	16	1	538	0.48	4.16
159	16	1	527	0.54	3.26
160	16	1	685	0.85	2.58
161	16	1	702	0.95	4.61
162	16	1	379	0.38	4.08
163	16	1	638	0.63	3.93
164	16	1	683	0.59	4.60
165	16	1	707	0.57	2.73
166	16	1	622	0.38	2.36
167	16	1	591	0.35	3.85
168	16	1	616	0.36	3.67
169	16	1	298	0.29	2.55
170	16	1	626	0.98	3.93
171	16	1	648	0.5	2.54
172	16	1	677	0.52	4.03
173	16	1	779	0.59	2.62
174	16	1	670	0.6	2.62
175	16	1	599	0.36	2.38
176	16	1	254	0.21	4.23

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
177	19	1	1007	1.28	4.19
178	19	1	909	0.47	2.59
179	19	1	909	0.48	3.47
180	19	1	1002	1.28	3.41
181	19	1	1072	0.67	2.89
182	19	1	1077	0.78	3.81
183	19	1	1033	0.76	4.02
184	19	1	903	0.68	3.40
185	19	1	1130	0.63	2.65
186	19	1	979	0.35	2.55
187	19	1	901	0.48	4.20
188	19	1	784	0.79	4.08
189	19	1	839	0.58	2.53
190	19	1	863	0.66	4.27
191	19	1	786	0.69	3.35
192	19	1	967	0.81	4.16
193	19	1	1016	0.83	3.59
194	19	1	933	0.97	3.77
195	19	1	1064	0.36	2.87
196	19	1	686	0.39	2.61
197	19	1	389	0.16	3.42
198	37	1	467	0.56	1.50
199	37	1	283	0.38	1.48
200	37	1	586	1.37	2.04
201	37	1	315	0.6	1.73
202	37	1	407	1.06	1.73
203	37	1	279	0.36	0.37
204	37	1	348	0.46	1.62
205	37	1	414	0.72	0.83
206	37	1	551	0.72	1.85
207	37	1	441	0.63	1.84
208	37	1	466	1	1.11
209	37	1	347	0.69	1.85
210	37	1	279	0.36	0.86
211	37	1	446	0.65	1.56
212	37	1	347	0.29	1.50
213	37	1	394	0.31	2.00
214	37	1	510	0.49	1.89
215	37	1	472	0.48	1.48
216	37	1	391	0.39	1.52
217	37	1	289	0.19	1.61
218	37	1	163	0.19	1.01
219	37	1	160	0.09	2.01
220	37	1	194	0.21	1.71
221	42	2	138	0.12	4.12

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
222	42	2	201	0.12	3.62
223	42	2	335	0.3	3.33
224	42	2	31	0.08	4.58
225	42	2	410	0.26	4.09
226	42	2	154	0.05	3.48
227	42	2	199	0.11	3.85
228	42	2	471	0.35	4.57
229	42	2	169	0.14	4.15
230	42	2	79	0.01	2.76
231	42	2	84	0.04	2.57
232	42	2	48	0.04	4.32
233	42	2	13	0.04	3.89
234	42	2	258	0.2	3.82
235	42	2	414	0.2	4.01
236	42	2	26	0.03	3.37
237	42	2	152	0.08	3.78
238	42	2	438	0.44	4.36
239	42	2	389	0.3	4.32
240	42	2	330	0.23	3.97
241	42	2	417	0.19	4.02
242	42	2	299	0.2	2.22
243	42	2	400	0.23	4.03
244	42	2	80	0.07	3.97
245	42	2	262	0.16	2.18
246	42	2	289	0.27	3.78
247	42	2	188	0.18	1.79
248	45	3	573	1.28	6.48
249	45	3	425	0.64	5.75
250	45	3	600	0.52	5.23
251	45	3	554	0.45	4.70
252	45	3	449	0.29	4.49
253	45	3	570	0.5	4.60
254	45	3	416	0.8	7.33
255	45	3	523	0.42	4.24
256	45	3	378	0.52	5.57
257	45	3	491	0.53	4.62
258	45	3	446	0.4	4.50
259	45	3	523	0.41	4.72
260	45	3	524	0.55	3.35
261	45	3	786	0.75	5.05
262	45	3	520	0.36	4.27
263	45	3	596	0.63	4.43
264	45	3	547	0.23	4.24
265	45	3	517	0.37	4.88
266	45	3	261	0.29	3.31

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
267	52	1	801	0.65	4.33
268	52	1	726	1:19	2.37
269	52	1	676	0.77	0.85
270	52	1	702	1.16	1.28
271	52	1	536	0.68	1.13
272	52	1	271	0.24	1.17
273	52	1	752	0.61	2.76
274	52	1	731	1.13	2.29
275	52	1	743	1.7	2.12
276	52	1	643	1.1	1.77
277	52	1	624	1.35	1.77
278	52	1	704	0.78	2.19
279	52	1	686	0.74	1.66
280	52	1	713	0.47	2.62
281	52	1	693	0.75	1.74
282	52	1	503	1.27	1.38
283	52	1	709	0.8	1.93
284	52	1	747	0.51	1.66
285	52	1	752	0.72	1.85
286	52	1	617	0.96	1.86
287	52	1	532	0.82	0.95
288	52	1	428	0.52	1.61
289	52	1	464	0.91	1.58
290	52	1	90	0.24	0.36
291	60	1	307	0.24	3.26
292	60	1	323	0.23	2.24
293	60	1	816	1.24	4.16
294	60	1	741	0.97	3.72
295	60	1	876	1.26	3.77
296	60	1	440	0.31	3.81
297	60	1	692	0.74	3.76
298	60	1	732	0.61	3.96
299	60	1	666	0.76	3.47
300	60	1	807	0.25	2.38
301	60	1	824	0.79	3.55
302	60	1	629	0.62	4.95
303	60	1	730	0.74	4.87
304	60	1	767	0.58	3.29
305	60	1	531	0.37	4.03
306	60	1	730	0.74	3.51
307	60	1	793	0.9	3.87
308	60	1	798	0.85	2.33
309	60	1	827	0.74	3.65
310	60	1	859	0.42	2.93
311	60	1	305	0.19	2.40

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
312	60	1	673	0.56	3.58
313	60	1	508	0.13	2.83
314	60	1	334	0.36	3.39
315	60	1	70	0.05	3.09
316	64	2	493	0.47	4.47
317	64	2	186	0.08	2.59
318	64	2	20	0.01	2.01
319	64	2	700	0.39	4.18
320	64	2	388	0.31	7.96
321	64	2	641	0.69	5.94
322	64	2	736	0.55	4.99
323	64	2	861	0.69	5.10
324	64	2	855	0.6	4.90
325	64	2	536	0.25	4.25
326	64	2	877	1.03	5.64
327	64	2	590	0.37	4.46
328	64	2	939	1.32	5.92
329	64	2	389	0.24	4.85
330	64	2	691	0.57	5.17
331	64	2	703	0.53	3.55
332	64	2	770	0.41	4.06
333	64	2	705	1.24	6.65
334	64	2	423	0.15	3.15
335	64	2	743	0.26	4.77
336	18	3	510	0.63	5.73
337	18	3	552	0.76	5.96
338	18	3	560	1.02	4.64
339	18	3	730	1.29	6.62
340	18	3	475	0.22	3.94
341	18	3	642	0.79	4.29
342	18	3	574	0.89	6.11
343	18	3	498	0.6	4.24
344	18	3	505	0.6	4.19
345	18	3	485	0.89	3.99
346	18	3	634	0.79	5.14
347	18	3	541	0.87	4.89
348	18	3	490	0.95	5.35
349	18	3	657	1.26	5.25
350	18	3	426	0.63	5.94
351	18	3	475	0.38	4.38
352	18	3	565	0.58	6.09
353	18	3	624	0.99	5.59
354	18	3	696	0.71	4.37
355	18	3	616	0.6	4.27
356	18	3	640	1:20	7.82

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
357	18	3	336	0.14	2.84
358	18	3	459	0.91	5.31
359	20	3	947	1.2	5.11
360	20	3	906	1.32	4.93
361	20	3	900	1.13	4.08
362	20	3	832	1:04	5.37
363	20	3	752	0.89	4.56
364	20	3	902	0.95	3.90
365	20	3	752	0.8	4.59
366	20	3	834	0.93	5.56
367	20	3	792	1.54	5.22
368	20	3	619	1.09	4.76
369	20	3	973	1.12	4.71
370	20	3	54	0.05	3.65
371	20	3	813	1.58	5.69
372	20	3	590	0.58	4.22
373	20	3	717	0.74	4.83
374	20	3	692	0.76	6.02
375	20	3	878	1.42	5.25
376	20	3	797	0.73	4.06
377	20	3	723	1.07	4.91
378	20	3	763	1.28	6.10
379	20	3	729	0.87	4.42
380	20	3	712	1.17	6.97
381	20	3	743	1.14	4.77
382	20	3	795	1.15	4.96
383	22	3	682	0.77	3.44
384	22	3	734	0.84	4.25
385	22	3	723	0.75	2.51
386	22	3	722	1.01	3.58
387	22	3	578	0.39	3.70
388	22	3	692	1.28	4.28
389	22	3	484	0.55	2.06
390	22	3	666	0.56	2.46
391	22	3	540	0.56	2.43
392	22	3	323	0.31	2.36
393	22	3	659	0.37	3.01
394	22	3	529	0.83	2.14
395	22	3	456	0.39	1.26
396	22	3	515	0.57	2.21
397	22	3	732	0.72	2.96
398	22	3	274	0.23	2.86
399	22	3	759	0.89	3.01
400	22	3	598	0.48	3.58
401	22	3	637	0.93	3.84

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
402	22	3	627	0.33	2.46
403	22	3	523	0.44	2.74
404	38	2	808	0.89	
405	38	2	706	0.85	
406	38	2	656	0.53	
407	38	2	633	0.43	
408	38	2	794	0.78	
409	38	2	928	0.9	
410	38	2	919	1.08	
411	38	2	958	0.38	
412	38	2	898	0.6	
413	38	2	772	1.05	
414	38	2	786	0.47	
415	38	2	745	0.49	
416	38	2	690	1	
417	38	2	740	0.88	
418	38	2	572	0.61	
419	38	2	812	0.88	
420	38	2	582	0.44	
421	38	2	786	0.67	
422	38	2	850	1.01	
423	38	2	596	0.38	
424	38	2	229	0.16	
425	38	2	742	0.73	
426	43	2	672	1.12	2.09
427	43	2	102	0.08	0.85
428	43	2	715	0.65	1.74
429	43	2	750	1.01	1.51
430	43	2	713	1.22	2.39
431	43	2	842	1.25	1.61
432	43	2	513	0.34	0.66
433	43	2	542	0.57	2.40
434	43	2	682	0.92	1.90
435	43	2	697	1.58	1.74
436	43	2	888	1.07	1.61
437	43	2	753	0.64	2.41
438	43	2	898	0.87	2.32
439	43	2	1163	1.46	2.32
440	43	2	733	1.27	1.98
441	43	2	695	1.23	1.83
442	43	2	698	1.16	2.11
443	43	2	852	1.44	1.91
444	43	2	468	0.54	1.36
445	43	2	788	1.03	2.03
446	44	3	294	0.36	2.68

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
447	44	3	344	0.26	2.32
448	44	3	351	0.29	2.22
449	44	3	291	0.22	2.78
450	44	3	358	0.58	3.50
451	44	3	369	0.4	2.55
452	44	3	338	0.38	3.08
453	44	3	188	0.2	1.76
454	44	3	318	0.32	3.16
455	44	3	284	0.32	2.47
456	44	3	466	0.49	2.90
457	44	3	320	0.23	2.88
458	44	3	328	0.36	2.25
459	44	3	369	0.7	3.71
460	44	3	334	0.59	3.73
461	44	3	372	0.28	3.19
462	44	3	405	0.36	2.50
463	44	3	347	0.47	3.41
464	44	3	367	0.26	2.93
465	44	3	409	0.74	1.85
466	44	3	345	0.35	2.65
467	49	3	326	0.11	2.67
468	49	3	415	0.63	5.06
469	49	3	434	0.37	3.88
470	49	3	414	0.86	5.36
471	49	3	373	0.51	4.91
472	49	3	416	0.64	4.68
473	49	3	510	0.87	4.57
474	49	3	440	0.7	4.63
475	49	3	415	0.48	5.33
476	49	3	234	0.22	3.03
477	49	3	430	0.4	3.71
478	49	3	358	0.45	3.98
479	49	3	413	0.63	5.54
480	49	3	302	0.43	4.06
481	49	3	468	0.39	2.95
482	49	3	538	0.83	5.47
483	49	3	500	0.73	4.82
484	49	3	450	0.62	5.17
485	49	3	417	0.67	3.77
486	49	3	361	0.61	3.56
487	49	3	286	0.23	4.66
488	49	3	400	0.66	5.31
489	49	3	289	0.47	4.97
490	59	3	228	0.24	2.34
491	59	3	258	0.4	4.43

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
492	59	3	107	0.29	4.60
493	59	3	347	0.4	5.16
494	59	3	195	0.32	5.04
495	59	3	330	0.44	4.37
496	59	3	341	0.66	5.55
497	59	3	150	0.2	5.72
498	59	3	356	0.11	2.42
499	59	3	301	0.32	5.58
500	59	3	330	0.45	4.80
501	59	3	251	0.16	4.01
502	59	3	283	0.26	3.95
503	59	3	298	0.23	1.95
504	59	3	262	0.4	6.40
505	59	3	388	0.43	5.02
506	59	3	301	0.43	5.17
507	59	3	399	0.41	3.86
508	59	3	414	0.34	4.63
509	59	3	324	0.47	4.17
510	59	3	282	0.11	2.92
511	59	3	354	0.43	4.87
512	59	3	90	0.01	2.71
513	26	1	337	0.29	2.31
514	26	1	428	0.75	1.58
515	26	1	597	0.23	2.60
516	26	1	592	0.36	1.31
517	26	1	298	0.51	0.91
518	26	1	566	0.53	1.38
519	26	1	424	0.52	3.37
520	26	1	415	0.34	0.77
521	26	1	1587	0.5	2.11
522	26	1	520	0.64	2.38
523	26	1	457	0.4	2.06
524	26	1	286	0.44	1.00
525	26	1	333	0.33	1.45
526	26	1	539	0.38	2.42
527	26	1	441	0.64	1.80
528	26	1	380	0.32	2.20
529	26	1	490	0.48	2.40
530	26	1	476	0.46	1.33
531	26	1	407	0.21	2.45
532	31	3	594	0.6	1.93
533	31	3	332	0.63	1.59
534	31	3	509	0.61	1.00
535	31	3	250	0.21	1.60
536	31	3	107	0.05	1.79

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
537	31	3	509	0.77	0.88
538	31	3	348	0.33	0.65
539	31	3	558	0.97	1.44
540	31	3	472	0.64	1.30
541	31	3	378	0.69	1.13
542	31	3	462	0.6	2.00
543	31	3	408	0.78	0.88
544	31	3	152	0.29	0.98
545	31	3	381	0.48	2.42
546	31	3	436	0.72	1.11
547	31	3	374	0.31	1.75
548	31	3	426	0.25	1.37
549	31	3	495	0.85	1.04
550	40	3	337	0.42	2.15
551	40	3	199	0.17	2.20
552	40	3	389	0.18	2.78
553	40	3	299	0.11	2.92
554	40	3	307	0.14	2.68
555	40	3	174	0.1	2.40
556	40	3	158	0.13	1.64
557	40	3	377	0.3	1.84
558	40	3	308	0.17	2.19
559	40	3	288	0.23	1.64
560	40	3	359	0.42	2.21
561	40	3	253	0.23	1.55
562	40	3	325	0.26	1.86
563	40	3	317	0.22	2.28
564	40	3	417	0.28	1.90
565	40	3	301	0.18	2.42
566	40	3	222	0.11	2.13
567	40	3	409	0.21	2.22
568	40	3	181	0.2	0.96
569	40	3	357	0.26	1.76
570	11	3	360	0.24	2.11
571	11	3	382	0.59	1.43
572	11	3	477	0.68	0.98
573	11	3	441	0.24	3.58
574	11	3	474	0.51	1.95
575	11	3	516	0.24	2.51
576	11	3	510	0.54	3.65
577	11	3	377	0.23	2.77
578	11	3	368	0.9	1.22
579	11	3	482	0.3	2.91
580	11	3	490	0.51	2.20
581	11	3	498	0.71	3.53

Student No.	Teacher ID	ICM Group	Time in Minutes	Cumulative Gain	Grade Level Average
582	11	3	487	0.46	2.53
583	11	3	471	0.43	2.48
584	11	3	386	0.21	2.82
585	11	3	445	0.53	3.41
586	11	3	474	0.36	1.72
587	11	3	310	0.56	0.98
588	11	3	480	0.85	1.32
589	11	3	260	0.21	2.58
590	55	3	291	0.32	2.29
591	55	3	377	0.21	1.65
592	55	3	519	0.28	2.80
593	55	3	291	0.15	2.95
594	55	3	581	0.19	2.82
595	55	3	567	0.81	1.89
596	55	3	316	0.15	2.61
597	55	3	534	0.41	2.62
598	55	3	561	0.79	1.83
599	55	3	580	0.46	2.69
600	55	3	539	0.33	2.75
601	55	3	477	0.18	1.92
602	55	3	551	0.37	2.39
603	55	3	531	0.65	3.36
604	55	3	693	0.18	1.68
605	55	3	64	0.03	2.27
606	55	3	430	0.31	1.92
607	55	3	461	0.33	2.34
608	55	3	288	0.22	1.72