Diffusion of an Innovation: Computer Technology Integration and the Role of Collaboration

Sharon L. Hoerup

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Dr. Glen Holmes, Chair
Dr. Susan Magliaro, Co-Chair
Dr. John Burton
Dr. Jerome A. Niles
Dr. Barbara Lockee

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(Abstract)

This study investigates the extent to which teachers adopted a computer technology innovation and the role of collaboration in the adoption process. Semi-structured interviews with seven teachers and one Computer Resource Teacher, supplemented by observations and documentation regarding the innovation, provide data for an in-depth, ethnographic case study. Six months were spent in the setting recording the teachers' interactions and processes centered on adopting the innovation. Results show collaboration efforts among teams and the level of uncertainty regarding the innovation influenced the amount of time and the degree to which each team adopted the innovation. Two other factors influenced the adoption rate of the innovation: the interaction that the teachers had with a change agent, which helped to decrease the level of uncertainty about the innovation with two of the teams and thus, increased their adoption rate, and the innovativeness of individuals, which had a direct connection to the rate of adoption and which influenced other members of the grade level and their rate of adoption. Each participant's level of innovativeness, their compatibility and comfort with the innovation, and their efforts to collaborate were significantly related to successful implementation of the computer technology innovation.

Dedication

This work is dedicated to the memory of my grandfather, Frank Prokop, whose example in life taught me the true meaning of perseverance. He will be missed.

Author's Acknowledgments

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Chapter One: Introduction

Innovations in education occur with each new demand placed on the educational system based on the cycle of society (Miles, 1964). Many innovations introduced in schools are chosen or mandated by the administration with little or no input from the teachers who will be charged with the task of implementing the innovation (Sarason, 1982). The concerns of the teachers are often overlooked by the administration (Fullan, 1982), and the teachers are often overwhelmed with the responsibilities placed on them (Fullan & Hargreaves, 1992).

Once an innovation is placed in the school, how do the teachers process the new innovation? What steps are taken to ensure the adoption of the innovation after the mandate is handed down from administration? Many reform movements, such as hot lunches, kindergartens, and school nurses, have remained in the school systems long after the initial introduction of these innovations. However, many reform movements come and go before time can tell if they will be successful or fail (Cuban, 1992). Over the last century policymakers have defined problems and tried to solve them with reforms only to have the same problem resurface a generation later with new reforms created by policy makers (Cuban, 1995).

Training should be provided to teachers about the new innovation (Fullan, 1982). However, it would be hard to assume that each individual in a system can be provided with enough new knowledge during training to return to their real-life setting and be comfortable enough to encourage others to accept the new behaviors as their own (Sarason, 1990). Teachers experience little or no support after the initial training and have to look inside their school to other teachers who have implemented the innovation for guidance through the decision-making process (Lieberman & Miller, 1990). Each innovation affects what teachers believe about their opinions, values, beliefs, and views about teaching (Cuban, 1995; Katz & Kahn, 1975; Little, 1992; Sieber, 1975; Welch, 1998). Understanding the needs of teachers as they encounter the new innovation and finding additional tools or strategies to assist them in successful adoption are preliminary steps in successful innovation implementation (Cohen & Bredo, 1975; Fullan, 1992; Lieberman & Miller, 1990, 1979; Little, 1982; Sarason, 1982).

In an effort to understand how teachers were integrating computer technology into their classrooms and daily lives, an in-depth case study was conducted. Many factors change year-to-year in schools that affect the roles teachers and administrators play in successful implementation of innovations. A long-term, qualitative case study affords the teachers an opportunity to represent their interactions and collaborative choices to adopt or reject this innovation as a way to explain the internal processes at one school within a larger school division.

Many research projects on computer technology have focused on the tool and how it is being used in the school or how many of one technology is available in a school (Holloway, 1996). Other studies that did consider the viewpoint of the teacher focused on teacher attitudes and outside pressures, which resulted in the presence of computer technology in the schools (Cuban, 1993; Dalton, 1989; Wiley, 1992). This research focused on *how* teachers were integrating computer technology into their classrooms over a course of six months and the *collaboration* efforts necessary between teachers to implement this new innovation.

In chapter two, the literature review describes innovations and conditions surrounding innovations in schools in greater detail as well as the role of collaboration in successful innovations. A brief description of how the school division began to initiate this innovation is presented. Chapter three is the methodology section and outlines the analysis used in this study. An ethnographic analysis is constructed and the results of the data collected – interviews, observations, and field notes – are presented. Chapter four is a discussion of the data and the representation of the information uncovered during the in-depth study in the setting. This chapter contains personal accounts from the participants with observations about their efforts to integrate computer technology. Finally, chapter five contains relevant conclusions. Expectations of what occurred in the setting as well as events that were unexpected are described and related back to the literature review.

Chapter Two: Review of Literature

The purpose of this chapter is to outline the theoretical framework and relevant research, which shapes this study. The first section summarizes the diffusion of innovation research of Everett M. Rogers (1983), who has remained a leader in the field of innovation, along with the research of other relevant researchers (Charters & Pelligrin, 1972; Cohen & Bredo, 1976; Downs & Mohr, 1976; Fullan, 1982, 1992, 1993, 2001; Fullan & Hargreaves, 1992; Sarason, 1982, 1990; Sieber, 1975) who examine and try to apply Rogers' work to the field of education. The next section reviews diffusion studies in education, focusing on both reforms that were adopted as they were presented and reforms that failed in their original intention but still persist in education today. The last section synthesizes diffusion studies in education specific to computer innovations.

Diffusion of Innovation

In this section, Rogers' (1983) theory of innovation is discussed in four sections. The first section analyzes of the adopter categories Rogers outlines in his work. The second section details the innovation-decision process used by the participants to adopt or reject an innovation. The third section focuses on facilitators and inhibitors of the adoption process. The final section summarizes contributions and criticisms to Rogers' theory.

According to Rogers (1983) an innovation is "an idea, practice or object that is perceived as new by an individual or another unit of adoption" (p. 11). The innovations presented to individuals or organizations provided alternative solutions to problems or created solutions to meet needs within the individual or organization. The newness of the innovation does not just involve new knowledge but also new ways to approach the perceived problem or need (Rogers). Some innovations are continuations of a previous innovation, and the information necessary to form a decision has already been presented to the individual. Innovations begin with the perceived knowledge of the innovation, followed by persuasion to adopt or reject the innovation, and concluding with a decision to adopt or reject the innovation.

Diffusion of innovations is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983, p. 5). The major players in innovation diffusion are the participants or the unit, hereafter referred to as *adopters*, in the social system that is making the decision to adopt or reject an innovation, the *change agent* who is brought in by the change agency to promote and encourage the innovation, and the *change agency* who wants successful implementation of the innovation. The adopters will work through a decision-making process while communicating with other members of the social system to determine if the innovation will be successful or a failure within their organization. The change agent is usually brought in by the change agency to facilitate the adoption process. The change agent's role is to provide support to the participants, guide them to the direction of adoption, and provide reassurance once the decision to adopt has been made. The change agency is committed to meeting the goals of the hierarchy in the social system, not to meeting the needs of the participants or units of adoption. Therefore, the change agent balances his or her loyalty between the two groups he or she works for or with (Rogers).

Adopter Categories

Each participant or potential adopter matches the characteristics of one of five adopter categories as proposed by Rogers (1983). These include innovator, early adopter, early majority, late majority, and laggard (Rogers). In diffusion research these categories were derived from "ideal types," what Rogers defined as "conceptualizations based on observations of reality and designed to make comparisons possible" (p. 248). Each category contains dominant characteristics that help to set each apart from the next. These characteristics are intended for theoretical formulation of the adoption or rejection of an innovation.

According to Rogers, "the innovativeness dimension, as measured by the time at which an individual adopts an innovation or innovations, is continuous" (p. 247). Rogers stated the adopter categories can be "partitioned by laying off standard deviations from the average time of adoption" (p. 247) creating a bell curve. While this is not a symmetrical curve, three groups on the left and only two on the right, the three groups on the left end, innovators, early adopters, and laggards, cannot be broken down or combined due to unique and different characteristics.

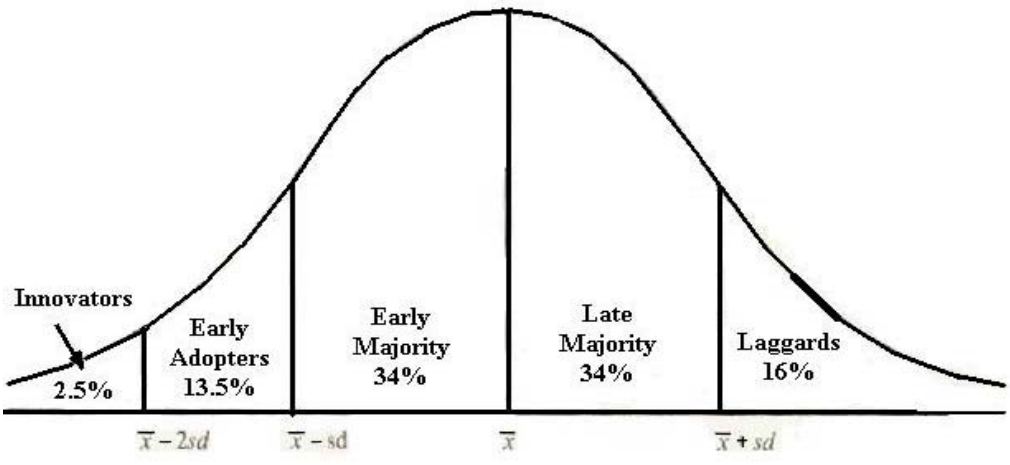

Figure 1. Adopter categories across a bell curve.
Source: *Diffusion of Innovations, Third Edition* by Everett M. Rogers (Fig. 7-2, p 247). Copyright © 1962, 1971, 1983 by The Free Press, a Division of Simon & Schuster, Inc. Used with the permission of the publisher.

The innovator category is defined as "venturesome" (Rogers, 1983, p. 248). Innovators have been observed as obsessed with the idea of trying new ideas. They are risky, adventuresome, daring, and rash. Their desire to step out and try the latest new trend leads them into very small circles of individuals with the same values and beliefs. The level of communication and the relationships formed among innovators form a distinct and common pattern, even though the "geographical distance between the innovators may be considerable" (Rogers, 1983, p. 248). There are several prerequisites to being an innovator: substantial financial resources, the ability to understand and apply complex technical knowledge, and the ability to cope with a high degree of uncertainty at the time of adoption (Rogers).

The other members of the social system may not respect innovators because they adopt new ideas quickly. Innovators usually have the resources – money, contacts, or knowledge – that the other adopter categories are lacking. However, the innovator plays a key role in the diffusion process. The innovator is the gatekeeper who brings in the innovation from outside the social system walls and presents the new idea to other members of the group (Rogers, 1983). Because of their resources, innovators can introduce a new idea that might not have otherwise reached the social system. The innovator as gatekeeper can also choose not bring an innovation to the social system if he or she does not see any benefit in adopting the innovation.

Early adopters are the next group to adopt the innovation. They do not have all the resources innovators have, but they are more respected by the social system and have the greatest degree of opinion leadership, the ability to influence others' decisions in the adoption process, among the group (Rogers, 1983). The early adopters set the stage for potential adopters, and the early adopters are the example that potential adopters mimic or rely on for advice and information about the innovation. If early adopters have success with the innovation and can express that to potential adopters, the innovation has a greater chance of full adoption among the social system. Change agents often rely on this group to help speed up the delivery of an innovation to the group.

While the early adopter is aware of his or her place in the social system, choices for adopted innovations must be chosen judiciously to maintain a central position in the communication structure. Early adopters must reduce the "uncertainty about a new idea by adopting it and then conveying a subjective evaluation of the innovation to near-peers by means of interpersonal networks" (Rogers, 1983, p. 249).

Early adopters have a high level of opinion leadership, which Rogers (1983) defines as "the degree to which an individual is able to influence other individuals' attitudes or overt behavior informally in a desired way with relative frequency" (p. 27). Because many of the members in a social system rely on the experiences of the early adopters during an innovation, this group often has the most opinion leadership. The leadership is earned and maintained from innovation to innovation based on the individual's "technical competence, social accessibility, and conformity to the system's norms" (p. 27).

Early majority members "adopt new ideas just before the average member of a social system" (Rogers, 1983, p. 249). Early majority adopters provide the interconnectedness of the network. These members interact with many of the group but do not move into leadership positions. Early majority members' innovation-decision process lasts longer than that of the innovator or early adopter members. These members tend to observe the previous members' choices and decisions and form their own when the time is right. Early majority member reflect on their decision to adopt or reject longer than any of the other groups according to Rogers (1983).

Late majority members "adopt new ideas just after the average member of a social system" (Rogers, 1983, p. 249). The reasons for adoption may be due to increased pressure from the network or economic need. Late majority members do not adopt an innovation until most of the other members of a social system have done so (Rogers). The late majority must be

persuaded and the pressure from peers is necessary to motivate the individuals to adopt (Rogers). Almost all uncertainty must be removed from the innovation before the cautious late majority will feel safe enough to adopt (Rogers).

The "traditional" (p. 250) category is that of the laggards. Rogers (1983) referred to this group as "traditional" because their point of reference is in the past. The laggards are always the last to adopt and unlike the early adopters, they have no opinion leadership (Rogers). Laggards interact with other members of the social system who also share a very traditional background and who also look to the past for guidance on innovation choices. Often when laggards finally adopt, a newer innovation has presented itself to innovators and early adopters. Laggards' resources are often limited, so they must be certain the new idea will be successful when they adopt (Bandura, 1977; Rogers). They are often suspicious of the innovation and those who are in support of the change especially change agents (Rogers). The term laggard often carries with it a negative connotation, but Rogers explained that the negative connotation exists because most non-laggards have a pro-innovation bias. The other categories adopt the innovation and follow the advice and examples set by near-peers. The laggards, however, are often blamed for their lack of innovativeness when the system encouraging the innovation needs to be focused on as to why they failed to assist this group in the innovation (Rogers).

Another player in a diffusion of innovation process outside of the adopter categories is the change agent. Change agents are "individuals who influence clients' innovation decisions in a direction deemed desirable by a change agency" (Rogers, 1983, p. 312). The main role of the change agent, as shown in Figure 2-2, is to filter the information the change agency wants delivered to the audience of individuals who are in the innovation-decision phase. The change agents are responsible for balancing an enormous amount of information, objectives, goals, and desired outcomes, between two groups. The change agent/individual relationship is most often a heterophilous one, which is the "degree to which pairs of individuals who interact are different in certain attributes" (Rogers, 1983, p. 18). The change agent's goals or background knowledge will most likely be different than that of the individual the change agent partners with in the adoption process.

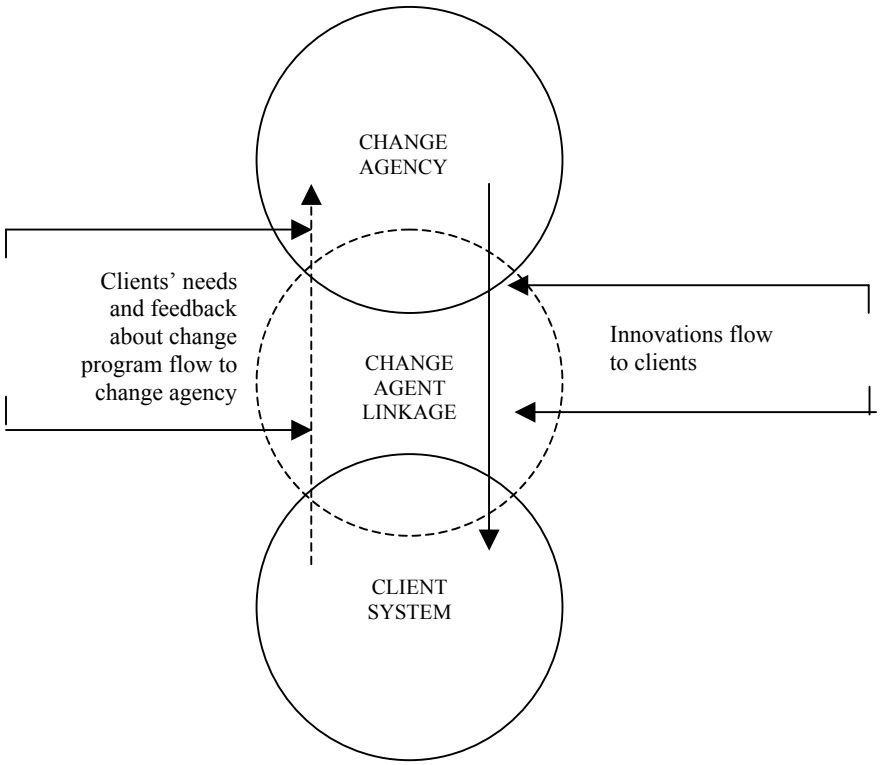

Figure 2. The linkage provided by change agents in an innovation.
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Change agents must decipher the information being presented by the change agency and determine what needs to be shared with the individuals who are adopting (Dalton, 1989; Rogers, 1983). The change agency has a different goal than the individuals who are adopting. The change agency has already determined the value of the innovation and expects that all members of the social system will adopt. They are not concerned with uncertainty at any level. Therefore, the change agent must be able to "screen and select only the most relevant information" (Rogers, p. 315) for the individuals who are adopting that will help them in forming a decision. Too much information could increase the amount of uncertainty and increase the chance for rejection of the innovation (Rogers).

The change agent will have more knowledge and a different background than the individuals he or she is working with to speed the adoption process. The innovation will contain different individuals who may have many similarities, such as beliefs, education, and social status, but who perceive the innovation differently. Unfortunately, with many innovations, the individuals come in with different levels of knowledge about the innovation, have different experiences, and are not from similar educational backgrounds (Rogers, 1983).

Rogers (1983) listed a sequence of seven change-agent stages of interaction with potential adopters. These stages are often followed in the process of introducing a single innovation to an individual. The first stage of the change agent interaction is to develop the need for change. The change agent "points out new alternatives to existing problems, dramatizes the importance of these problems, and convinces clients that they are capable of confronting these problems" (p. 315). At this stage the change agent assesses the needs of the client by trying to understand and create solutions for the problems.

In the second stage the change agent must create "credibility, trustworthiness, and empathy with the clients' needs" (Rogers, 1983, p. 316). The clients or individuals must accept the change agent and his or her role in the innovation before they accept the innovation. The clients or individuals will judge the innovation based on their perception of the change agent. If the change agent does not create rapport with the clients or individuals, the rate of adoption will have a negative affect for the innovation (Rogers).

During the third stage, the change agent "analyzes the client's situation . . .to determine why existing alternatives do not meet their needs" (Rogers, 1983, p. 316). This should be done with the needs of the clients or individuals as the focus, not the change agency. The problems with the adoption must be "viewed empathically from the clients' perspective" (p. 316).

The fourth stage for the change agent is to then "create the intent to change in the client" (Rogers, 1983, p. 316). Again, this must be done through the clients' perception of the innovation. The focus of the change created must be on the clients' needs and problems, not on the innovation.

The fifth stage is to "translate intent into action" (Rogers, 1983, p. 316). Much of this stage's interactions may be through the opinion leaders who will activate peer networks (Rogers). The change agent's goal during this stage is to "influence his or her clients' behavior in accordance with recommendations based on the clients' needs" (p. 316). Near-peers are most important for clients during the persuasion and decision stage of the innovation (Rogers).

The sixth stage is to "stabilize the adoption and prevent discontinuance" (Rogers, 1983, p. 316). It is important for change agents to provide reinforcing messages to encourage the continuance of new behaviors the individuals have adopted. This assistance is most important at the confirmation or implementation states in the process.

Finally the change agent is trying to "achieve a terminal relationship with the individuals or clients by developing the clients' ability to be their own change agents" (Rogers, p. 316-317). The intent is to create self-reliance within the organization to foster continued use of the innovation without the need for outside assistance and to provide the change agent an opportunity to remove him or herself from the process.

Innovation-decision Process

This section analyses the stages a potential adopter attains to reach a decision of adoption or rejection. Each adopter category has to work through the innovation-decision process, which Rogers (1983) defined as "the process through which an individual passes from first knowledge

of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject the innovation, to implementation of this new idea, to confirmation of this decision" (p. 163). The distinction between an innovation-decision and another decision by an individual is "shaped by the perceived newness of the innovation, and the uncertainty associated with this newness" (p. 163). An individual is characterized and associated with an adopter category by the amount of time an individual takes to form a decision as compared to other members in that social system.

Rogers (1983) stated that "one cannot seek knowledge about an innovation until he or she knows it exists" (p. 164). Often individuals come upon information about an innovation by accident and then pursue additional resources to discover more. Individuals expose themselves to different innovations based on their needs, interests, or existing attitudes. Rogers asserted that a need, "a state of dissatisfaction or frustration that occurs when one's desires outweigh one's actualities" (p. 166), must precede an awareness or knowledge of an innovation. It is the change agent who points out desirable new ideas that creates the need with the individual.

There are five stages in the decision-making process. The stages are knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983). This process takes time and the adopters may return to a prior stage if uncertainty forms after a decision is made. The adopter may especially return to the persuasion stage for confirmation of his or her choice to adopt or reject.

The knowledge stage is "when the adopter is exposed to the innovation's existence and gains some understanding of how it functions" (Rogers, 1983, p.164). There are two theories as to how knowledge of an innovation presents itself. Some argue that an adopter seeks out new innovations that agree with his or her interests, needs, or attitudes, while some conclude that the adopter comes across a new innovation accidentally, "as one cannot actively seek an innovation until one knows that it exists" (p. 164). According to Rogers, "current research does not provide a clear answer to this question" of which comes first. The knowledge stage sequence may depend on the users and the type of innovation.

The persuasion stage is "where the individual forms a favorable or unfavorable attitude toward the innovation" (Rogers, 1983, p. 169). The individual actively seeks information about the innovation from peers and other members of the social system. In this stage, the important behaviors are "*where* he or she seeks information, *what* messages he or she receives, and *how* he or she interprets the information that is received" (p. 170). General perceptions about the innovation are formed, and it is important to understand where the individual is getting information, what messages are being stored, and how the information gathered is interpreted (Rogers). Individuals at this stage seek knowledge from peers whose opinions are most convincing. The desired outcome at this stage is a reduction in uncertainty about the innovation and a change in behavior, either the adoption or rejection of the innovation. Once the individual creates a favorable or unfavorable opinion, he or she moves on to making a decision.

The decision stage is where "the individual engages in activities that lead to a choice to adopt or reject the innovation" (Rogers, 1983, p. 172). Often individuals seek a trial of the innovation before adopting. A small-scale trial will help to eliminate uncertainty about an innovation and will increase the chances for adoption. If an innovation can be divided up for

trial the adoption rate may occur more rapidly (Rogers, 1983). Also a "trial-by-others" (p. 172) provides the same effect for many individuals as if they tried the innovation themselves. Once a decision is formed the individual begins to implement the innovation.

Until the implementation stage, Rogers (1983) defined the innovation-decision process as a "mental exercise" (p. 174). Many problems occur at this stage when the individual begins to use the innovation. The change agent's role becomes very important at this stage as he or she assists the individual with the technical understanding. The implementation stage follows the decision stage directly. Uncertainty still exists at this point in the process although a decision to adopt has been made.

Often during the implementation stage re-invention occurs. Rogers (1983) defined re-invention as " the degree to which an innovation is changed or modified by a user in the process of its adoption or implementation" (p. 175). It is important to understand re-invention and to view its impact on an innovation. "The fact that re-invention occurs is a strong argument for measuring adoption at the implementation stage as change has actually happened" (p. 175). There is evidence of action instead of only intention. The implementation stage may continue for a long period of time until the innovation is institutionalized. At this point some innovations end while other go on to the last stage of confirmation (Rogers).

In the confirmation stage the "individual seeks reinforcement for the decision already made" (Rogers, 1983, p. 184). Individuals may reverse their decision if they are exposed to conflicting messages about the innovation. Change agents have an important role at this stage. They must provide supporting messages to individuals who have previously adopted, so they in turn will provide supporting messages to individuals in the confirmation stage (Rogers). In past research change agents assumed because of secured adoption discontinuance would not occur. However, without reassurance, negative messages circulated the social system and research "plateaued" (Rogers, 1983, p. 186).

Facilitators and Inhibitors

This section contains five specific characteristics described by Rogers (1983) as facilitators or inhibitors to the adoption of an innovation. Also included is the role that communication, both verbal and non-verbal, plays in the success for failure of an innovation.

Rogers (1983) listed five main characteristics of an innovation that accounted or the rate of adoption of innovations for individuals. Rogers generalized that innovations that have greater "relative advantage, compatibility, trialability, and observability with less complexity will be adopted more rapidly than other innovations" (p. 16). He goes on to assert that these are not the only factors in the rate of adoption but past research indicated these qualities are most important (Rogers).

The first characteristic, relative advantage, is defined as "the degree to which an innovation is perceived as being better than the idea is supersedes" (Rogers, 1983, p. 213). Economic and status factors can affect the rate of adoption. Relative advantage provides uncertainty-reduction in the diffusion of an innovation. The less uncertainty an individual has

with an innovation the more likely the individual will adopt it. "Relative advantage is one of the best predictions of an innovation's rate of adoption" (p. 217).

The compatibility characteristic of an innovation is the "degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 1983, p. 223). The innovation can be compatible or incompatible with an individual's "values and beliefs, previously introduced ideas or the clients needs for innovation" (p. 223). For example, in education, many "innovations that are persuasively publicized across the nation become candidates for adoption, regardless of their educational significance" (Sieber, 1975, p. 80) and are not compatible with teachers' beliefs or values.

Complexity in an innovation is "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1983, p. 230). Rogers generalized that the "complexity of an innovation is negatively related to its rate of adoption" (p. 231). Some innovations are clear to the adopter and are rapidly accepted while others are not, and this will affect the rate of adoption.

Trialability is "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 1983, p. 231). If an innovation can be broken down into parts and tried small portions at a time, the innovation has a greater chance for adoption. Innovations that do not provide for trialability will have a more difficult time being adopted. Early adopters perceive trialability as an important component of an innovation more so than late adopters. Later adopters have the experiences of the innovators and the early adopters to learn from while early adopters have had no precedent to follow (Rogers).

Finally, observability is " the degree to which the results of an innovation are visible to others" (Rogers, 1983, p. 232). As with relative advantage, compatibility, and trialability, observability is positively related to the rate of adoption of an innovation. As with complexity, some innovations are easily observed and communicated to others, while some innovations are more difficult to describe to individuals (Rogers).

Communication is another factor that can facilitate or inhibit an innovation. A key in the success or failure of an innovation is the way the idea is shared with the stakeholders. Rogers (1983) defined communication within diffusion research as "the process by which participants create and share information with one another in order to reach a mutual understanding" (p. 17). The communication channel for an innovation contains the innovation, one person who has knowledge about the innovation, one person who does not, and a way for them to communicate (Rogers, 1983). Communication within innovations usually occurs between individuals with similar beliefs, education, and social status, i.e., homophilious individuals. If the individual can only interact with a small number of people, the most likely individual chosen would be someone like them (Rogers). When individuals of an innovation interact and they are from different beliefs and educational backgrounds, these interactions are heterophilous as defined earlier. Heterophilous interactions usually occur between the change agent and members of the late majority and laggards (Rogers).

One piece of the communication web is the role of opinion leadership with groups of individuals or organizations. Often the originators of the innovation will transfer information to opinion leaders within the organization. These leaders then spread their influence to the remaining individuals within the group. The rate of adoption of an innovation depends on the amount of time opinion leaders take to activate diffusion networks in their organization (Rogers, 1983).

Non-verbal communication is also an important factor when studying the rate of adoption of an innovation. Individuals observe the trials of others who adopt and innovation before them for confirmation or rejection about that innovation. According to Bandura (1977), individuals learn from one another by means of observational modeling, not imitation or mimicry, but by re-invention as in an innovation. This social modeling allows the observer to pull out the elements that he or she connects with in order to create a similar result that is then owned by the observer (Bandura). Individuals can learn from observing other's activities, so dialogue is not necessary. This goes back to the necessary characteristic of observability within the innovation.

Social modeling or observational learning plays an important role not only for the individual adopting an innovation but also plays an important role in spreading the new ideas "within a society or from one society to another" (Bandura, 1977, p.50). Bandura stated successful innovations follow a common pattern but "the mode of transmission, the speed and extent of adoption, and the lifespan of innovation varies for different forms of behavior" (p. 50).

Contributions and Criticisms

A major contribution of diffusion research is the conceptual paradigm with relevance for many disciplines the diffusion model creates (Rogers, 1983). Diffusion research has a pragmatic appeal to many users. It can provide "solutions to individuals who have invested in research on some topic and seek to get it utilized or to those who desire to use their research results to solve a particular social problem or to fulfill a need" (p. 90). These solutions allow scholars to repackage findings in the "form of higher-level generalizations" (p. 90). This repackaging provides one of the greater strengths of diffusion research.

One point that Bandura (1977) made in his discussion of innovations is that "innovations spread at different rates and patterns because they have different requirements for adoption" (p. 53). The adoption rate will depend on whether the necessary requirements are within the means of the individuals willing to adopt. "Money, skills, or accessory resources" (p. 53) are attributes that may be necessary to adopt that the individuals lack. "Social prohibition," Bandura stated, "wields additional influence over what is adopted" (p. 53).

Diffusion in Schools

This section explores the studies of many researchers and their analysis of diffusion in schools. Included for discussion are the history of innovation in schools, illustrating that school are constantly in the innovative process, facilitators and inhibitors of innovations in schools, and a comparison of this research with the work of Rogers (1983). Many of the researchers reviewed in this section used Rogers' innovation theories as a framework to their studies. Additional

references were added that are more recent relating to educational reform, but these are not necessarily out of this framework.

History of Innovation in Schools

According to Miles (1964), the focus of innovations in schools should be on the change process in a social system. The value of an innovation is based on its intended outcomes or accomplishments for the system or unit of adoption (Miles). However, the main focus in many change efforts is on content and not on the features of the change process (Miles). For example, why do some innovations spread more rapidly than others or what are the causes of resistance to change in the educational setting?

Miles (1964) examined educational reforms trying to pinpoint how and why innovations occurred. Miles listed causative factors for the underlying increase in educational reforms. He stated that the struggle for the nation's survival was a key reason for increases in educational reform. For example, the launching of Soviet satellites in 1958 spurred the acceleration of the public's request for better schools and increased learning (Miles). Other relevant issues that guided the movement for educational change were the "size and growth of the educational establishment, increases in technological capacity for information handling and retrieval, and the growth in the production of knowledge in contemporary society" (p. 8-9). The change process readjusts with each cycle of society and with each new demand on the educational system to meet the needs of the population (Miles).

Fox and Lippett (1964) studied the instigation and support of teacher innovations in improving the classroom learning environment. They hypothesized that teachers create change in their classrooms in two ways: "(1) by collaboration with a research team or (2) by examining the innovative efforts of other teachers." The second case would be a re-invention or adaptation of the innovation to fit the unique situation of the modifying teacher. They identified some emerging conclusions about innovations in classrooms:

- Classroom improvement must start with a teacher's concern for improvement.
- The channels of communication are not developed in most school situations; therefore, little sharing takes place among teachers who are facing the same dilemmas in their classroom with the innovation.
- Help from an outside trainer provides the visibility to potential adopters.
- All stakeholders, administrators, principals, teachers, and outside resource people, must all work in a collaborative effort to promote the instructional improvement. (Fox & Lippett, p. 296-297; Kozma, 1985)

According to Eichholz and Rogers (1964), most of the educational diffusion studies through 1960 had been done through one school under the sponsorship of Paul Mort. Most of these studies were "mailed questionnaires . . . and the unit of analysis was the school system in almost all of these investigations." Eichholz and Rogers stated that in most of the diffusion studies in education done by Mort, as with other fields of research, the adoption of an innovation is studied, not the rejection. Often innovation trials in education are ambiguous, incomplete, or confusing because responsibility must be maintained to the student not the research.

Carlson (1964) discussed a deficiency in Mort's innovation studies. Most of the studies done by Mort and his students assumed the characteristic of the main adopter, the superintendent, was unimportant to the results of the studies. Carlson argued that most innovations in school systems have to go through the process of approval by the superintendent and these innovations are "directly related to his rate of adoption of educational innovations" (Carlson, 1964, p. 330). Carlson stated that many educational diffusion studies did not consider the efforts of the superintendent in discussing "the school systems' rate of adoption of new educational practices" (p. 341) and therefore, do not give a complete picture of the process. The efforts of all personnel involved in diffusion of innovation studies should be considered. The connection between the different levels of a system must present itself for success.

Barton and Wilder (1964) noted one concern with educational literature on diffusions of innovations. They noted the tendency for school change was to "lag behind in accepting the implication of research" (p. 363). However, another extreme has presented itself in educational literature where "writers . . . change doctrines and practices without adequate evidence, thus creating new problems which lead to the swinging back of the pendulum" (p. 363).

The following studies continue the discussion of educational reform and innovations in schools, but they are outside Rogers' framework. These researchers have studied collaboration and collegiality in schools as well as staff development issues surrounding educational reform movements.

Little (1982) studied six urban schools and their social organization and determined characteristics of participants who facilitated interactions between and among teachers to encourage successful schools. These characteristics are status and knowledge and skill. Staff members with status can influence fellow faculty members and sustain successful development of change in schools over time. Knowledge and skill in faculty members "establish boundaries on their latitude to initiate, participate in, or lead collegial work" (p. 337). She also reported that for collegiality to be successful in the professional development of teachers several components were key: teachers talking about their teaching; joint work; teacher's planning, evaluating and developing teaching materials together; and teaching each other the practice of teaching. Without supporting one another's work, the implementation of new innovations' adoption lingered.

Little (1993) stated, "Professional development in the service of implementation may obscure questions related to purpose and may mask the internal contradictions and tensions within and across reform initiatives" (p. 130). To understand the purposes of reforms required understanding to extent to which "they are congruent or not with teachers' existing beliefs, commitments, and practices" (p. 130).

Miller and Wolf (1978) stated that "the promotion of change in educators and schools that improve the conditions for learning and teaching" (p. 145) should be a major goal. This statement is further supported by Lieberman and Miller's (1990) study of professional practice schools. Lieberman and Miller asserted staff development was a teacher's continuous inquiry into practice and re-invention of pedagogy. They stated that teachers have a tacit knowledge base and as they engage in staff development activities, they build upon this tacit knowledge by

continually inquiring about and analyzing their values and practices while sharing their experiences with other teachers. Staff development activities allow for teachers to gather together to discuss new innovations and learn from each other how to implement each change.

Educational change studies surface with each new innovation presented to schools. McLaughlin and Marsh (1978) concluded that after the "Decade of Reform" (1965-1975) changes and improvements were still necessary. This reform movement did not provide adequate advancements for growth in schools and in teachers. No longer could schools rely on new teachers to bring in fresh ideas to the classroom. Most innovations affected veteran teachers as well as new teachers. Staff development needs shifted to all teachers and were no longer only for new teachers. Schiffer (1980) claimed that staff development used to be about training deficiencies in teachers, but more recently, there had been a recent shift from upgrading competencies to promoting professional growth.

Miller and Wolf (1978) concluded that change occurs most effectively in situations where the organization supports the change. Lieberman and Miller (1979) identified the necessary support infrastructure to facilitate organizational change in education. The presence of a supportive principal and district, available resources to be accessed and used in different ways (a teacher can lead a workshop, for example), administration acknowledgement of the energy drain, and professional development activities on a constant basis will foster growth of a supportive culture. Collaboration constitutes a long-term responsibility and teachers must have a share in the decision-making processes. Teachers must be given the opportunity to participate meaningfully on all levels for continued problem solving (McLaughlin & Marsh, 1978). Sharan and Shachar (1994) stated that teacher participation should be authentic in school change. There will be tension and lower participation when administrators delegate authority. Welch (1998) listed three objectives school improvement plans should contain including all individuals in a school community need to have similar values and goals regarding the education of all students, collaborative partnerships must be supported at all levels of the school system, and both the structure and the organization must be in place to support collaborative efforts.

What innovations have successfully been implemented in schools? What innovations have failed and why did they fail? Did an innovation initially fail only to return in another form, reinvented by educators to fit their needs? These are questions Cuban has been researching during his educational career. According to Cuban (1992) the following innovations have either partially or wholly become part of the public schools since World War I: "hot lunches, summer schools, community centers, vocational guidance, kindergartens, health clinics and school nurses, social workers (or visiting teachers), sex education, playgrounds and organized physical education programs, after-school recreation, and Americanization programs for newcomers from other cultures" (Cuban, 1992, p. 168). Many of these became the minimum standards for children and changed the public's perception of what constituted a quality education.

In 1995, Cuban stated there is "no one way of teaching and no one best system of schooling" (p. 7). So why is there so much focus on altering the conduct of teaching and schooling? Over the last century policymakers have defined problems and tried to solve them with reforms only to have the same problems resurface a generation later with new reforms created by policymakers affirmed Cuban (discussed previously by Barton & Wilder, 1964).

Cuban agreed that there are "deep-seated value conflicts in teaching, administering, policy-making and research [that] will not vanish . . . and practitioners . . . do not inquire into these conflicts to see how they color their thinking and action, especially as these conflicts shape moral choices" (p. 9).

Cuban (1998) argued that many school reforms of today are similar to the "Platoon School," and as these reforms are implemented into the daily practices of teachers, they are transformed into a new design that is not similar to the original. Many reforms cannot be determined as effective or successful because educators may add, adapt, or omit original features. The policymakers heading the innovation can no longer rate success based on the original blueprint (Cuban, 1995, 1990). Reformers see adaptations to the design as failure of the innovation while teachers view these modifications as signs of inventiveness and positive attributes to effectiveness (Cuban, 1995).

Facilitators and Inhibitors

Baldridge and Deal (1975) stated there were at least three things needed to understand change processes in educational organizations: "a comprehensive organizational perspective, that is, an understanding of crucial organizational subsystems and process involved in innovation; familiarity with strategies that can be used to cause and support educational changes, such as leadership dynamics, the role of change agents, the dynamics of organizational politics, and the use of program evaluation processes; and practical experience with the dynamics of educational change, either from actually administering a changing institution or from gaining vicarious experience through case studies of actual attempts to change educational organizations" (p. 1-2). These three factors can be either a facilitator in educational change and understanding the process through which change occurs or each factor can be an inhibitor of the diffusion process if a component is removed or ignored during the innovation process.

Katz and Kahn (1975) reported, "The major error in dealing with problems of organizational change, both at the practical and theoretical level, is to disregard the systemic properties of the organization and to confuse individual change with modifications in organizational variables" (p. 35). Often decisions in educational settings are made top down where the superintendent advocates an innovation and the teachers within the system must now adopt or reject the innovation. According to Katz and Kahn, the lack of understanding of the larger process of innovation introduction in schools creates assumptions about change.

> In short, to approach institutional change solely in individual terms involves an impressive and discouraging series of assumptions – assumptions that are too often left implicit. They include at the very least, the assumption that the individual can be provided with new insight and knowledge; that these will produce some significant alteration in his motivational pattern; that these insights and motivations will be retained even when the individual leaves the protected situation in which they were learned and returns to his accustomed edge to that real-life situation; that he will be able to persuade his co-workers to accept the changes in his behavior which he now desires; and that he will also be able to

> persuade them to make complementary changes in their own expectations and behaviors. (p. 36-37)

All members of the school system who will eventually become potential adopters need to have input into the selection of innovations (Katz, et al., 1975). Innovations that are influenced by public decisions based on fears their children will not be able to compete in the real world when they graduate guide choices that do not match the beliefs and value systems of those who need to implement the innovation.

Diffusion in Schools: A Comparison with Rogers' Work

While critiques of Rogers' work support the basic underlying theme of diffusion research, they do not agree that the diffusion results are as generalizable as Rogers' states (Charters & Pellegrin, 1972; Cohen & Bredo, 1975; Downs & Mohr, 1976; Sieber, 1975). Others (Fullan, 1982, 1991, 1993, 2001; Fullan & Hargreaves, 1991; Sarason, 1982, 1990) discuss educational reform focusing on the process of change and necessary support systems to implement innovations. There are too many factors in education that, on a daily basis, can fluctuate the success or failure of an innovation (Cohen & Bredo, 1975; Fullan, 1982, 1993; Fullan & Hargreaves, 1992; Sarason, 1982, 1990). Roles in schools can change from the principal to the opinion leader at a school, which will influence the diffusion of information. In addition, many of the studies by Rogers' are about an individual making a choice to use an agricultural product or a health product (Sieber). School diffusions deal with an organization and an individual. There are more layers in educational diffusion studies than in the agricultural, social science and industry studies Rogers' defined.

Downs and Mohr (1976) reviewed the literature on diffusions of innovations after Rogers and Shoemaker's (1971) first book and discussed complex issues arising in innovation research. In their work they defined the sources of instability and suggested prescriptions for research in education similar to Rogers' ideas of innovation but with a focus on educational concerns.

Downs and Mohr (1976) stated there are two attributes, primary and secondary, that have important implications to the relationship in theory building for innovations. These attributes influence how an innovation is portrayed within an organization and are defined as follows: "secondary qualities are those which are perceived by the senses, and so may be differently estimated by different participants; primary qualities are those which are essential to the object or substance and so are inherent in it whether they are perceived or not" (p. 166). The existence of these attributes affects the interpretation of an innovation among the potential adopters and assists in explaining differences in the research and theory. Downs and Mohr proposed the following prescriptions for research on innovation in dealing with the attributes:

> 1 - Use studies of different innovations to expose the impact of primary-attribute variation on models of innovation. This will involve observing and reporting the primary attributes of innovations and restricting generalizations from a given study to innovations in the same category of a primary-attribute typology rather than expecting all results to be identical.

2 - Measure the secondary attributes of innovations (compatibility, relative advantage, etc.) with respect to each organization and consider them as characteristics of adopters. (p. 712)

Charters and Pellegrin (1972) found, while studying four cases of differentiated staffing, that it would be impossible to establish criteria for adoption or rejection especially in diffusion where the innovation was not clearly defined. They found the "stages of innovation" created by Rogers apply to imported innovations not those innovations that are defined by local use and the meaning given by the participants.

Charters and Pellegrin (1972) warned against researchers using the language of an analytical model and to describe an innovation that occurred within the school boundaries. The researchers would miss the importance of certain aspects of the change process including "value conflicts, power struggles, and negotiations that might arise over what the innovation is to be during the formulation phase" (p. 13-14).

Cohen and Bredo (1975) stated that within the literature on educational innovation, the subject is often "handled in a diffuse but concrete manner, with emphasis on adoption rather than implementation. Little attention is paid to the way such innovations affect teaching" (p. 133). They identified current instructional and organizational practices as examples of changes in structure and technology of teaching and then examined what current practices mean for teachers in terms of working together and new ways of teaching. The focus for their research was not on the success or failure of adopting an innovation, but on the individuals who were responsible for the success or rejection of that innovation.

According to Sieber (1975) innovations are adopted in school systems, which are promoted by the public and are not necessarily the goals of the teachers. These innovations bypass all of the generalizing Rogers' characteristics of innovations because while there may not be any relative advantage, compatibility or ease of complexity, the innovation is forced upon teachers by pressures from outside the system (Sieber). "Indeed, political feasibility often carries greater weight than does educational value in determining the adoption of certain innovations" (Sieber, 1975, p. 80).

House disagreed with Rogers' (1983) theory that diffusion studies' outcomes are generalized across categories of research studies. House (1991) stated that trying to generalize events common to one site that would be common to another and therefore solvable based on results at the first site is useless because no two days, events, classes represent uniform interactions among common sets of variables. Dalton (1989) stated that it could be difficult from year to year to identify the opinion leaders in a school because of the increased teacher turnover and the teacher shortages. A teacher identified one year as an opinion leader may not be at the same school the following year. This will increase the uncertainty of the innovation in late majority and laggards (Dalton).

More recent reviews in educational reform address similar issues of the implementation process, effects of the innovations on teachers, and the different characteristics of educational settings, but their work is not built on Rogers' framework. This group is part of an "invisible

college" of researchers and students of educational change focusing on the point of view of the teachers, students, parents, and administration who are implementing the innovation.

Fullan (1982, 1992, 1993, 2001), Fullan and Hargreaves (1992), and Sarason (1982, 1990) have written extensively on the subject of educational reform and the process of change. Fullan stated reforms fail for two reasons: "the problems are too complex and intractable; and therefore, the solutions are hard to conceive and put into practice; and strategies used for implementation do not focus on the things that will make a difference" (1993, p. 46). Most innovation attempts oversimplify what will be necessary for the teacher, school, or local education institute to implement an innovation. Considerations for time, training, and resources are bypassed in the development of the innovation (Fullan, 1992; Sarason, 1982)

Reforms require teachers to make adjustments in many aspects of their teaching pedagogy. Teachers implementing new reforms change the curriculum material they use, change their teaching practices and behavior, and change their understanding of past experiences of educational innovations (Fullan & Hargreaves, 1992). Sarason (1982) stated "an effort at institutional change is observable by, has different meanings for, and will be differently judged by a variety of people in the setting in which change is being sought" (p. 79) in his discussion of the Rand Studies. Fullan (1982) compiled many of the theories and practices to explain change and what makes it successful. He asserted much is at stake with many of the changes in implementing reforms: occupational identity, a teacher's sense of competence, and a teacher's self-concept. In addition, he stated that successful implementation of an innovation is strongly related to a teacher's self-efficacy (Fullan).

Both Sarason (1990) and Fullan (1982, 1993, 2001) listed necessary ingredients for successful implementation of reform initiatives. Sarason reported the process of implementation requires a greater understanding of the settings in which the implementations will be maintained. Too often that understanding is faulty or incomplete and the reforms are not sustained (Sarason). He listed two understandings that should inform implementation: "a theoretical framework that makes sense of the reform idea… and a clear understanding of the context" (p. 122). Fullan stated that it was not enough to just explain the process of change. The influences on the change process were as important to understand how the process is affected by other factors. He also stated the importance of understanding what is happening at all levels in education; one level cannot be understood without the others (1982).

One final aspect of school reform that these researchers discussed is the need for collaboration and change agents. Fullan (1993) listed four components necessary to build greater change capacity in schools: vision-building, inquiry, mastery, and collaboration. Without these four components, Fullan claimed it would be impossible to learn or to continue to learn as much as is needed to be successful. He also asserted the importance of the role of teachers and their responsibility to be a member of the change process, seeking "collective inquiry and continuous renewal" (p. 39). Fullan and Hargreaves (1992) listed several things organizations must do to create successful implementation: "listen to and sponsor the teacher's voice, establish opportunities to confront assumptions and beliefs underlying their practices, and create communities of teachers who discuss and develop purposes together, over time" (p. 5). Fullan

acknowledged the need for a climate of support combined with a commitment to learning together.

These discussions were general to the topic of educational reform. Cuban's work (1995, 1992, 1990) discussed specific reforms implemented in the past while generalizing what allowed those to be successful or failures. The next section focuses the history of diffusion efforts related to computer technology in education, facilitators and inhibitors of educational technology and a comparison to Rogers' work. A specific innovation, computer integration in schools, and the implementation processes that have occurred are discussed which lead to the research questions.

Diffusion of Computer Integration in Schools

This section focuses on the diffusions of innovation relating to computers in education. The areas discussed are the history of computer integration in schools, the research identifying the facilitators or inhibitors of computer integration, and how this research compares with the research of Rogers' work and other diffusion of innovations in schools.

History of Computer Integration

Holloway (1996) reviewed past research in educational technology and provided a category overview of the three forms of research performed. He listed survey research, correlational studies, and action research as distinct categories. Early indicators in survey research was on who was buying what and how much. Learning and use were not considered indicators of adoption (Holloway). Correlational studies provided the most grounded speculation about what was happening in educational technology. Based on information from survey research, correlational studies provided the relationships during the adoption (Holloway). Action research provided an understanding of adoption at both the quantitative and qualitative level (Holloway). Holloway reported that action research studies "emphasize[d] a constructivist perspective" (p. 1109).

The context of many diffusion studies in educational technology was on the equipment being used in the schools, not on the effects of the new technology on the users or the integration of computers. These studies have included numbers of televisions and computers per school per student and on installing technology for instructional purposes rather than on the effects of technology in instructional settings and how the new tools were being utilized (Holloway, 1996). The evidence of learning outcomes was lacking in these types of studies (Fullan & Pomfret, 1977; Holloway, 1996).

Many early educational technology studies that focused on the equipment and not the individuals who were affected by the new technology missed important interactions between the students and the technology and the teachers and the technology. Equipment was easily measured and was often the major indicator of diffusion research (Campbell, 1971). Zoski (1989) reported twelve areas of focus including learner control and instructional strategies that were identified by leaders in the field of educational technology in a national study of research concerns. Each of these areas needed to be addressed to gain a complete picture of the factors that influence the adoption or rejection of an innovation.

Several researchers studied the impact of educational computing on teachers and their professional uses of computers. In a study on teachers' attitudes and computers in education, teachers viewed educational computing as an "add-on" to the existing curriculum and as a burden to be "squeezed into" the already loaded schedule of instruction (Dalton, 1989; Wiley, 1992). According to Dalton (1989), many teachers viewed learning the skills necessary to operate a computer as too complex requiring too much effort to master regardless of the benefits the computer may provide.

Canning (1988) found that the informants of his study, six teachers adopting technology, did not make a conscious decision to adopt or to not adopt. They believed that adoption would be inevitable, and they had accepted this perspective toward technology.

Mehan (1989) studied four elementary classrooms and concluded that how people used the computer and not the features of the computer determined how the computer would be used in education. He concluded that since the features of the machine could not be altered, it would be more informative to focus on how it was used.

Cuban (1993) reported that the acceptance or success of computers in the classroom was based on the belief systems of the teachers who were actually responsible for integrating technology. However, the impulses to bring technologies in to schools were for economic and empirical reasons and did not factor in the concerns of the teachers who would be using the tools the most (Cuban; Dalton, 1989). This theme of innovation integration based on outside pressure can also be found in other diffusion studies (Sieber, 1975) in education not just computer or technology innovations.

One way to improve our understanding of the impact of educational technology is to provide more studies in action research, according to Holloway (1996). "Action research has the potential to help us understand why diffusion and adoption occur as they do," said Holloway (p. 1109). Holloway stated, "the perception of the teachers . . . their real reason for use and nonuse, requires research that is reflective, grounded, and open" (p. 1130). These studies need to transpire in the natural setting of the adopters while the integration process is developing.

Facilitators and Inhibitors

The facilitators and inhibitors of computer integration with curriculum in education are similar to those facilitators and inhibitors in other school diffusions as stated previously (Lieberman & Miller, 1979, 1990; Little, 1992, 1993; McLaughlin & Marsh, 1979; Miller & Wolf, 1979; Schiffer, 1980; Sharan & Schachar, 1994; Welch, 1998). The superintendent, principal, and peers can all be either facilitators of a new innovation or inhibitors of a new innovation for any teacher. The teacher needs to feel support from the administration in adopting the innovation. Most of the uncertainty about the innovation needs to be removed before many potential adopters will implement an innovation (Rogers, 1983). According to Barker (1990), "teachers must be provided clear and relevant objectives . . . that are directly linked to instruction" (p. 35) if they are to transfer computer skills to classroom learning. This will be a motivational factor for participation and will assist in securing the success of the adoption in the schools.

Diffusion of computer integration in schools: Comparison with Rogers' work

Holloway (1996) stated the diffusion pattern is true of education in general since any study is time and resource intensive. Studies of diffusion of educational technology draw heavily on a research tradition of studies across disciplines. However, Holloway stated, "The weakness [in weaving together many research traditions in innovations] is that differences in settings and culture are less apparent" (p. 1120).

Holloway (1996) reported that the generalizability of diffusion research in educational technology is very limited. There are many variables that affect diffusion studies and since "few studies consistently identify the same sets of variables" (p. 1130) influences on diffusion studies are distinct to each setting (Holloway). He stated, "The change process is too often approached as an objective organizational alteration…rather than a cultural shift and the individual level…where the innovation occurs" (p. 1130). He concluded that the larger context of education and technology must be studied in order to understand diffusion and adoption of educational technology.

This section has included research and reviews of educational reform movements and innovations over a period of time. Educational reform movements inspired by Russian advancements in their space program propelled the movement in this country to enhance the focus on science and math to stay competitive (Miles, 1964). Cuban (1995, 1992) reviewed specific reforms, such as kindergarten, hot lunches, and summer school, and argued that it is difficult to generalize the success of an innovation without considering all factors including reinvention and changes to the reform made by teachers (1995). Little (1993, 1982), Lieberman and Miller (1990, 1979) and Miller and Wolf (1978) all studied the effects of change as a result of innovations and encouraged more staff development and opportunities for teachers to share ideas, lessons, and planning to advance the adoption of each reform. Finally, Holloway (1996) discussed the reform issue of computer technology innovations and the effects of these innovations in school systems. He argued for a wider range of studies to be performed to provide a wider variety of results and encouraged more action research studies to gain greater understanding of the end user's issues with adoption.

Collaboration

Collaboration plays a central role in school change (Fullan, 1982, 1992; Fullan & Hargreaves, 1992; Little, 1982, 1993; and Sarason, 1982, 1990). This section discusses the role of collaboration in change wherein three sections of collaboration are examined: definitions of collaboration in staff or professional development, features of collaborative efforts in schools, and contextual issues that facilitate or inhibit successful collaboration.

Several researchers (Fullan & Hargreaves, 1992; Hargreaves, 1994; Lieberman & Miller, 1990; Little, 1982, 1993; Little & McLaughlin, 1993; Miller & Wolf, 1978; Welch, 1998) attempted to define collaboration in staff and professional development. Little (1982) classified components that were key in collaboration efforts in professional development: teachers talking about their teaching; join work; teacher's planning; evaluating, and developing teaching

materials together; and teaching each other the practice of teaching. Hargreaves (1994) characterized professional development as a tool to take teachers to a level where they can learn from one another in a collaborative environment. Miller and Wolf labeled professional development as "the promotion of change in education and schools that improves the conditions for learning and teaching" (p 145).

An important feature discussed by researchers surrounding collaboration and staff development is collegial communities (Hargreaves, 1977; Johnson & Johnson, 1994; Little, 1982, 1993). Collegial communities are often small and heterogeneous with the goal of improving each other's instructional knowledge (Johnson & Johnson, 1994); develop from physical proximity and common circumstances among teachers (Little, 1993); and share grade equivalence and compatibility (Fullan, 1992) with the innovation being developed. Many social scientists built on this notion of the "norms of collegiality" and in studies of professional development highlighted characteristics that were common in successful collegial environments (Fullan & Hargreaves, 1992; Hargreaves, 1994; Lieberman & Miller, 1990; Little & McLaughlin, 1993; Welch, 1998).

Several researchers have identified necessary components of successful collaboration in schools. McLaughlin and Marsh's (1978) four primary components included: institutional motivation, project implementation strategies, institutional leadership, and teacher characteristics. Lieberman and Miller (1990) listed five elements they included as essential to the culture of collaboration in the professional development of teachers: "norms of colleagueship, openness and trust; opportunities and time for disciplines inquiry; teacher learning in context; reconstruction of leadership roles; and networks and coalitions" (p. 107). In addition, Little (1995) theorized that the conditions of a collaborative culture fall in to two categories: structure (time, space, authority and resources) and culture (values and beliefs about purpose and practice of education).

Lieberman and Miller (1990) identified the necessary support infrastructure to facilitate organizational change in education. The presence of a supportive principal and district, available resources to be accessed and used in different ways (a teacher can lead a workshop, for example), administration acknowledgement of the energy drain, and professional development activities on a constant basis will foster growth of a supportive culture. Sharan and Shachar (1994) stated that teacher participation should be authentic in school change. There will be tension and lower participation when administrators delegate authority. Welch (1998) listed several items which must be in place to support collaborative efforts: all individuals in a school community need to have similar values and goals regarding the education of all students and collaborative partnerships must be supported at all levels of the school system.

One of the biggest obstacles for successful collaboration and collegiality is "contrived collegiality" (Hargreaves, 1977). Structured activities, such as peer coaching, peer mentoring or other collaborative efforts, can alter and/or adjust naturally occurring relationships between teachers (Little, 1990). Grimmett and Crehan (1992) reported that contrived collegiality is when it is in the form but not the spirit of collegiality. Their example was one of an administration imposing collegial practices without regard for the culture of the teachers; that is to say, without regard for their beliefs, values and "norms" of professional interdependence. While studying

teachers and teaching, Hargreaves (1994) described contrived collegiality as mandatory planning and required meeting with different subject areas. He continued in his description with the lack of teacher empowerment given by administrators. Little and McLaughlin (1993) stated that contrived collegiality was collaboration imposed by others. Teachers would be invited to collaborate but only on agendas predetermined by decision-makers and administration. So if administration imposes collaboration, it most likely will not be successful.

For successful collaboration to occur in schools, teachers' values, beliefs, and objectives for teaching must be considered and at the center of the efforts for implementing change (Fullan & Hargreaves, 1992, Little, 1982, Miller & Wolf, 1978). Staff development is a teacher's continuous inquiry into practice (Lieberman & Miller, 1990). Staff development activities provide teachers with the opportunity to build upon their tacit knowledge and continually inquire about and analyze their values and practices for teaching (Lieberman, etal. 1990).

The next section focuses on a specific innovation that began in the Stewart County School Division.

A Case of Computer Innovation

Stewart County School Division began a division-wide effort to integrate computer technology into the curriculum and created opportunities for computers to become a part of the daily work of students as well as teachers. This section presents the context for this study of computer integration and the role of collaboration.

In May 1996, the General Assembly of Virginia passed the Computers/ Technology Standards of Learning (SOL) for grades K-8. These standards were designed to be the minimum proficiencies that students would be able to achieve by the end of grades 5 and 8. SOL implementation of these objectives was expected to begin at the kindergarten level and continue through each grade level all working toward the grade 5 SOL test requirements and then again continuing through grades 6 and 7 to achieve the grade 8 SOL test requirements. Around the same time, House Bill 1848, Guidelines for Technology in the Commonwealth's State-Approved Teacher Education Programs, was passed as a guideline for all teachers regarding technology competence.

The Stewart County School Division[1] school division initiated a pro-active step to diffuse the new innovation, the integration of computers to help meet the expected SOL implementation. The Office of Technology initiated the K-8 SOL Technology Innovation. This project included five different phases of activity and involved extensive participation by classroom teachers. These five phases were identification of proficiencies, sequencing grade-specific proficiencies, compiling of activities for proficiencies, assessment, and teaching other staff members about the proficiencies. Teachers were participants in all phases of the process. By including teachers, the school system attempted to hear from representatives of the various groups who would be similar

[1] The school division name and that of all the participants are pseudonyms.

in make-up as the teacher groups who would eventually be deciding to accept or reject the new innovation.

An important goal of the innovation was that all teachers share the responsibility for training the students. The school system did not expect the full responsibility of training the students to fall on the shoulders of the teachers in grades 5 and 8. The plan was developed so students would begin their training sequentially in kindergarten and continue learning different skills and expanding upon skills learned the previous year through the eighth grade.

In the first year (1997-1998) of this diffusion of innovation into the elementary schools, only two women were responsible for the maintenance of 54 elementary school computer labs and classroom computers. Classroom teachers who participated in Phase V were expected to be the innovators in their school, promoting the innovation among their peers. The women divided the region for school system in half and each was responsible for that one-half for the year. This became too burdensome for them, and the subsequent school year (1998-1999) each elementary school was assigned a technology teacher who was in charge of the lab, the maintenance of the computers, and the teaching of necessary skills to the students as well as the teachers. These Computer Resource Teachers became the main innovators at each school, completely committed to the implementation of the objectives of the new plan. The schools at that time were upgraded to IBM compatible labs and each teacher had a Mac computer as well as a PC in his or her classroom.

Because the Stewart County School Division took many pro-active steps to implement the new innovation, it became a model place to study the effects of a computer technology innovation and its influences on the daily process of teachers.

Research Questions

The purpose of this study was to gain knowledge of how teachers adopt or reject an innovation and the role collaboration played in the adoption process. This study focused on a portion of the innovation, a six-month period, after the introduction of computer resource teachers into the schools, during the innovation-decision process, and before complete adoption of the innovation had occurred. This was a key time to observe because the process of adoption or rejection had just begun, and many of the roles, innovator, early majority, laggard, etc., were still being defined. It was important to ask questions during their decision process and not rely on the participants' memory of how things happened or what happened.

Specifically, this study concentrates on the characteristics of the potential adopters as defined by Rogers (1983), how those characteristics influenced the rate of adoption of the innovation, what traits facilitated or inhibited adoption, and on the collaboration efforts made by the adopters to facilitate adoption in order to answer the research questions. There were two specific questions that guided this study:

1. How did this team of teachers integrate computer technology with instruction?
2. To what extent did collaboration facilitate the adoption of an innovation in the teams?

Chapter Three: Methodology

This investigation is a case study of seven, fifth-grade teachers, a computer resource teacher, and a researcher and their efforts to design, develop, and implement computer technology as well as adopt computer technology into their classrooms through collaboration. This chapter identifies the qualitative tradition that frames this study, describes the design of the research, explains the types of data sources and how these data sources were collected, managed, and analyzed. The issue of trustworthiness is also discussed.

Research Design

This research project was structured as an ethnographic case study with the intent to describe the team implementation of technology as a new part of the curriculum and to examine what these seven, fifth-grade teachers, a computer resource teacher, and the researcher said relevant to the adoption and integration of technology for a six-month period. According to Miles and Huberman (1994), case studies are the research methodology implemented when studying a sustained process in which a new innovative program by a school district could be described and monitored. These studies can provide great depth and detail of a single unit being studied. The research is intended to be both rich in detail and explicit about contextual factors that influence the research (Merriam, 1998; Miles, et al.).

This research project was designed as a case study to better understand how this group of teachers, as individuals and as teams, adopted and integrated technology into their current practices. The descriptions represented in this case study could be useful in presenting information regarding the adoption and integration of technology and computers in schools.

The Qualitative Tradition: An Ethnographic Case Study

The collaborative interaction among the participants and how their innovative characteristics shaped their view of integration of computers were studied. A key focus was the efforts in collaboration among the participants and their comfort level in adopting the new innovation of computers into their curriculum and work. The qualitative tradition of an ethnographic case study focused on the sustained processes of these participants. The innovativeness of each participant was studied as well as the time each team spent together working to achieve success with computer integration.

To gain a better understanding of the interaction among teachers, an in-depth engagement in the setting was required. A total of 72 days were spent in the setting collecting initial data for analysis and ten days were spent in the setting completing any final paperwork or data collection. The intent was to observe the seven, fifth-grade teachers in their natural classroom setting and in the computer lab. The observations included each teacher's class and recorded how each teacher functioned in his or her natural environment through his or her transition to the computer lab and back to the classroom again. In addition, observations of their daily interactions and conversations with other members of their grade level were recorded. The objective was to build a descriptive picture of teachers were adopting and integrating technology into their curriculum as mediated by collaborative efforts.

Setting

This investigation was located primarily in an elementary school in a southern suburb of a mid-sized city in the Mid-East. The road directly to the school is not heavily traveled and is fairly quiet. This area of the city is being developed for new housing and until recently was mostly farmland. Directly across the street from this school is a middle school. A new wing was added to the school 5 years ago due to increased enrollment. The hallways are divided up by grade level; however, with the hiring of several new teachers due to student numbers, some same, grade-level classes have been placed wherever an open room existed. The school has been fortunate to have enough room and has not had to rely on trailers being placed in the back of the school for more space.

The population of this school during the investigation included 875 students, 37 teachers, one principal and one assistant principal, and 15 teacher assistants. The average class size was 24 students. There was one teacher's aide per classroom in the kindergarten and in first and second grade classrooms with identified learning disabled children. In the third, fourth and fifth grade classroom, teacher's aides were provided to classrooms with special needs students.

The computer resource lab held 32 Compaq computers purchased in 1998, in the first round of the a technology project. All classroom computers were added to the local network. The library had all new computers that were networked to the local server and contained all the software that was available in the computer lab. Test scanners were provided to all elementary schools to score the quarterly reading tests. The score results were automatically downloaded into the connected computer's files created by the user and were used by administration to determine areas in reading for remediation.

Participants

The primary participants included seven fifth-grade teachers (4 females and 3 males), a computer resource teacher, and me, the researcher. Secondary participants included the administration and the gifted resource teacher. The fifth-grade teachers were selected because they have multiple responsibilities related to technology. They are responsible for teaching the necessary technology skills that will be assessed, and they must administer the state-mandated technology-standardized exam to their students at the end of the year. In addition they are required to take a technology exam for instructors that is based on the state technology requirement for teachers. The range of computer knowledge and skills the students need to pass the technology exam includes word processing (required at some point in K-4 grade levels), spreadsheets, presentation tools, and databases (each mostly taught in fifth-grade). The teachers needed to acquire the computer skills for themselves in order to pass the technology exam, and they needed to share this knowledge with their students to integrate technology ideas into their core curriculum lessons.

In terms of secondary participants, an additional staff member was included based on her input and interaction on the design, development, and implementation of new lessons for one of the teams. This additional teacher and the administrators were helpful in understanding how

collaboration occurs across subject areas. Also, the support and participation from the principal was observed to understand if this participation has any affect on the teachers.

The fifth grade case consisted of three new teachers and four veteran teachers at this school setting. These seven teachers created three teams who worked together and shared teaching responsibilities. Team members mentored the three new teachers on their responsibilities in the school and their roles as teachers. Only one team showed any mentoring of technology lessons as of an original meeting in November. At the beginning of the investigation, technology tutoring for the teachers was only occurring occasionally, and the grade-level had finally opted out of the tutoring by January because no new information was being covered to help them integrate technology better into their lessons.

Team One consisted of one veteran teacher and two new teachers. Ms. Cardinal, the veteran teacher of this team, had been teaching for eleven years, seven at this school. Upon discovering that technology would become part of the curriculum, Ms. Cardinal began taking as many classes as she could to learn the skills necessary to teach with the computer. Mr. Harley, a teacher of twenty-three years with experience in special education as well as regular education, transferred in to this school from another in the city. He first had a computer in his classroom in 1987, but he did not use the computer as part of his daily practice. Being new to this school, he relied on Ms. Cardinal to tell him what was necessary for the computer lab. Ms. Justice, the third member of this team, had been teaching for eight year, seven of which were in another state. She had worked in computer labs and had a computer in her classroom for all eight years of her teaching career. However, the difference at this school was the designing and developing component of lessons that use computers. She was not required to do that portion at her other school.

Team Two consists of two veteran teachers, Ms. Welch and Mr. Lawson. Ms. Welch has been teaching for twelve years, ten at this school and all in the fifth grade. She does not consider herself computer literate and did not use a computer in or out of school unless it had to be done. Her partner, Mr. Lawson, had been in education for twenty-five years. Twelve years were in a classroom and thirteen were in administration. He encouraged the integration of computers while in administration and was an avid user both at home and in school.

Team Three consisted of two teachers: one veteran, and one new to the grade level. Mr. Mulder has been a fifth grade teacher at this school for twenty years. He does not have a background in technology and only uses the computer for email to colleagues. Ms. Blue, his partner, has been teaching for three years and this was her first in fifth grade. She uses the computer at home more than school but had begun to record grades on the computer in the grading program provided by the school.

One computer resource teacher, Mr. Clark, was part of the study initially as he was the original change agent in the school trying to help the teachers adopt and integrate technology. This was his second year at this school and second year in education. He retired from the military after serving twenty years and made the transition into education. He had an extensive background in computers while working in the military.

I was the final primary participant. My role as the researcher was multifaceted. I originally entered the setting as a participant observer, and I was the instrument through which this information was shared. I was given an opportunity to enter the lives of these teachers whom I observed and interviewed for a 72 days. They afforded me a chance to discover their culture and gave up their time to help me succeed. I was compelled to participate in the work of teachers to meet the demands of reciprocity (Marshall & Rossman, 1995). I assisted them as well as I could without stepping out of the role of researcher.

My role in the setting shifted as time passed and relationships were established. I started off the study as an observer trying to gain entrance into the culture of teachers. As my role shifted to one of "helper" or "teacher's aide" in the classrooms, the teachers began to ask questions based on integrating technology into the classroom. My role then became one of a change agent for the fifth grade teacher for technology integration lessons. Mr. Clark continued supporting the other five grade levels, kindergarten through fourth grade, with their technical needs. The teachers remained the subject matter expert and the lessons created were based on their objectives and activities each teacher wanted the students to master. The technology integration component was co-created by the teacher and me. However, their views and opinions remained the focus in the design, development, and integration of lessons.

I attended planning meetings during normal operating times to see what typical collaboration was like. There were specific time periods when meetings were attended (i.e., the beginning of my observation to understand the setting, during testing time to understand the impact of the exams, and after testing time as they planned teaching strategies for the next year), but I did not attend all of them to encourage a natural dialog among the teachers. I did not intentionally express my opinion or biases about technology integration, but I offered assistance if asked and in doing so asked questions of the teachers to ensure that my assistance was still based on their need. When I was asked a question, I answered the question. I understood the mission of the school system in regards to technology integration. I attempted to guide the teachers in the direction of being successful with the school's intention without agreeing or disagreeing with the school's position. I was aware that my presence altered how some teachers engaged with others, but my actions were not meant to interfere with the "normal" activities of the teachers. My field notes included "observer's comments" to separate my own feelings and interpretations from that of the participant being observed. It was necessary to include myself in the field notes, as my presence was part of the interaction, intentionally, and unintentionally.

Because I was afforded this opportunity to work in the culture of these teachers as an observer, I stayed in the setting through the end of the school year even though my data collection stopped in May when the focus of the teachers shifted to the administering of SOL exams. There were ethical factors that I need to consider. I built a trust with these teachers so they would feel comfortable in my presence to talk about their experiences. I maintained a good working relationship throughout my study, respecting "norms of reciprocity" in that I could not be a sponge-like observer and offer no assistance in return for the open doors (Marshall & Rossman, 1995). The participation in the setting became less frequent towards the end of my time in the setting. I returned to the setting for 10 days following the exams to assist the teachers who participated with me in the study, to attend any follow-up SOL planning meetings, and to receive any clarification from observations or interviews.

Data Sources and Collection Procedures

Data collection for the study began on January 4, 2000 and continued through the administration of the standardized exams in May. Once the exams were given, participation in the field was spent following-up on data collected, attending meetings about projections for technology use in the following year, and finalizing any notes or interviews with the participants.

Two categories of data sources were gathered in this research: primary and secondary. Primary data sources included participant observation, interviews and field notes. Secondary data sources included a variety of documents (i.e., public records and personal documents). The following information related to each category is explained in this section: the purpose of the data source, what the experts have recommended in using and dealing with the data sources, how my own study was framed around the use of the data sources, and the collection of each data source.

Primary Sources

Three types of primary sources of data collection were used in this research: participant observation, interviews, and field notes. This section describes the sources, how these sources were used for data collection, and how each source framed the study.

Participant observation. Participant observation was my primary means of data collection. Participant observation afforded me two roles: one was to engage in the activities of the setting, and the second was to observe, report, and describe the aspects of the setting. The purpose of participant observation in the setting was to become immersed in the language and lives of the participants I was there to understand. By essentially living in the situation, I had a greater chance to understand the collaboration between teachers that took place over prolonged periods of time.

I gained initial entrance into the setting through the assistance of the computer resource teacher and the principal. My observations concentrated on recording the words and actions of the teachers as they dealt with technology in order to analyze them in greater detail later (Bogdan & Biklen, 1998). I had a legitimate role in the community being studied, but that role was limited, and I made every attempt not to interfere or influence the results of the study. By immersing myself into the school culture, I developed a unique perspective and understanding of the interactions between members of the environment (Bogdan & Taylor, 1975) as they collaborated on ideas or lessons that worked to integrate technology.

Interviews. The purpose of the interviews was to follow-up on the observations from the classrooms and resolves questions or issues created through the observations. Interviews are described as a conversation to obtain specific information. In-depth, semi-structured and informal interviews added to the theories developed in the observations (Bogden & Biklen, 1998). As Patton (1980) explained, "we interview people to find out from them those things we cannot directly observe" (p. 196). Rossman and Rallis (1998) stated that "talk" is essential for understanding how participants view their world. Interviewing also allowed participants a

chance to release what was on their mind (Bogdan & Taylor, 1975). I had an opportunity to learn what was important to the participants before focusing the research study. Moreover, these interviews combined with observations helped define how the talk changed across participant groups. Each classroom teacher participated in four, semi-structured interviews over the duration of the study for a total of 28 interviews and the computer resource teacher participated in three interviews.

Merriam (1998) suggested mixing the interview with description and setting questions at the beginning of the interview and building upon this information of how the participants describe their environment. She listed several types of good questions:

- Hypothetical: speculation as to what something might be like
- Devil's advocate: challenges participant to consider an opposing view
- Idea position: description of an ideal situation
- Interpretive: checking on your understanding; opening the floor for more opinions, feelings and information

The type of questions being asked in the interviews was an important consideration. (See Appendix A for interview questions.) I asked some pre-determined questions to guide the direction of the interviews based on my need for background information about each participant. It was important for me to understand their experiences with technology and their comfort level. This line of inquiry guided the initial interview. The follow-up interviews were semi-structured, there were specific questions pertaining to the study that were asked of all participants, but the interview was not bounded by these questions to allow for the participant to discuss issues that were important to his/her view of the culture. Important information could have been passed over if I only used to the interview guide. In the conversation a teacher may discuss something that happened last year with collaboration that could explain other events. Other information could have become available during the interview that could be of interest to the study, and I did not want to restrict any questions or answers for the participants.

The participants were each asked to engage in four, one-hour interviews during the study for a total of 28 interviews. In-depth interviews were used to clarify observations or to focus in on issues that emerged during the study. Each interview was conducted after three weeks of observation and one week of analysis throughout the study. Each set of interviews began with an explanation to the participant the purpose of the interview and contained, but was not limited to, questions pertaining to the things going on in the classroom, external activities such as staff development, and planning meetings. The objective of each set of interviews was to find out what the participant being interviewed thought about collaboration with his or her peers and how the adoption and integration of technology was occurring.

Field notes. The purpose of collecting field notes was to maintain a written account of the observations in as much detail as possible. Bogdan and Biklen (1998) defined field notes to include "descriptions of people, objects, places, events, activities, and conversations. In addition, as part of such notes, the researcher record[s] ideas, strategies, reflections and hunches, as well as note patterns that emerge" (p. 107). In this study, field notes were recorded each day during the study and for each different class and teacher observed for a total of 389 pages of field notes. The amount of notes taken during the observation varied depending upon the extent of my

participation in any given setting and time. Notes were jotted down whenever possible during the session to remind me of important issues from the session; however, greater detail was audio-recorded and written down immediately after the session was over. Immediately following a session, I took a break from observing and went to the library or another quiet room to audio-record and write down details that I observed in chronological order during the session.

The field notes contained descriptive and reflective materials (Bogdan & Biklen, 1998). The descriptive part includes the greatest amount of information. The objective of the field notes was to capture for the reader what was occurring in the setting. The field notes were very specific to the daily interactions of the teachers as they moved throughout their day. I used the six key points in the descriptive aspect of field notes by Bogdan and Biklen listed above as a checkpoint during analysis to ensure I was gathering all the necessary information. The descriptions helped answer concrete questions about what was actually said or done.

The reflective side of the field notes was my own journey through the data. This section contained feelings, speculations, problems, ideas, and prejudices from my side of the setting (Merriam, 1998). This section became my confessional where I was able to admit mistakes or inadequacies. I planned additional research ideas in this section and asserted what the outcomes of the study might be. The notation, "O.C" (observer's comments), mark this section of the field notes. These were my own observations, biases, surprises, comments, and interpretations of what was observed. The field notes were a way to track my own interpretations and my own participation in the setting.

Field notes were also used after face-to-face interviews with each participant to record what was going on around the room during the interview and any additional dialog that may have occurred before or after the taping began. The tape recorder, used during the interviewing process, picked up the dialog, but other factors not recordable, like gestures or different people that may have come in during the interview that may have influenced the session, needed to be recorded on paper. (See Appendix C for examples of field notes.)

Secondary sources

Secondary sources consisted of a variety of documents (i.e., public records and personal documents) and were used to supplement the primary sources of observation and interviews.

The personal documents that were collected during the study included recorded journals each participant taped during the study. The purpose of journals was for the teachers to be able to record personal reflections and interpretations of the interactions they had with other members of their grade level. These were personal documents that were created within the bounds of the research. The journals were a way for teachers to discuss their experiences and feelings about technology integration. The journals also gave me a sense of their organization of time and materials and when technology was going to be used in a lesson. Since I was not able to be in every classroom every minute, the journals were a connection to occurrences that I might have missed. The entries into the journals were usually daily and were collected once a week for processing, transcribing, and analysis.

Another set of personal documents collected were audio-recorded team meetings. I recorded those team meetings I was able to attend, or they were recorded by a teacher liaison who agreed in my absence to record the conversations. The purpose of audio-recorded team meetings was to record planning meetings they had with each other as well as those meetings with the computer resource teacher. These audio-recorded tapes afforded exact details of who spoke, how often they spoke, time on task, who came to the meetings but just listened, and so on. The tapes documented the verbal interactions of the fifth-grade teachers and offered insights into the different kinds of interaction with or without the computer resource teacher and with or without my presence as well. I tried to attend some of the meetings to understand their engagement in meetings. I was absent, however, from other meetings to encourage natural talk that might have been altered in my presence.

Public records were collected to support assertions made about the integration plan. The Technology Integration Project was a public record that was collected to support the initial interest and purpose of this investigation. The collaborative technology lesson plans, collected with permission, to support assertions made during the study were another set public documents collected.

Management of Data

Bogdan and Biklen (1998) offered suggestions for novice researchers to remember when dealing with the data. Their suggestions included the understanding that these processes are time-consuming and setting aside adequate time to deal with the information. Another one of their key points is to not procrastinate with the data. Rossman and Rallis (1998) stated the importance of disciplining yourself to deal with the data every day and also suggested logging the day's activities including information such as the date, what was done, time, place and participants of the activities. Data should also be kept on attendance to any special events and maps of the settings. They suggested building in quiet time during each day of the study for reflections and writing up field notes. These practices helped me keep my information intact, complete, organized, and accessible (Rossman & Rallis).

Following these suggestions, after each day's worth of observations and/or interviewing, the notes from the day were transcribed onto the computer or noted in journals. This allowed me the chance to review my notes and make sure I had captured everything I can remember about that day's events. Each set of notes transcribed was printed in two copies and reread for pertinent information. Separate sheets of important information and general assertions were created for each set of notes and placed on top of those notes for easier access to the information later in the study (Merriam, 1998). Each set of transcriptions was then analyzed (see analysis section) and general assertions were made that guided the next phase of the data collection. After this process had been done, the transcribed field notes and interviews were categorized and filed in folders based on these initial, general categories:

- Participant
  - Observations
  - Interviews
  - Journals
- Planning meetings without CRT

- Planning meeting without the researcher
- Planning meetings with CRT
- Planning meeting with the researcher

Each of these categories had its own hanging folder for information storage, and the participant folders had additional sub-folders for observations, interviews, and journals. Additional folders and sub-folders were created for documents and as assertions were formed from the data.

Data Analysis

"Data analysis is the process of systematically searching and arranging the interview transcripts, field notes, and other materials accumulated to increase understanding of them to enable the presentation of what was discovered" (Bogdan & Biklen, 1998 p. 157). Data analysis, according to Merriam (1998), is making sense of the data by consolidating, reducing, and interpreting what people have said and done. The purpose of the data analysis was to work with the data, arranging and rearranging the collected information into manageable units searching for patterns and sharing results and interpretations with others. The analysis of data was done in many steps and contained different elements from the collected sources.

Initially, data were collected in broad categories based on the scope of the study, and as the study continued, the data collection became more focused and refined based on the emerging categories of study including the characteristics of the participants and how their characteristics influenced their decision to adopt or integrate computers in their classroom (Bogdan & Biklen, 1998). I collected the data, analyzed the data, made assertions about the direction of the study, and identified new data to be collected. I continually modified my plans and narrowed down the study to a more directed collection of data and analysis (Bogdan & Biklen). The data were classified in terms of the initial general assertions was then classified in more specific categories as the design becomes more narrow in scope (Holloway, 1996).

I followed the advice of Merriam (1998) and analyzed data during the collection procedure. Following Merriam's prescriptions, after each observation and transcription to field notes, the notes were read and reread commenting on areas of interest, concern, questions, or general assertions. The second set of transcribed notes were read and reread following the previous set of guidelines.

The interviews were audio-recorded with the permission of the participant. The recorded interviews were transcribed and returned to the participant within one week to allow the participant to make any changes or adjustments that he or she wished to make to the original statements. The information from the interviews was added to the field notes from the observations to be analyzed and helped to create assertions that guided the duration of the study.

Once this second set was completed, the first two were compared for consistencies, discrepancies, and similar assertions made. A new sheet was made consisting of both transcribed notes information and assertions to be measured against the next set of field notes. This process continued through each day's notes and interview transcriptions. Doing this allowed me to see

what was happening in the setting and gave me a chance to ask important information right away instead of waiting until the end to think of additional questions.

Coding

Bogdan and Biklen (1998) listed general coding possibilities that included but were not limited to the following examples:

- Definition of the situation codes: participants' definition of the setting; their world view
- Perspective held by participants: thoughts shared by participants that indicate shared language or points of view
- Setting codes: most general descriptions of the setting, classrooms, computer lab
- Process codes: some categories that might fall under this heading could be "the school year" or "stages in the career of a teacher" (p. 174)
- Activity codes: regularly occurring behavior
- Strategy codes: ways the teachers accomplish the integration of technology
- Relationship and social structure codes: descriptions of relationships within the social structure of the culture.

Coding, according to Merriam (1998), is assigning shorthand designations to aspects of data to be able to retrieve that information later during analysis. The shorthand designations can be numbers, letters, or even small words. These designations are concepts indicated by the data; they are not the data (Taylor & Bogdan, 1984). Based on the suggestions of Bogdan and Biklen (1998), Merriam, and Taylor and Bogdan, coding categories and sub-categories were established and used during the analysis process. (See Appendix B for coding categories)

Once the field notes were transcribed into a computer, the documents were read and reread for coding placement. These coding categories were my initial guide to breaking out important information from the observations. There were several sub-headings under these general categories as the process continues. After the coding was done, some initial assertions were made based on the differences in personality of each teacher that guided the interviews for clarification and that also guided the next three weeks of observation and engagement in the setting to confirm or disconfirm the original assertions. This process was continued during the study. Assertions made and monitored were based on each teacher's choice to adopt or integrate technology and what factors influenced that choice.

In analyzing all the collected data during the week out of the setting, I made general assertions about the study after reviewing and rereading the field notes from observations, transcribed interviews, and additional artifacts and documentation collected during the study. After determining the general assertions I followed, I reread through all of the collected data in search of sub-assertions and to disconfirm other assertions. This was a systematic search to piece together fragments of information that framed the general assertions. In the next round of reading the notes, I connected these "key linkages" and placed these matching ideas on note cards to review the connections to the sub-assertion. An important part of my process was to find the disconfirming evidence as well as any confirming evidence, maintaining an open mind to reframe the assertions with each round of analysis.

It was important to identify the evidence to support my assertions and that this evidence was triangulated from varied sources (both by participants and through different data collection means). Strength of assertions was based on the amount and quality of supporting information as well as verification of those assertions across sources. A strong assertion was supported by observations, journal entries, and interviews. Weaker assertions that were not supported were maintained separately in case the assertion appeared again later and were eventually detached if no other evidence presented itself.

The next part of data analysis was writing up the assertions in particular descriptions (Erickson, 1986). Particular descriptions included vignettes of the every day lives of the participants written clearly and with enough detail that the reader could have a sense of "being there." These vignettes established what people were doing during different parts of the study. Supported with evidence from observations and interviews, these vignettes set the stage for the reader. Direct quotes were another tool used in the write-up to express the participant's point of view. (See Appendices C, D, and E for examples of data analysis.)

Trustworthiness

Goetz and LeCompte (1993, 1984) have written extensively on ethnography and qualitative design in educational research in which they discuss the major issues of reliability and validity. In their first book (1984), they stated that reliability was the "extent to which studies can be replicated." In a reexamination of their work, LeCompte and Preissle (1993) changed the terminology from validity and reliability, which take on quantitative and conventional usages, to "trustworthiness" which greater reflects the nature and research processes of qualitative investigation. They list several criteria necessary to ensure trustworthiness in the qualitative study:

- Participant corroboration
- Theoretical and empirical consistency
- Rigorous review by peers familiar with similar methods
- Personal reflections and introspections
- Later contributions by others in the same field

In my study of the fifth-grade teachers, these criteria for trustworthiness were adopted during each phase of the data collection, processing and analysis.

Participant Corroboration

Each participant was afforded opportunities to read transcriptions of their journals. At any time, participants were allowed to read my field notes and observations if they were curious about what was being written. After each interview, the data were transcribed and the participants could read the information to ensure accuracy.

Personal Reflections and Introspections

Once the study was complete, the next several months were spent reading and rereading the data. A friend, who knew about my study from the beginning, read the transcribed interviews, notes, journals, and observations to corroborate my assertions and to point out angles

I was not seeing. I asked her to assist me because she has her Masters in Elementary Education and Speech. She was continuing on to another advanced degree and had also done research in an elementary school setting. She was not involved in the Instructional Technology program with me, but that provided me with a different perspective on the data collected. I also walked away from the data for a month to gain a new perspective on what I had seen and recorded.

Each phase of the study addressed concerns of trustworthiness. Some concerns with data sources, according to LeCompte and Preissle (1993), could be where and when the study was done. For example, if the participants are from a place that is not easily accessible and facts are not easily examined, the study may carry more credibility than one done on the neighborhood school. However, if the neighborhood school participants can speak out, for or against the study, those questioning the study may be less apt to discredit the work. The participants had every opportunity to read passages and parts of the study, and while I did not get complete consensus, the participants had their chance to revise portions.

Another factor that created a concern for the trustworthiness of this study was my own experience or lack there of. Certain factors about who I am, where I was educated, who prepared me, how I reported my participation in the research and whether or not I made efforts to self-monitor my engagement generated some doubt about the credibility of the study. I was the filter through which this information was transmitted. My background was in teacher education, and I worked in a middle school as a teacher's aide. I am interested in technology integration as a field of learning and have had experience in trouble-shooting computers for use in schools. These experiences shaped the way information from the participants was described. I took every opportunity to have the participants proof all my drafts to ensure their voices were the ones coming through the descriptions. LeCompte and Preissle (1993) stated the possibility that the more open I am with my novice experience and that I acknowledge my weaknesses could give my study more credibility in the end.

It is important to state up-front that I cannot begin to assume that I captured the level of understanding necessary to keep the field notes untainted. I tried to take into account the perspectives of my participants and tried to understand who they are, where they came from, what went on during the day, and where their ideas came from and added to that my understanding of who I am and where my ideas come from. To check my interpretations and myself, the observations guided the interview questions to uncover meaning that I may not have. Also, teachers were given an opportunity to read the observations to add or offer details that were missed because of my peripheral engagement in the culture.

The write-up contained my own reflections and comments. I could not describe the setting without discussing my impact on the setting. I did not want to deny my participation in the setting or how that participation may have affected outcomes. There was a running account of my own commentary and the changes in my point of view during my time in the setting. It was important to describe my role in the report and constantly examine its influence (Savenye & Robinson, 1996).

I was the tool that collected the data, but the data were not mine alone. I had assistance from the participants in making sure I expressed their views of their culture during the

integration of technology as accurately as they saw fit. I am a novice researcher and used the guidance of committee members as we discussed my assertions, data collections techniques and directions for the continued study. I was in the setting to learn about the process of researching, to engage in a lengthy study of teachers in an elementary school as they adopted and integrated technology into their classrooms, and to report on my discoveries and their realities.

Chapter Four: A Case Study of Fifth Grade Technology Integration

When the school division initiated the adoption of computer technology as an innovation, the teachers studied began their work to integrate lessons that included use of a computer to enhance their daily lessons and to integrate the computer into their daily administration. This chapter identifies the players, i.e., the teachers, and adoption categories of each of the teachers as individuals and of the teams as a group, describes each teams' efforts to adopt the innovation, and discusses the research questions in terms of the emergent themes from the data collected.

Players and Adoption Categories

This investigation focused on a case of computer integration into the curriculum and the daily practice of seven fifth grade teachers and one computer resource teacher. The teachers taught in teams: two teams of two teachers and one team of three teachers. There were distinct differences within each team, and there were different degrees to which each team adopted the innovation. The team of three teachers – Team One – was categorized as early adopters, the first team of two teachers – Team Two – was categorized as early majority, and the final team of two teachers – Team Three – was categorized as late majority.

Table 1

Teacher Identifiers and Category of Innovativeness

Team Number	Teacher Identification	Innovativeness
Team One	Three Teachers: Ms. Cardinal, Mr. Harley, and Ms. Justice	Early Adopters
Team Two	Two Teachers: Mr. Lawson and Ms. Welch	Early Majority
Team Three	Two Teachers: Mr. Mulder and Ms. Blue	Late Majority

Earlier innovators, in this case study, were the members of the Department of Education who had presented the ideas of technology competence to the lawmakers. Locally, the innovators in this case study were the technology coordinators, who had done the greatest amount of work in getting funding and grants to initiate this project within the schools division. In this study, the initial change agent was the Computer Resource Teacher, CRT. However, as time in the setting continued, I became the change agent as my role was redefined from observer to full participant.

Computer Resource Teacher – Original Change Agent

Mr. Clark was hired by the school system after the initial innovators, the coordinators of the technology in elementary schools, realized there was too much work to be done in the schools, and a person needed to be in each school full-time to assist with adoption of computers. Each school hired a Computer Resource Teacher (CRT) to promote the innovation and to provide assistance to the faculty on the adoption of the project. Many CRT's were teachers within the school system who were hired to implement the new project. Some like Mr. Clark, were retiring from other fields such as the military, and were entering an educational setting for the first time. Opportunities were provided by the school system that afforded the CRT's a chance to exchange information, concerns, and lesson integration ideas.

Mr. Clark saw this program as essential to the academic program of each school. He was excited about the opportunity to work in a school system and help them maintain the computer networks being established. Mr. Clark worked long hours the first year the CRT's were hired making sure that each machine was working and contained all the software necessary for the computers to be used in both the lab and the classrooms. He organized each classroom setup as best he could despite the inconvenient location of many of the network drops in the classrooms. He was meticulous about the lab appearance and the cleanliness of all the computers. As far as he was concerned, he was "doing the job the administration was asking him to do." Despite having a great deal of technical knowledge and being the technical expert in the building, Mr. Clark was still a novice. While he exceeded his job requirements for technical support and expertise, he had not been a teacher and had not been a part of a culture of teachers designing, developing and implementing lessons. He had no prior knowledge of working with teachers and teaching curriculum.

Mr. Clark created a comfortable work environment with the principal, Mrs. Presley. She had a clear mandate from the Superintendent to implement technology and hired the best person she could for the position. Mr. Clark and the principal discussed every move he was going to make including what to do with his time during the day. The maintenance of all the computers was a big task and that would be Mr. Clark's focus.

Mr. Clark's said, "Mrs. Presley wants me to focus on the maintenance of the computers. As I understand it, the teachers are to create the lessons in the lab and I am to provide assistance only when they ask me." He was not to teach the lessons; the principal wanted the teachers to be comfortable in the lab and expected the teachers to work with or without Mr. Clark in the lab. Many teachers rose to this challenge; however, there were some who did not have enough skill or knowledge to feel comfortable in the lab.

Mr. Clark and the teachers did not share the same beliefs and values about teaching and this created a communication gap. The teachers expressed concerns regarding the training session provided by the CRT on Monday mornings, so Mr. Clark stopped offering lessons to the teachers. This widened the gap of collaboration. After my entrance in the setting and my interactions with the teachers, Mr. Clark asked me to be "the go-between for him and the fifth-grade." He said, "A lot of objectives need to be covered before the end of the year, and if they do not want to work with me, I am afraid it will not get finished." He acknowledged that I had a better understanding of their needs, so his interactions with the fifth-grade ceased until May before the SOL exams were given.

At the end of each school year, the fifth grade students take a technology exam for competence. Mr. Clark used the last month of lab lessons to review essential knowledge with the students. The principal allowed him to take one Physical Education class period the week before the exam and to give all fifth grade students a practice test. This provided Mr. Clark with great success on the end-of-the-year exam and his scores have remained in the 90th percentile.

Mr. Clark said, "[Computer] technology is going to have a greater role in education than it does today." "The teachers will have to learn more about computers and computer integration because the school division is investing a lot of time and money to have computer labs in every school, and [the school division will not] just walk away from this investment," he said. He envisions a laptop on every desk with a portable, wireless teacher station at the front of the classroom within five years. He expects that students will be taking exams on the computer instead of paper and pencil tests and as the test is submitted to the teacher it will automatically be scored for the teacher. "When that happens," he said, "The teachers will need to be comfortable working with computers, so we (Mrs. Presley and he) are working to make sure the teachers start learning now."

Mr. Clark said, "[his] role will become more technically oriented" as the school division advances their mission for computer integration. Within three years, Mr. Clark predicts having three to four networked computers in each classroom and having a second computer lab to run to provide all the students with an opportunity to go to the computer lab once a week. He will be "very busy maintaining all the equipment" and will not always be available to help the teachers in the lab. He wanted them to become comfortable designing and teaching lessons now, so he can provide support when he has time. He did not want them to rely on him so much that when things change as he anticipates, the teachers would be left without any prior knowledge or experience working in the computer lab.

Mr. Clarks works to "keep his principal happy and to meet her goals for the school." As long as his end-of-the-year scores remain high and all the computers are maintained in the school, there would be no reason to change the way things were working in the computer lab.

Team One

Team One consists of three teachers: Ms. Cardinal, Mr. Harley, and Ms. Justice. This was their first year working together. This was Ms. Justice's first year in this system and Mr. Harley's first year in this school and in a regular education classroom after having spent 11 years in special education. Ms. Cardinal has been at this school for six years all in fifth grade.

Ms. Cardinal – early adopter. Ms. Cardinal has 11 years experience teaching, all in fifth grade. Her philosophy of teaching is "kids should have fun and not realize they are learning." She felt technology fit in her curriculum as long as it was taught in the proper way. She did not want the experience for the students to be a "sit and do as I say while never getting to experiment." The computer would become just "one more thing kids hate about school if they could not create or imagine." "Computer integration," stated Ms. Cardinal, "is an on-going process."

Ms. Cardinal works hard to provide her students with a multitude of learning experiences. She works with the inclusion students, so she feels it is her responsibility to teach to the needs of all her students, not a particular group. She tries to provide lessons that differentiate instruction to maximize the potential for her students. An example of this is a vocabulary game she created for technology terminology. She did not like the way the CRT quizzed the students at the end of the year as practice for the SOL test. This did not work well for her children. "Many," said Ms. Cardinal, "can't even read the questions." Instead, she created a round-robin vocabulary game where students read a question; the answer was on another question strip. When a student had the sheet with the correct answer, he or she then read the question on the strip. The kids learned more by hearing and reading, and it became a game that was fun for them.

Her classroom arrangement changed depending upon the units being taught. If she has math or social studies units where students need to work in groups, for example, she arranges the desks into the groups she wants the kids to work in. She also puts the students in rows when she needs to regain some order to the classroom. The computer is located in the front corner by the door. Her desk is in the back as well as a sitting area with a small carpet and a couch for students to use during reading time.

Ms. Cardinal is very comfortable working on a computer. She has two sons in high school and her husband is self-employed. Often she would help him take care of his bookkeeping all done on the computer. There are several computers at home for her to use. She was not afraid to experiment and often searched on-line for lessons that she could use in the lab for her students.

When the CRT first arrived at the school, she approached him about some ideas she had seen in other schools. She was hoping to help create a lab environment that would be easy for students to work in. For example, Ms. Cardinal told the principal and the CRT about one CRT who had created Velcro hands that the students could attach to the top of the monitor when they had a question. This encouraged the students to keep working until the CRT could get to them. The CRT would them put the hand back on the bottom of the monitor after the child was assisted. The CRT's response to Ms. Cardinal's suggestion was there "would be no cutesy things going up in my lab." Ms. Cardinal was upset and embarrassed by his reaction. Ms. Cardinal said their next team meeting was when the CRT informed them he would not be helping out with teaching in the lab.

Ms. Cardinal was not happy with the way the CRT program was run at her school. She realized she had to depend on her own knowledge, so she signed up for as many classes as she could take after school and in the summer to become more familiar with what the students needed to know. In many of the classes she took, she met CRT's from other schools who told her that they were doing so much more to help their teachers create lessons in the lab. Many of these CRT's shared their lessons with the teachers. She had expected the CRT to be someone who "guided the teachers through their learning process in the lab as well as help write lessons based on the technology goals." Ms. Cardinal also secured several volunteers to come in and help her when she is in the lab so there is more than one adult in the room to answer the students' questions.

Ms. Cardinal learned a great deal about integrating technology from many of the classes she took. She created a variety of lesson plans and was told about different websites to go to find appropriate material for her students. In January she was teaching the students how to create an advertisement for a book that the students had read. The students were creating pictures in KidPix Studio and then copying the pictures into a Word document. In the Word document the students would add the text for their advertisement. Several language arts SOL's as well as technology SOL's were covered in this simple lesson. Also in January, Ms. Cardinal introduced databases and had each student create a simple database of the books they had read. The students would update the list with every new book.

In February for African American and Black History Month, she had the students research 3 famous African Americans. She found a website that listed over 300 biographies. The students had to write down facts about two of these people and the third person was to be the subject of an acrostic poem. On President's Day, the students had a crossword puzzle to work on. Ms. Cardinal went to Scholastic.com website for lesson ideas, and one of them was a crossword puzzle with a link to a presidential website. The students read clues and looked up the answers on the website and filled in the puzzle. She had the students work in teams to make sure everyone finished on time.

Ms. Cardinal accepted the computer integration as another way to help reach her students. As long as she kept the lessons fun and informative, she believed the students would learn and not be aware they were learning. She was not afraid to try new things and often practiced the lesson several times before presenting new ideas to her students. She would write down glitches students might encounter with the directions and keep those around so if students had the same problems, she would remember how she fixed it.

Mr. Harley – newcomer. Mr. Harley is one of Ms. Cardinal's partners. He had been teaching for 23 years. He taught nine years in regular education and then taught emotionally disturbed students for 11 years before going back in to the regular education classroom. His first experience with a computer in his classroom was in 1987 in a private school in North Carolina. He continued to see the importance of computers in education grow with each new development and with each new software package created for students.

Mr. Harley was an energetic teacher who constantly tries to find new ways of looking at the same problems. When working in Science, often the students did not understand the concept of cells and atoms being presented in a two-dimensional way, so he asked a student to look on the Internet for information. It became a lesson for the student in searching the Internet and a lesson in being self-sufficient to find answers to questions. The student found a picture of an atom that was three-dimensional and Mr. Harley moved the monitor so the whole class saw the information. His impromptu teaching with the computer created new directions for students asking and answering question.

Mr. Harley's classroom was set up in rows with spaces between each student on all sides. Mr. Harley found it easier to work in rows since he taught several different classes, both subject and student. His desk was in the back of the room along with a rectangle table where he

conferenced with students individually or in small groups. There was a TV/VCR stand that could float around the room depending upon space. The computer was in the front of the room along the chalkboard, which had posed a problem not only for Mr. Harley but also for the computer. "Chalk dust and computer wiring," Mr. Harley said, "do not mix."

Mr. Harley admitted that he approached the computer lab with anxiety. He did not see himself as computer literate based on his lack of typing skills. He said he had a computer at home and all he knew about using it was opening ClarisWorks or the Internet. After discussing some computer software packages with me, he went home to ask his wife, and she showed him their computer already contained the Microsoft suite of software. He said he "often relies on student knowledge to help him through a computer lab lesson." This bothered him. He could see the importance computers would play in the future of learning, but he was not the qualified person the students needed to teach them the necessary skills. For Mr. Harley, "computer lab was like art and music," a specific skill you go to school to learn about to teach.

Because there is no term in Rogers' theory (1983) to explain the status of people who enter an innovation after it has started, I placed the two new teachers in a newcomer category. A newcomer was someone who entered a setting where an innovation had already been put in to place. A newcomer would not have any preconceived notions about the setting, participants, or the innovation. Mr. Harley was a newcomer to this innovation. Having not been a member of the staff at this school, he did not have an opinion to adopt or reject the innovation presented to him. He had no prior experience with the original change agent – the CRT, so he had to look within his grade level and team members for guidance. He had a strong team leader in Ms. Cardinal and followed her opinion leadership. She was supportive and understanding to his concerns about the computer lab and provided him with the necessary guidance to be successful working with his students in the lab. Ms. Cardinal provided him with a volunteer to help him in the lab as well as shared lesson plans. Mr. Harley landed in the middle of an on-going process and because the leadership of his team had already accepted the computer integration, it was an easy transition for Mr. Harley.

Ms. Justice – newcomer. Ms. Justice had been a teacher for 8 years. Her first seven years were in another school district. This was her third year teaching fifth grade. She believed that every child can learn, and it was up to the teacher to tap into the interests of her students to find engaging ways to teach based on those interests. Computers can fit into her teaching pedagogy; however, she reminded teachers around her that not all students enjoyed working on a computer.

This was her first year in a collaborative, team-teaching setting. In her last two schools, the system she was in did not encourage team-teaching. She enjoyed working with two other teachers and having another body to bounce ideas off of, but it was hard at times having three different groups of students. Ms. Justice was a stern teacher, but she tried to be fair to all her students. For example, after a substitute teacher had been in a note was left listing all of the problems she had with Ms. Justice's class. Ms. Justice had a long discussion with her class about the behaviors that were and were not acceptable and listed the privileges that would no longer exist in her classroom. This upset many students because the whole class was being punished for the few students. She agreed to think about changing her mind, but she stated she needed to

know who caused the trouble. None of the students wanted to speak against his or her classmate, so in computer lab, Ms. Justice had the students write her a letter claiming their level of responsibility in the previous day's activities. She promised to read the letters and write back to each student explaining their punishment. This strategy worked out very well for her in this incident. "My students," she said later, "opened up to me after this and we had greater success in solving problems."

Like Mr. Harley, Ms. Justice keeps her classroom in rows, but the desks are next to each other for group work in Math and Language Arts. The computer is in the front by the teacher closet and by the door. Her desk and worktable are in the back and she has created a reading area similar to Ms. Cardinal with beanbags where students can sit for reading. Her classroom is on a different hallway than the other fifth grade teachers. This can cause some problems, especially when important information needs to be passed around the grade level quickly.

At her last school, Ms. Justice went to the computer lab two times a week. The only thing new for her at this school was that she had to teach the lessons in the computer lab herself. She stated that she "was not a computer shy person, but to teach tools I had never used was hard." She was overwhelmed at times learning not only a new curriculum in math and language arts but also all the technology skills she was expected to teach as well. She was not frustrated by anything because she was too busy planning and spending her time figuring out what she would be teaching. Ms. Cardinal had been going to the lab on Thursday and Ms. Justice on Monday, but this arrangement did not help with planning. So Ms. Cardinal switched to Monday and shared her ideas with Ms. Justice. This arrangement helped Ms. Justice cover all the objectives and continue to focus on the core curriculum subjects.

Like Mr. Harley, Ms. Justice is a newcomer. Ms. Justice was comfortable with using the computers in her classroom and saw the importance of computer integration into her curriculum. She was nervous about taking on the responsibility of teaching computers, but with the support of her team leader, Ms. Cardinal, Ms. Justice even began planning lessons for the lab, which she shared with Mr. Harley and Ms. Cardinal. Again, Ms. Cardinal's strong opinion leadership assisted Ms. Justice with the transition into teaching in the lab.

Team One Summary – Early Adopters

Ms. Cardinal, Mr. Harley, and Ms. Justice were part of the early adopters of the innovation to integrate computers into curriculum. Ms. Cardinal served as a role model for Mr. Harley and Ms. Justice. She was comfortable enough with the task presented to her and shared any knowledge and experiences she had had to make the transition for Mr. Harley and Ms. Justice easier.

Ms. Cardinal, Mr. Harley, and Ms. Justice were in the confirmation stage of the "innovative-decision process" (Rogers, 1983, p. 184) and were now working on maintaining the successes of their choice to adopt. Ms. Cardinal saw immediately that the computers were not going to be phased out after a few years. Her advancement in the innovation-decision process and her confidence in using the computer lab provided enough security for Mr. Harley and Ms. Justice to confirm the use of computers in their daily work as well. Ms. Cardinal's leadership on

this team as well as in the school eliminated much of the uncertainty for Mr. Harley and Ms. Justice. They understood that the school system was offering classes during the summer and after school and had been investing in top-of-the-line computers for the students and teachers to use. Team One talked to other teachers in their school as well as in other schools and with other CRT's to learn about new ways of using computers with their daily subject lessons. They asked questions of others who had adopted looking for reassurance about the success of the adoption.

Ms. Cardinal was completely comfortable taking her students to the lab and being by herself if the CRT had other requirements. She did seek assistance from volunteers and teaching assistants only to manage the students while in the lab. She shared all of her experiences with Mr. Harley and Ms. Justice from the beginning of their partnership. She encouraged the others to find lesson ideas that they wanted to try and would support them by using their work as well as her own. She afforded Mr. Harley and Ms. Justice a safe environment to explore their use of computers in their work.

Ms. Cardinal had been aware that there was a Technology Integration Project and used the resources created from them to initially design her lessons for the computer lab. As she became more comfortable in the lab and with the software, she began to design lessons that related more closely to what she was teaching in her classroom. Work on the computer in the classroom became a "center" for exploration for the students. She encouraged typed reports and taught research skills through the Internet. Mr. Harley and Ms. Justice shared the Technology Integration Project activities Ms. Cardinal provided them to help them start off with basic lessons for lab implementation.

Ms. Cardinal was much more integrated into the social system at this school and helped create communication connections for Mr. Harley and Ms. Justice with these members. Ms. Cardinal was aware of her position in the school and shared her successes with the innovation with other staff members. She understood the mission of this school to help the students be successful with computers as well as art, music, and their core curriculum. Ms. Cardinal provided a "trial-by-others" (Rogers, p. 172) for Mr. Harley and Ms. Justice. She had gone through many of the questions and difficulties before they teamed up. She removed much of the uncertainty for Mr. Harley and Ms. Justice because she had already adopted and was practicing integration.

Ms. Cardinal, Mr. Harley and Ms. Justice all had their frustrations with working in the lab, and like the other members of the fifth grade level, had moments of not wanting to work in the computer lab. To appease this concern, Ms. Cardinal found volunteers to work with all three teachers in the lab so they would never be by themselves. Many of the volunteers had experience working with computers, and these people could fix some of the minor errors the computers produced. Ms. Cardinal had become resourceful in finding ways to work in the computer lab without having to ask Mr. Clark for assistance.

Despite those efforts by Ms. Cardinal, Mr. Harley wanted someone to teach the lessons and help him understand the intricacies of the software packages available for him to use. Mr. Harley also felt that the Monday morning training session the CRT had scheduled failed because of timing as well as material. The timing of Monday mornings was difficult for any grade level.

To lose a planning break first thing at the beginning of the week was difficult. For the fifth grade teachers, Monday morning was packed with money collections, permission slip collections, and attendance in addition to getting ready to teach that day and that week. There was not enough time to do all the paperwork due to the office by 10:00, and there was not enough time to meet. Mr. Harley said, "The CRT was only willing to reach out so far. He did not connect with our needs, and we did not connect with what he wanted to teach."

Ms. Justice felt the CRT made assumptions that every one had to be comfortable in the computer lab and he never asked if he was needed for anything. She was uncomfortable being left alone sometimes in the lab because she could not always fix a crashed computer. She said, "He was available for my questions in the beginning of the year, but he did not stay in the lab with me when I taught." She wanted him to ask her what she was teaching and if she needed help.

Team One was working well together before my arrival. After initial contacts in January, the four of us sat down for a team meeting. The focus of the meeting was what areas of technology this group had not taught and what were the objectives still to be met before the end of the year. Ms. Justice and Mr. Harley asked a lot of questions about what they had already done, and Ms. Cardinal reminded them of the objectives they had covered by relaying the lesson plan they used in the lab. The major objective remaining was the multi-media project. Ms. Cardinal was concerned about this because it had taken a long time the previous year to complete. We plotted out a schedule of lab dates to work on the project and the Team created the lesson goals. They decided on creating a multi-media show on a book the students had read.

After this meeting, my interactions with this group was less than with the other two Teams. Team One had a strong leader in Ms. Cardinal and she was comfortable making decisions for the other two members. We did meet to talk about specifics regarding the software program to be used as the year before Ms. Cardinal used Hyper-Studio™ and was not as familiar with the new program. We worked well together but each member initiated any contact.

Team Two

Team Two consists of two teachers: Mr. Lawson and Ms. Welch. This is their second year team-teaching. Mr. Lawson teaches language arts and Ms. Welch teaches all other subjects: math, science, social studies, and health. They are the teachers who have identified gifted students in their room. They receive additional support from the Gifted Resource Teacher (GRT).

Mr. Lawson – early majority. Mr. Lawson has been in education for 25 years. He taught for nine years, entered into administration and was a principal at a school, then returned to the classroom three years ago. He considers himself a "classical" teacher who provides students opportunities to learn what works best for them. He has remained "hooked" on this idea for 25 years because it has worked for him. He does not consider himself to be a nurturer of the body, as in doing things for the students and providing emotional comfort. He does consider himself a nurturer of the mind creating independent, self-motivated learners.

Mr. Lawson saw education as a "give and take society." "Teachers," he stated, "in each individual classroom must meet the needs of their students. Teachers must understand children as children are, must understand this is not a perfect world of perfect children, and must have high self-esteem to deal with the complexities of teaching." He found computers to play a key role in what he was trying to accomplish in his classroom, but he was not training computer technicians. He saw the computer as a tool to enhance and challenge student abilities. Mr. Lawson said there was a place for computers and someday there may be laptops on every desk, but the importance was how computers were presented and used for the students' learning.

As a principal, Mr. Lawson included the need for a computer lab when the school he was in was being redesigned. When working in Central Administration, his first task was to tap into any electronic resources he could find. Yet, coming back to the classroom and learning to teach using computers in his curriculum has been more frustrating than he expected. He wanted to know all there was to know about the computer before teaching aspects to his students. He felt he could provide explanations as to what different software applications could do only if he practiced enough at home before presenting the information to his students. He was surprised by all the information he had to learn before teaching his students.

Mr. Lawson classroom arrangement was in clusters of desks. The computer sat around a corner by the door and the coat racks for the students. There were two tables, a kidney-shaped and a rectangle one, along the same wall as the computer that were used for small student conferences or as a place where students could meet in a group to work on a project. The bulletin boards were decorated with information about the two clubs he sponsored after school: one a reading club about sports for boys and the other called "Free Goals" about rights and responsibilities.

Mr. Lawson is comfortable working on a computer. He has had a computer at home for his two children and his wife to use. They are always engaging in some activity on the computer, to which he commented on the state of this society: "We are becoming overloaded on computers. If mine at home crashes, all four of us [his family] panic because something we considered of value was lost. I cannot even do my grades anymore without the computer. Sometimes I need to just slow down and read a book instead of searching the Internet. We forget the little things."

Mr. Lawson did a lot of searching on the Internet for ideas for lessons both in the classroom and for the computer lab. Many journal entries were full of his dialog to me about what sites he was looking at and what ideas he was trying to formulate for lessons the next day. It became a useful tool for him, especially in a rushed situation. For example, he wanted to do something for Lincoln's birthday, but he could not find his books on Lincoln. He remembered Walt Whitman's poem "Oh! Captain, My Captain!" and searched for it on the Internet. He found a copy, printed it out, and shared it with his students the next day. He was not afraid to venture around the tools on the computer to find some useful pieces of education that would help him.

Even though Mr. Lawson was instrumental in adding a computer lab to his previous school and worked with electronic resources in administration, the journey has been more deliberate for him as a teacher. He found the amount of knowledge he needed frustrating

because there was not enough time to learn how to use the computer inside and out. He did not want to go into his classroom unprepared. "It is one thing to search by yourself for that button to change font or to change formatting of a paragraph," he said, "but when you are teaching students certain skills, you, as teacher, need to have this information memorized. I am not there yet." Mr. Lawson continued by explaining that it takes him twice as long to learn some of these software packages, so he follows a different path then some of his co-workers.

In this new setting of being back in the classroom, Mr. Lawson interacts with many different members of the faculty, but he had chosen to take a "back seat and not a leadership role." He had been principal and just wanted to work with students. Like other early majority members, Mr. Lawson chose each step in the adoption of computers into his curriculum carefully. He wanted to understand all aspects before integrating the tools completely. He worked with many members of the social system and had open dialog and communication with different grade levels. He did not pursue leadership roles and worked in the background.

Ms. Welch – late majority. Ms. Welch has been teaching for 12 years, 10 of them in this school and all in fifth grade. She has been part of the gifted cluster program, in which identified gifted students are placed in certain teacher's classes, for several years and enjoys working with the resource teachers available to help her reach gifted students. Ms. Welch values the opinions of her students and feels she is doing a better job teaching if the students are active and involved in the direction of their education. Ms. Welch works hard to integrate computer ideas into her classroom lessons, but the computer and computer lab are not as important when other factors disrupt the classroom environment. Snow days and no heat in her classroom caused Ms. Welch to miss two weeks in the computer lab, but since losing that time was not her priority, she focused on the other lessons lost.

Ms. Welch, like many others on her grade level, considers herself to be computer illiterate. She did not go to school to be a computer teacher, and even though she has taken many classes, she still does not understand one-half of what she needs to know to sound qualified to teach it. She also has arranged to have volunteers with her in the lab. She said, "[she] could not handle the awesome responsibility of answering questions she did not understand." She does not use the computer in her classroom every day and one day a week for 40 minutes is not enough time to gain new knowledge. She said she feels as if she is practicing what she has learned but never reaches a new level of understanding.

Ms. Welch's classroom arrangement is very tight. There is not a lot of room to move around. She has the desks set up in clusters to allow for group work. She has two computers, a PC and a Mac, against the coat rack wall. These computers cannot be shifted to allow for more room because the cords attaching them to the outlet and Ethernet are not long enough. Her desk is in the middle of the opposite wall. There is a kidney-shaped table in the back next to a carpeted, sitting area for students.

Ms. Welch does not use the computer at home. She has three small children who are involved in many activities after school. By the time she finishes the sports, the dinner, and the kids are in bed, she is too exhausted to do anything on the computer. She does not enjoy working on one, so there is no motivation outside of school. In many of the classes she has taken

to better understand using the computer, she has found useful ideas but none of it has excited her to want to integrate lessons more with the lab.

For Ms. Welch computer integration was "sink or swim." If she was going to teach the gifted cluster classes, she had to provide for them a wide range of learning opportunities. She had to overcome her insecurities as a teacher and present the software skills to her students. She taught basic word processing and basic databases and borrowed Mr. Lawson lessons for using the Internet. She provided many lessons that incorporated science and social studies, and being a part of the Josten's™ math pilot program, she had opportunities to work math lessons into the lab. She found preparing students in the classroom rather than the lab for the lesson created a level of comfort because she could still hold the attention of the students. If the students knew going in to the lab all the expectations of the lesson, Ms. Welch would be more confident directing the students to the appropriate software package. To her benefit, many students worked on computers at home and had a higher level of comfort than she.

Ms. Welch wanted the CRT to be someone who would act like another team teacher. She works extensively with the gifted resource teacher created lessons that will help students reach "outside the box" of regular education. Ms. Welch said, "This arrangement works very well because I am the expert in the classroom, and [she] is the expert on learning styles and creating new and innovative ways to teach ideas." Ms. Welch wanted that same collaborative effort with the CRT. She does not know what software package would best be used for numbers or data. She never created a multi-media slide show and did not see how one could be used with her students. She wanted to plan with the CRT lessons that would highlight both of their areas of expertise. The CRT did not always provide the necessary information the teachers were seeking. Ms. Welch could not communicate her needs to Mr. Clark, and Mr. Clark could not communicate what he was capable of assisting her with in the lab. Because of the communication gap, she had been left as the sole instructor for 25 or more students and she did not know how to solve any of the problems that would come up.

Ms. Welch was the first teacher to approach me for assistance. Ms. Welch was under increased pressure to provide learning opportunities in the computer lab, presented not only by her team partner but also by the parents and students who had high expectations. At the end of January, she wanted to work on the rock cycle but did not know how to present the information to the students in the lab. I asked her what her goals were and her need was graphing and helping the students understand that the percentage of rock in an area could help determine where the rock originated. We began working on a spreadsheet lesson explaining percentages of rocks and graphing the data. This was the beginning of greater involvement with the teachers in trying to understand how to integrate technology.

Team Two Summary – Early Majority

Mr. Lawson and Ms. Welch are part of the early majority. Their choice for adoption came right before many other members of the social system made the choice. Being gifted cluster teachers moved them toward adoption quicker due to pressures and expectations of the program and the parents. Mr. Lawson had a great deal of interaction in not only this social system but within the school system based on his past participation in administration. He had

contacts with other schools and knew the direction technology was going. The innovation of integrating computers and curriculum was not going to "fade away" as so many others had in the past. Mr. Lawson also provided a connection between Team One who adopted quickly and his partner who was on the slower end of adoption. His contact with Team One allowed some of the uncertainty issues, such as the success of the innovation and continued use of the computer technology, to diminish for him and his partner.

Both Ms. Welch and Mr. Lawson approached the integration deliberately, making choices that would benefit not only their students but themselves as well. Their direction for learning about the innovation was different. Ms. Welch took as many computer classes as she could to learn whatever would be helpful with integration. Mr. Lawson tried to learn as much on his own as he could. It was easier for him to be self-taught; the mistakes he would make only enhanced his understanding of the software. Although they increased their knowledge about working with a computer, neither had become fluent enough to be comfortable creating and teaching lessons in the lab. That was a greater task than just learning how to work a computer.

Mr. Lawson and Ms. Welch provided their students weekly lessons in the computer lab even though their comfort level was not as high as Team One's level. Their lessons were simple and often did not take longer than one week to complete. Both felt it would be hard for students to transfer learning from a week ago to another lesson in the lab at a later date. The lessons did connect their content areas to the work on the computer in small ways. The letters to a famous American leader of the Revolutionary War had to contain specific questions or comments about America at that time. During interviews, however, neither Ms. Welch nor Mr. Lawson felt their lab work related or was helpful to their students.

Ms. Welch also took her students to the lab twice a week for 30 minutes to work on a math tutorial program. Ms. Welch knew how to run the math tutorial and how to get her students to the specific lesson she wanted them to work on. Despite this, Ms. Welch complained or worried that something would happen and she would not know what to do. During the investigation, the lab time for the math tutorial program ran smoothly with only one computer failure.

Ms. Welch still approached the innovation with caution but she was not sure if her caution was based on the idea of curriculum integration or caution with relying on assistance from the CRT. Ms. Welch was cautious about asking for assistance or relying on assistance in the lab. She was not comfortable in the lab, but some of that discomfort was frustration because she could not work with the CRT as she had hoped.

Like Team One, Ms. Welch and Mr. Lawson were in the beginnings of the confirmation stage of the "innovative-decision process" (Rogers, 1983, p. 184) and were working on maintaining the successes of their choice to adopt. Their need was reassurance and guidance. They were at a crucial point of maintenance. If Ms. Welch had been given any indication that the adoption would fail, she might have changed her mind and rejected the adoption. It was one more curriculum she had to master to be the teacher she wanted to be for her students. Mr. Lawson was willing to accept setbacks or failures, but he would only be able to maintain his positive attitude for a period of time before he would need confirmation from other teachers

about successes or failures. As change agent, the CRT or I needed to provide Mr. Lawson and Ms. Welch with direction and support in the computer lab. The direction and support provided by Mr. Clark was less than what Mr. Lawson or Ms. Welch expected at that point. I tried to understand what their issues were with the adoption, and we worked out some plans together to assuage any new anxiety they were having about the innovation. Ms. Welch had been teaching the rock cycle and wanted to create some graphs of data. She established the objectives for the lesson and I provided her with some lessons on the software package that would best suit her needs. Together we designed the lesson for the computer lab based on her original objectives. The lesson connected directly with what the students did in class.

Team Two had been working on collaborative planning with the Gifted Resource Teacher (GRT) for the two years they worked together. That relationship flourished as the GRT provided links to lessons that enhanced Mr. Lawson or Ms. Welch's classroom lesson. Because of the success of this relationship, Team Two attempted to create lesson plans with the CRT, Mr. Clark, before I arrived, but the planning sessions proved fruitless. Mr. Lawson became comfortable in learning computer technology on his own and sharing information with his students when the time was right. He often searched the night before for lessons pertaining to the computer. He had established an understanding of the CRT's role and began to work around that. Ms. Welch needed more guidance and was not comfortable creating a plan the night before. Her frustration level with the CRT was growing, but she did not communicate any concerns to Mr. Clark. Ms. Welch had high expectations of her students, herself, and any specialist working with her. Mr. Clark was no exception.

Once a relationship had been established with Team Two and me, Ms. Welch sought out advice on different software packages. We were able to move beyond her frustrations, and she was able to obtain answers to questions she had been asking for two years. Our collaboration started the entire grade level's collaboration with technology integration.

Team Three

Team Three consisted of two teachers: Mr. Mulder and Ms. Blue. This was their first year teaching together. Mr. Mulder was considered a laggard in terms defined by Rogers. Mr. Mulder was not comfortable with new innovations or with change. His partner, Ms. Blue, was more willing to attempt new innovations, but she still looked at the innovation through cautious eyes and was considered a late majority.

Mr. Mulder – laggard. Mr. Mulder had been a fifth grade teacher for over 20 years. He believed that it was important to teach children not only the general knowledge necessary for them to be successful in other grade levels, but also that they should be taught where to go to find the answers they are searching for. He tried to include in his teaching the importance of responsibility and self-discipline. He team-taught with Ms. Blue and taught the languages arts curriculum for both sets of classes.

Mr. Mulder was very light-hearted and cares for the children he teaches. He was stern with his students but offered them opportunities to express their needs for learning. His class was set up in tables (groups of four desks placed together) with his desk at the front by the board.

There was also a worktable in the front and a round worktable in the back for flex grouping or one-on-one work with students. His TV and VCR cart were moveable around the room and during a presentation with it, the cart was moved to the front. There was one computer, a PC, around a corner from the door along the coat rack wall and there were two Mac computers in the back that were not used. He taught languages arts in two blocks: morning and afternoon. Mr. Mulder took his morning block of students to the lab because of the computer lab schedule.

Mr. Mulder only worked on the computer at school. He did not have one at home, and during the study "ha[d] no desire to have one at home." He said, "I use the computer for emailing school personnel and for writing letters to parents." He tried to only spend 20 minutes a day on the computer. Because of these simple needs, he knew how to create a document for typing, and he knew how to connect to his email. He said, "The only thing I know how to do on the computer is ClarisWorks™ and print a letter. I [do not] know how to do the other things, which I would name specifically if I knew what they were called." He would be easily 'turned off' from computer use because of glitches out of his control that he could not fix. Several times in the course of the investigation, he typed an entire letter, was ready to print, and the machine shut down following an illegal operation. This event caused great distress and Mr. Mulder would go back to not wanting anything to do with working on the computer. Also, several times a week, the computer path to a specific student program would disappear, and Mr. Mulder would have to find the CRT to have the path reinstalled. For Mr. Mulder, these problems with the computer only caused greater frustration because he could not fix them. He felt he was letting his students down because he did not know more.

Mr. Mulder said that, "technology is a wonderful field for students. Children work best when they do audio, visual, or tactile learning," he continued. He went on to state that in his opinion there will be a computer at every child's desk by 2010 and children would be given grades in elementary schools based on their knowledge of the computer. For students there were immediate results and feedback when playing and working on the computer and Mr. Mulder saw why students were so attracted to working on them. However, for Mr. Mulder, the idea of a computer in his classroom or a lab in the school was wonderful if someone else was charged with the responsibility of teaching the tool to the students.

Mr. Mulder said he did not go to school to be a computer teacher. He went to school to become a fifth grade teacher who teaches language arts to his students. His own knowledge on the computer was sparse, and he stated that he is computer illiterate. He had great frustrations when it came to the use of computers in the school including the way the school system had placed the responsibility on the teachers to teach this new tool especially when they had no formal training. He would liked to have had "concrete lessons from 'downtown' explaining all of the skills in order that [he] could follow." He felt the school system had not prepared the teachers for the enormous task they asked the teachers to take on.

Mr. Mulder described himself as a traditionalist. He taught the same way successfully for over 20 years. He saw innovations come and go and found that if he waits long enough to adopt an innovation, a newer idea will come along to replace the previous and he would not have to change. He was an isolate in the social network of the school. He would come in, do his job, and go home with little contact with other teachers. He made the effort to work with the teachers

on his grade level, especially his partner, but he did not engage in social conversations. He kept to himself. Because of his lack of computer knowledge, his choice to adopt was full of uncertainty. He waited for others around him to adopt the innovation to provide the necessary knowledge he needed to form an opinion. His process of forming a decision about the innovation was taking the longest and at the end of the study, a choice to adopt or reject had not been fully made. Mr. Mulder was very suspicious of the original change agent, Mr. Clark, at the school and said that the adoption of the innovation was going to allow "big brother" to have access to all of his work on the computer.

Ms. Blue – late majority. Mr. Mulder's partner, Ms. Blue, had been teaching for three years. This was her first year in fifth grade. She believed that all students were capable of learning and as a teacher she had charged herself with incorporating opportunities for the many different learning styles in her classroom so all children could be successful. She felt that technology fits in the realm of teaching if, and only if, "it was tied to the standards that need to be taught in the core subjects. That makes it more real to [the students] rather than just going in and using rote memorization to remember [what each screen] does."

Ms. Blue was in charge of teaching all other subjects to her team of students: science, social studies, math, and health. Being her first year in fifth grade, she was nervous about the expectations put on her for student learning. The students took tests at the end of the year, which they were required to pass for advancement to the next grade level. She feared that she would not have enough time during the school year to accomplish all of the objectives placed before her.

Ms. Blue had high expectations of herself and the work her students produced. She had a great deal of material to cover before the end of the year, so things in her classroom moved at a quick pace. There was not a lot of time to get off track. Her classroom was arranged in rows with students facing the board in front. She had her desk and front worktable arranged along the board. The computer was set up around the corner from the door along the coat rack wall.

Ms. Blue used the computer a bit more than her partner, Mr. Mulder. Ms. Blue had a child at home who uses a computer for schoolwork so there was a computer at home. Ms. Blue used the computerized grading system to produce her quarterly averages for report cards. The grading program was loaded on her home machine as well as her school machine so she could work on grades at home and bring in the file to print. She also used the computer in her room for email and also typed letters to go home to parents.

Ms. Blue tried to learn more about using the computer in her classroom on her own. However, because these new skills were not something she used every day, she forgot what parts of programs were for or what different software programs did. She had few expectations for the work that was done in the computer lab because the lessons take too long and she had often moved past the lesson in her classroom, and the skills the students were learning were not meaningful outside of the lab. She had trouble making a connection for the student to see the use of the computer outside of school. She was comfortable enough on a computer to agree to work on a pilot project incorporating a math software program into her classroom work. This program required that the teacher do nothing to interact with the students while they were working on the

problems. The students came in to the lab, logged in to the math server, and were presented with math problems that addressed the students' weak areas.

Unlike her partner, Ms. Blue had made a choice to adopt the innovation, although she was very cautious in doing so. Her uncertainty was lessened by her own knowledge and use of a computer at home. She waited until other members of the school had adopted and sought their advice on the benefits of the computer. It had appeared to Ms. Blue that this was going to be the direction of the school system, and whether she adopted now or later, she would be using a computer in her classroom. Some classes she had attended provided her with the insight that others were having a greater success with the innovation, and she would have to make choices that worked for her. She realized it would be up to her to learn how to integrate the computer without relying on the CRT.

Team Three Summary – Late Majority

Mr. Mulder and Ms. Blue were part of the late majority. While Ms. Blue was more willing to adopt the computer use in her daily work, Mr. Mulder was still waiting for facts to come to him about the benefit of using the computer for a multitude of tasks. He still was not sure he would get the support he would need to integrate, and along with Ms. Blue, felt a great deal of uncertainty and skepticism about the innovation.

Mr. Mulder and Ms. Blue were still in the "innovation-decision process" (Rogers, 1983, p. 22) even though the school system had moved past this process. Mr. Mulder and Ms. Blue have had one and one half years to hear about the new innovation of computers in the school. The lab had been set up and computers had been moved out of the old lab into classrooms. Computers were now available for teachers in their room, as well as in the library and computer lab. Mr. Mulder and Ms. Blue were still framing their opinions about the new tool. They had frustrations and concerns with regards to how the computer was being used by them in conjunction with classroom lesson plans. They both saw a value if someone else teaches it and if it relates to their core subject areas. Mr. Mulder and Ms. Blue knew that at some point they would not have a choice. The school system had made this decision and had provided all schools with the equipment to follow through. They were waiting for the school system to move on to another project or to hear of all the problems and to learn from there.

While Mr. Mulder and Ms. Blue did take their students to the computer lab once a week, the computer had not become a part of their pedagogy. They provided their students with opportunities to explore and use the computer, but they themselves did not engage in learning or using the computer provided for them except within a small frame of required engagements. They continually relied on the need for the CRT to be in charge of the computer lab. They said the computer lab was a specialist area just like art, music, or physical education. They needed help or guidance as to what was required of them in this field. They said no training had been provided for them, and they were left behind because they did not agree to the terms when computers were first introduced. Mr. Mulder and Ms. Blue did not feel secure in their environment and felt an increasing pressure to adopt the innovation before they had a chance to uncover all the evidence.

For Mr. Mulder integrating his classroom lessons with the computer in his classroom or the computers in the lab was a concept he had not yet grasped. There were objectives listed for computer lab lessons from the beginning of the year to the end, and there were no specific goals in mind for finished student products as far as Mr. Mulder knew. He wanted language arts programs that would help him cover SOL objectives such as cause and effect, spelling, puzzles, or writing skills. He did not think he would be any more prepared for working in the lab or at his classroom computer until those types of software programs were made available to him. Without a baseline to start with or programs to use for his subject, Mr. Mulder did not feel he had any creative ways to work with the computer in his class.

Despite all of his concern and feelings of illiteracy with computers, Mr. Mulder took his students to the computer lab once a week and for 40 minutes they worked on projects focused around language arts but not necessarily covering any SOL objectives. Mr. Mulder often "apologized for bland, boring lessons," but the work his students were doing was valuable to them. Mr. Mulder only showed the students how to do the things he knew how to do: center text, change size, change font, indent with tab key, for example. Yet, this was enough to get them started on their task. In the beginning of the study the students were writing scientist reports for Ms. Blue. Mr. Mulder worked on these with the students as part of their language arts requirement for writing a five-paragraph essay and used the objectives for proofreading and editing to finish their drafts. He used lab time to allow them the chance to create polished reports. The students all appeared to appreciate having a finished printed product to take out of the lab. Mr. Mulder was glad to finally have the project finished. It took longer in the computer lab than he had originally planned for, but he did not account for student typing skills to be so slow.

Ms. Blue's primary concern was there were more core subject objectives that needed addressing, and she knew there were many more technology objectives to be covered, but she did not know how to teach them all without one losing out over the other. Ms. Blue felt she had a better sense of integrating the computer into lessons than Mr. Mulder. Having used a computer more, she could see how a computer could help get a lesson across to her students. She often decided what they as a team did in the computer lab week to week, but if Mr. Mulder did not want to use the idea he would not. Having so many subject areas to choose from made it easier for Ms. Blue to design a computer lab lesson. She had worked on presidential database, which took longer than she had wanted, so she copied the information on to the files of students who were behind. She had assigned famous scientist reports but asked Mr. Mulder to share in that assignment to help the students write before they typed. Her problem with the integration was that she had to teach in the lab. She understood the core subject she was teaching, but she never knew what program would be best suited for what task. She often relied on old lesson plans from previous teachers, or she used the word processing tool.

Ms. Blue's greatest frustration was the lack of a person in the room who was qualified to teach the students and qualified to fix machines if a problem occurred while they were in the lab. For example, twice during observations, a machine froze in the middle of a program. Not knowing what to do or how to help the student out of the situation, Ms. Blue shut off the machine and had the student move. With only 40 minutes in the lab, this frustrated Ms. Blue, as now the student would have to make-up the lost work during the week to stay on task with the

class. In addition, Ms. Blue did not consider herself qualified to teach the students anything on the computer. She had enough knowledge to work at home, but she cannot translate that for students to understand. She did not know the correct terminology and did not want to start off the foundation of their learning about computers with the wrong vocabulary. She also said she did not go to school to teach computers. She felt that "no real skills were being taught in the lab" because there was not a teacher in there to teach them.

Ms. Blue also took her students to the lab twice a week for 30 minutes to work on a math pilot program. This program was designed to follow the classroom instruction if set up properly. The students entered the classroom, logged-in to the math program and spent 30 minutes reinforcing the math skills they learned in class. This program frustrated Ms. Blue. The students who were working on the math program had considerably lower grades at the end of the marking period than the students who were not in the program. She did not feel that the students were taking this program seriously, and they were not using the strategies she taught them in class. She went to the principal who suggested Ms. Blue remove the students who were not taking the work seriously and leave the CRT in charge of the other students. She also suggested that Ms. Blue assist students when they were stuck. Ms. Blue expressed concern after the meeting about both options because each goes against the requests of the people in charge of the pilot program. Ms. Blue felt pressure between wanting to help her students achieve and wanting to follow the guidelines of the pilot program.

For Ms. Blue, there needed to be a computer teacher in the lab taking care of all the information that was available to the school for students. She was afraid of the vast amount of information and knew that if she learned all she could this summer, it would all change next year. Software programs would be updated, email systems would change, and even the operating system platform could change. She was concerned that she did not have enough time in her day, week, or year to learn all she needed to know for her students and what their needs were and to learn all about the computer technology that had changed and was available.

Being late majority adopters, Mr. Mulder and Ms. Blue did not engage in a great deal of social interaction with other members of their school and had little dialog with members of their grade level. As a grade level, the individual teachers did not share with each other the lessons they were teaching in the lab. Each team took care of itself and offered no assistance to others, and no assistance was requested. Mr. Mulder and Ms. Blue talked extensively about the SOL's and what would be expected of each of them at the end of the year. Ms. Blue often planned for events to occur in her classroom and solicited the assistance of Mr. Mulder to help her carry them out. Often, Mr. Mulder would give quizzes in his class for subjects taught by Ms. Blue, and Mr. Mulder graded any writing assignment the students had due to Ms. Blue.

Even though Mr. Mulder and Ms. Blue worked together and discussed their students often, the knowledge and success of this innovation had not convinced them to adopt and was not without uncertainty. Members of their grade level had chosen to adopt earlier and were having success in their classroom and in the lab. However, not enough time had passed and Mr. Mulder and Ms. Blue did not interact enough with other members of their social group to discover the successes or failures with the innovation, so their skepticism and caution remained their barrier to full adoption.

Mr. Mulder and Ms. Blue were still searching for the boundaries of the interactions with Mr. Clark, CRT. Mr. Clark had provided training, but the training was not what Ms. Blue or Mr. Mulder needed. Instead of asking Mr. Clark for other training opportunities, both stopped attending anything offered by Mr. Clark. Both Mr. Mulder and Ms. Blue wanted Mr. Clark to stay in the computer lab and assist them with any lessons. They were more comfortable knowing someone was there, but neither expressed this concern to Mr. Clark.

Mr. Mulder and Ms. Blue were cautious of me for the first month of the investigation until Ms. Welch started seeking assistance. When she realized I would answer her questions, Ms. Blue approached me with lesson ideas and asked for guidance. When I proved that I would help her, their comfort level and ability to ask me questions increased. My interaction with this group was greater than it was with either of the other two teams.

Researcher – Change Agent

My role in the setting was to be as an observer recording the integration of computer use by teachers. Early on in the study, I had to gain access to the teachers and gain their trust and confidence that what I would be writing about would support their view. I established dialog with each of the teachers and tried immediately to understand the problems they were having integrating computers.

Part of my task during the first month in the school was to gain access to the fifth grade teachers and to be able to become a part of their world. They had to see me as trustworthy and as empathetic to their situation. Initial conversations with the teachers could be considered guarded, as the teachers saw me as an extension of the computer resource teacher position. Until I created my own rapport with the teachers, involvement was strictly as an observer. The transition from observer to participant observer was after several requests from the teachers. Ms. Welch asked me software questions regarding a lesson she was going to teach in the computer lab. After hearing that I had assisted Ms. Welch, Ms. Blue asked me several questions about lesson design and asked me to help her with some software concerns. This process then continued throughout the fifth-grade and by the middle of February, I was a participant observer. In addition to studying the lives of the teachers and observing their actions and interactions, I became a part of the research working with the teachers during their processes. However, it was only at the request of the teachers that I offered answers to their questions.

Once I established myself with the teachers, my role became that of the change agent. According to Rogers (1983), change agents are usually different from the clients they are working to motivate into adoption of an innovation. Rogers also defined the change agent as someone who assists the clients in their understanding of the innovation and assists them in adopting the proposed project. I did not feel different from these teachers. I was trying to look at their situation through their eyes and trying to understand their hesitancy to adopt the use of computers. This study was to represent what was happening to them, and because of this, I felt that my questions and observations dealt with their concerns and needs, not those of the school system. Upon further reflection, I also realized that I did not have any accountability for what

successes or failures occurred in the computer lab as the official CRT, Mr. Clark, did. My role was that of a change agent who works to assist potential adopters with an innovation.

Bandura (1977) stated in his social learning theory that individuals learn from observations of peers and re-invention of the innovation to fit the needs of the individual. This non-verbal communication and observation is considered a key in behavioral change. This behavioral change is what the school system was looking for with computer technology in each elementary school. However, at this school, there was no one to observe and model lessons after. The teachers were supposed to engage the computer as a tool in the development and implementation of lessons – in the computer lab and in the classroom as well.

At the beginning of the study, there was little behavioral change among the teachers. Two teams had entered into minimal computer use as part of their daily work, and the third was still in the innovation-decision phase trying to understand how the computer would benefit them. As a change agent, I offered teachers a chance to ask questions about integrating computers and worked with teachers to design lessons for the lab. I tried to make a connection with their need to use the computer and with their need to teach certain objectives by the end of the year. As a group, we had many processes and roles to work through before the majority would feel comfortable.

Like many other diffusion processes, there are seven roles a change agent must work through that Rogers (1983) identified as adding to the success of introducing the innovation (see Table 2). Role one was developing a need for change. In initial meetings as a group, we first discussed the current problems: lack of resources available, no training, and no assistance in the lab; and designed a plan that would help address these problems. As part of my role in the setting initially, I had to develop an exchange of information with the teachers which is also part of role two. I had to build a relationship with each individual teacher as well as with the teams. If they did not accept me as a member of their group, they would not have approached me for ideas (Rogers, 1983) or feel comfortable enough to share their concerns for successful integration.

Something that was also missing for the teachers was someone seeing their problems through their eyes. I empathized with their concerns and accepted each teacher at the stage they were at regarding computer integration (role three). I attempted to understand their frustrations and needs in order to provide answers to their questions that would be most helpful. Role four included shifting the focus of the diffusion away from the innovation and on to the teachers. Their problems needed to be addressed and needed to be the central focus of the process to encourage their adoption. I began to work directly with the teachers in designing lessons that would be implemented to complete role five of "changing intent into action" (Rogers, 1983, p. 316). Role six and seven occurred as the process became more involved. Role six is helping teachers make connections with using the computer in lessons and starting the adoption process of the innovation. Finally, role seven is to not be needed as a change agent and that the teachers will be able to maintain their uses of the innovation without disruption, and at the end of this study, it was not clear if all members of the grade level would continue the adoption process or if they would return to the persuasion stage of the decision-making process.

Table 2

Change Agent Roles in Diffusion of Innovation

Role	Rogers' work	Within Study
One	Developing need for change	Discussed current problems including lack of resources, no training, and no assistance in the lab.
Two	Develop a relationship with participants.	If the teachers did not see me as a member of their group, they would not approach me or feel comfortable enough to talk.
Three	Seeing the problem through the participant's eyes	Original change agent, CRT, did not empathize with their concerns about computer integration.
Four	Focusing on teacher's needs	The teachers needed their problems and concerns to be addressed and the focus.
Five	Changing intent into action	Designing and implementing lessons that would address the computer technology objectives
Six	Stabilize adoption and prevent discontinuance.	Helping the teachers make connections and start the adoption process
Seven	Terminal relationship with change agent.	Unclear if role seven was successful.

Once the transition of my role occurred from one of observer to participant observer and I became the change agent working with the teachers in the process of adoption, the teachers began to ask questions of me searching for assistance in developing lessons that would integrate computer technology. Table 3 lists the types of interactions with each teacher and the amount of those interactions for the duration of the study. This process of working with the teachers for the duration of the study provided the teams with different levels of support in their steps toward adopting the innovation.

Table 3

Change Agent Contact with Participants

Participant	Asked technical questions	Asked computer integration questions	General Conversation	Planned Lessons	Lab Assistance	Answered Researcher Questions	Total
Cardinal	27	18	73	6	12	106	242
Harley	34	45	51	9	13	99	251
Justice	44	38	68	9	14	102	275
Lawson	66	38	89	10	11	117	331
Welch	26	74	123	10	37*	124	357
Mulder	62	61	132	9	14	136	414
Blue	51	72	129	9	34*	118	379
*Includes Josten's math lessons							

Steps Toward Adoption

For the first three weeks of the study, the teachers spoke with me and answered my research questions, but they were guarded. They saw me as an extension of the CRT and did not know whether they could trust me. Ms. Welch made the first contact with me about receiving assistance in the lab. Ms. Welch said, "I have too much to do and can not wait another month to ask for assistance."

For the next three months as teams, the teachers created lessons in spreadsheets and multi-media because these two topics still needed to be addressed as a requirement for the fifth grade objectives. Spreadsheets were taught during the month of February. Ms. Welch, Team Two, wanted to teach the rock cycle and the importance of understanding the different types and amounts of rocks found in different regions. Mr. Lawson agreed to teach the same information to his students even though he was not the Science teacher. Mr. Mulder and Ms. Blue, Team Three, wanted to teach averaging of grades, and Ms. Justice, Team One, thought that lesson would be a good motivator for her students as well. Mr. Harley, Team One, had been working on the times of the sun setting and rising and wanted to create a graph based on that data so he focused on that idea for his spreadsheet lesson. Ms. Cardinal, Team One, was finished with spreadsheeting and already planned lessons through February, so she worked alone until she taught multi-media.

At the end of February the grade level decided to create multimedia presentations to complete the technology SOL requirements. Again as small teams, the teachers planned what their students would be working on. As a whole group, we planned out the eight weeks of the program so all the teachers would teach the same skills. No one had used PowerPoint™ before and they were all at the same skill level. I was the expert on the software package and provided the teachers with the potential and the limits of what the package could provide educationally for their students. It was clear to the teachers this task would not be completed in one or two weeks. It was recommended that whatever subject was taught, enough lessons had to be designed to last throughout the process.

Team One

Ms. Cardinal, Mr. Harley, and Ms. Justice were already designing and working on lessons in the lab when the study began. The first round of interviews with these individuals focused on what lessons had been taught and what direction each teacher wanted to take to complete the objectives for the lab. With Ms. Cardinal, the dialog focused on differences she had noticed in the program and differences in the way she was teaching in the computer lab. Since she was the only one at the school last year, I needed to know her feelings about working in the lab, working with the grade level, and working with the CRT. The other two teachers would not have been able to provide me with a background.

We had a team meeting after the first round of interviews. The focal point of this conversation was about what technology SOL's would need to be addressed before May. Multi-media was a concern for Ms. Cardinal. She started working on it too late last year and did not

have enough time to finish. She warned Ms. Justice and Mr. Harley that the work on a multi-media project could be extensive. "[Multi-media]," she said, "took a while. You definitely have to do the groundwork before you get in there." Ms. Cardinal had tried to create the multi-media project in Hyperstudio™ last year, but there were too many steps for the students to follow. She worked in KidPix™ instead, but she did not like the limits of this software, and it was geared toward younger children.

Ms. Cardinal ran the meeting reminding Ms. Justice and Mr. Harley of the lessons they had done to cover databases, word processing, and graphics. Since she had already taught spreadsheets, she shared with them the lesson she had worked on and told them she had other plans created for February. She decided what project would be worked on in the lab for the multi-media presentations. Ms. Cardinal had done a book report last year and wanted to continue working with that idea. She felt that devoting one week each to cover the required slides: characters, plot, summary, main idea, etc., would provide enough lessons to last through the eight weeks of the project. She did want assistance in her classroom as well as in the lab when PowerPoint™ lessons were going to start. She knew from her experience last year that students will work better in the lab if they have all the information in front of them.

Ms. Justice and Mr. Harley agreed with recommendations made by Ms. Cardinal because regarding the final project because they had no experience working in the multi-media program. They did need assistance in creating and working on the spreadsheet program, so that was the goal of our meetings through February. Mr. Harley was already getting assistance from a Navy volunteer. This gentleman, Mr. Baird, had supplied Mr. Harley with the data of the sunrises and sunsets. Baird created a template in Excel that Mr. Harley and he shared with the students. They left certain times blank to provide the students the opportunity to enter in data. Once all the data were entered the next step was showing the students how to graph.

Baird, unfortunately, was not able to present this to the students in a way they understood and that was not overloaded with technical terms. There were several steps involved in creating a graph even if the wizard Excel™ provides was used. Mr. Harley and I sat down after this lesson did not work, and we walked through each step together and made notes that would help him explain the parts to the students. We wanted to avoid explaining too much that was not needed for this lesson to not confuse the students further. Mr. Harley worked out each step to help his students create their graph. Mr. Harley felt better about working with his kids and understanding what they had to do. He said, "I liked being able to sit and learn with the students when Mr. Baird was teaching, but it bothered me when I could not help them when they were stuck in a screen."

Ms. Justice agreed to work on the same lesson that was created by Mr. Mulder and Ms. Blue. The three of them did not plan out the lesson together; Ms. Justice asked for a copy when Mr. Mulder and Ms. Blue were finished. Ms. Justice worked on the spreadsheet lesson for three weeks and found the information helpful for her students. She said, "They were not aware of how damaging it would be to forget to turn in that one assignment." She said one student had gone home after and put in 50's for the missed work and realized how much better his grade could have been even if he failed. Ms. Justice said that was more powerful a lesson than

repeating over and over how important it was to turn in every assignment. Using the formula button in Excel gave the students immediate feedback on how their grades could have changed.

As March approached, Ms. Cardinal, Mr. Harley, and Ms. Justice assigned a book report to their students and told them about the requirements for the presentation. Ms. Justice said, "My students liked the idea of typing in smaller boxes of text instead of writing out a whole paper on a book." Ms. Cardinal and Mr. Harley agreed that their students preferred this format as well. Each teacher explained the slide requirements: title slide, character slide, central problem, plot, turning point, conclusion, recommendations, and an author's page. The students would be allowed to put in pictures and sound but only after all the text had been done on each slide. The teacher or another student would have to "sign off" on the work before any additional medias could be added.

For the first week storyboarding was taught in the classroom and the layout of PowerPoint™ was taught in the lab. Only the background information was given to the students on using this software. The teachers did allow the students to pick out a design template that would be used throughout. The students were not allowed to change the layout after the first day in the lab. The students created their title slide on the first lab lesson as well and then saved. This allowed each student a file they would have to open each week.

During the second week, we continued working on storyboarding in the classroom. Ms. Cardinal noticed several students had not started a book or the storyboards. She asked the special education teacher, who helped her in language arts, to pull those students aside and help them get caught up. With the three of us in the classroom working on storyboarding, many of the students' questions were answered before we got to the lab and the lab worked went quickly. Mr. Harley and Ms. Justice did some of the storyboarding alone and some we worked together on. Many students had questions on representing their information and were concerned they were not including enough facts from the book.

Ms. Cardinal, Mr. Harley, and Ms. Justice did not meet to discuss the lessons in the lab after the initial planning. Ms. Cardinal had offered suggestions to Mr. Harley and Ms. Justice based on her experience from last year and based on her experiences this time since she was in the lab on Monday before the other two team members. Many of these conversations occurred during the change of classes in the hallway or during lunch. These conversations were more "by the way" than sitting down and discussing the outcomes of each lesson in the lab.

With most of the storyboarding finished, the work in the computer lab was almost finished as well. By the fifth week the students were checking each other's work and making recommendations for improvements. When a majority of the class was ready to move on to the next step, Ms. Cardinal, Mr. Harley, and Ms. Justice provided a whole class lesson on inserting pictures into the slides. They talked about appropriate pictures and the importance of finding a picture that correlates to what they were writing about. The students who had not finished the text portion, worked feverishly to catch up so they could insert pictures.

Finally with SOL testing within two weeks, the teachers were looking to finish this project so they could focus back on objectives the kids would have to know for their exams. We

showed the students how to insert sound and had them create a sound file of their title slide. Once all the text, pictures, and sound were complete, the students were allowed to print out their reports. They were going to be graded in the classroom as a book report with the technology only counting as a small portion of the grade.

Team One had been planning lessons together from the beginning of the school year. Ms. Cardinal was a strong team leader, and she provided her partners with many lessons she had worked on in the lab. Her support and guidance encouraged Mr. Harley and Ms. Justice to try lessons in the computer lab and share their ideas with the group. The multi-media project was another collaborative effort by Team One. They planned the project together and also shared any problems or concerns that arose during each of their lab times. Each teacher selected a book report from their class to share with the other two classes just to show how different each one could have been. The teachers were confident in their choice of using a book report and their confidence transferred to the students. Once the project began, Ms. Cardinal only requested hands-on assistance in her classroom with storyboarding. She was comfortable with the transfer of knowledge to the lab. Ms. Justice and Mr. Harley were comfortable in their classrooms, but both requested more hands-on assistance in the lab answering computer questions. The students enjoyed working on this project and enjoyed the freedom to be creative within the guidelines of the report.

Ms. Cardinal's opinion leadership provided the necessary spark to help her team adopt the innovation quickly. She had more mass media (Rogers, 1983, p. 282) contact throughout the school she taught in as well as the school system. Her children had gone through the school system and as a parent, Ms. Cardinal was very involved in the PTA organizations at their schools. She participated on many different school improvement committees for her children's schools and for the school she taught in.

Ms. Cardinal provided opportunities to have face-to-face conversations with Mr. Harley and Ms. Justice. Even though their communication patterns were brief and often spontaneous, both Mr. Harley and Ms. Justice knew they could ask any questions at any time. This level of comfort on their part with Ms. Cardinal created a constant dialog between the team members.

Another advantage Ms. Cardinal had was what Rogers referred to as "socioeconomic status" (p. 282). Ms. Cardinal was the only member of her team who had taught previously at this school and one of the team members was new to the school system. Ms. Cardinal had knowledge and experience with the principal, the staff, the grade level, and the school system requirements. She had more experience integrating computers into the curriculum. Because of her previous experience in this school with this faculty, she had a higher social status (Rogers, 1983) in the school than either Mr. Harley or Ms. Justice, but she afforded them the opportunities to be a part of her experiences and share with them knowledge that would help them become more successful.

Team Two

Mr. Lawson and Ms. Welch designed lessons in the computer lab based on the subject(s) they taught. At times this was a difficult arrangement because the students in Ms. Welch's class

did not get to work on the same assignments in the computer lab as Mr. Lawson's class. For example, Ms. Welch assigned a friendly letter to be written to Thomas Jefferson, George Washington or Patrick Henry. Mr. Lawson worked with his students on the letters in class as part of their language arts requirement, but only Mr. Lawson's class received instruction on how to type letters on the computer, what different shortcut buttons could do, and how to insert pictures. At the same time, Ms. Welch was teaching her students about databases, and they were recording the presidents' names, dates of birth, States of birth, and time in office. Mr. Lawson's class did not have this same opportunity. Mr. Lawson and Ms. Welch had taught the same technology objectives through January, but the students did not have the same experiences in the lab.

Ms. Welch also took her students to the computer lab two additional times a week for Josten's™ math. Ms. Welch said, "I am frustrated with this program for my students and for me. It lacks correlation to what I am teaching in the classroom and leaves me with 30 fewer minutes of valuable teaching time." The students were supposed to take an initial test that placed the students at appropriate levels for maximum learning. Some of the students did not take the test seriously and were placed at the beginning levels of math working through addition and subtraction problems while the remaining classmates were working on area, perimeter, multiplication, and division. Because Ms. Welch could not assist the students, she felt this was a "free period" for the students. Mr. Clark, the CRT, gave a spontaneous survey on whether or not the students felt any benefit from working through this math program. They responded that they enjoyed not being in class, but they did not think the math program was helping them in class at all.

Ms. Welch did not express a positive attitude when bringing her students to the computer lab. Her teaching style in her classroom was that of a teacher in charge. Her voice was loud and constant and confident. She led her students through science and social studies lessons and welcomed their questions to enhance the conversation. In the computer lab, she was quite different. She was not as loud or as confident in leading the lesson. When students asked questions, she often directed them to one or two students she said knew more. She said, "The success I have had in the lab is because of the students' prior knowledge and experiences before having me for a teacher." It was an additional burden that she did not benefit from and did not feel the lessons were benefiting her students because she did not know what she was doing.

In a conversation with me about lessons in the lab, Ms. Welch asked if I could help her design a lesson working with spreadsheets. She had some ideas but did not know how to present this information to her students. She also wanted both classes to work on the same lesson, so she approached Mr. Lawson about sharing his lab time with her so his students would benefit from the science lesson. I agreed to help them create a lesson that would cover Ms. Welch's SOL objectives for science as well as cover the technology SOL's for spreadsheets.

Ms. Welch wanted to cover rocks and minerals and explain to the students how you can tell where an area is on the Earth based on the amounts of certain rocks in that region. She was more interested in the charting part of the spreadsheet program, and Mr. Lawson thought that would be fine to cover while his students were in the lab as well. We designed the lesson around

the information in the students' science books about rocks and minerals. Ms. Welch wanted to focus on the regions of this state since that would also cover one of the social studies objectives.

The first lesson was presented to discuss the background information in Excel, the system chosen software. The students learned terminology that would also be on their exam: cell, row, column, formula bar, scroll bar, and menu bar. A template of the spreadsheet was printed and copies for all the students and they were to write in the terms on their copy. This provided both the teachers and the students a "cheat sheet" of terms to use when working in the program.

The next two lessons included filling in the data and creating graphs from the data. Ms. Welch and Mr. Lawson created three invented locations and input certain amounts of rocks in each: igneous, metamorphic, and sedimentary. The students would have to match the fake location to the genuine region in this state based on the percentages of the kinds of rocks. The graph created helped give the students a visual to work with. Each student printed out their graph to use in class for another science lesson.

Mr. Lawson and Ms. Welch worked together often, especially being the gifted cluster teachers and having to plan lessons with the GRT. They taught based on different educational philosophies, but respected the work of the other. Mr. Lawson did not criticize Ms. Welch's work in science, social studies and math, and she respected his work with language arts. It was hard for Mr. Lawson to share his teaching time to work on a product for science. He knew it would benefit his students and he needed to cover the spreadsheet objectives, but he said, "It is hard to give up your class for another teacher's goals whether it be art, music, computer, or science."

When the conversation came up about what PowerPoint™ lesson to work on in the lab, Ms. Welch recommended covering Physics since she would not get to that chapter before the tests in May. Again, Mr. Lawson agreed to work with his students in computer lab on creating a multi-media presentation on Physics. Ms. Welch had to create all the outlines and present the necessary materials to the students in class before they came to the lab. She asked me to find pictures in Clipart™ that would match the outline of slides the students had to create. This was a problem because the Clipart™ for PowerPoint™ was not as extensive as the teachers needed, so she requested help in finding better pictures off the Internet. A small group of fifth grade students who were in the gifted program were working on another project downloading pictures from the Internet, so we utilized their new skills and had them research and pull the necessary pictures. These students created a Physics folder in a shared folder on the network and stored all the needed pictures there. When it came time to teach the students how to insert pictures, Ms. Welch and Mr. Lawson showed them how to pull a picture from that shared folder instead of from Clipart™.

Like Team One and Team Three, the students had to create all the necessary slides before they could insert pictures and sound. Mr. Lawson's class, which had been much more independent in the lab, worked quickly to get the necessary information from their textbook and on to their slides. Mr. Lawson and Ms. Welch did not use storyboarding as the other classes had done. The students used the outline created by Ms. Welch to record information, and many just followed the outline and brought their books to lab and pulled the data right from the book.

The first lesson in PowerPoint™ included only the background information on multi-media slide shows. The teachers did allow the students to pick out a design template that would be used throughout. The students were not allowed to change their choice after the first day in the lab. The students created their title slide on the first lab lesson as well and then saved their work on the hard drive. We had discussed floppy disks to save the work, but eventually the floppy disk would not hold all the data. We looked into working off the network but found out the system administrator deleted the student folder once a week and all student work would be destroyed. The hard drive storage space allowed each student a place to save the file they would have to open each week.

Once a majority of the students were finished with the text portion, Mr. Lawson and Ms. Welch presented a lesson on inserting pictures. They walked students through the steps so that each student tried to insert a picture while following directions. They showed the students the shared folder of pictures as well as Clipart™. These presentations were much more extensive than the other two teams' student work. On average the students created twenty-two slides from the outline.

While I was working with both Mr. Lawson and Ms. Welch, Ms. Welch made more of the decisions and choices for what would be taught in the lab. This was a different picture than was presented earlier in the semester when Mr. Lawson did more of the researching and decision making for what he would teach in his class and Ms. Welch had no ideas for teaching in the lab. Ms. Welch brought ideas to the lab with her when she brought the students for Josten's™ math. She would ask questions about designs and layouts, and we would create templates. She would then give the lesson to Mr. Lawson to teach. After some guidance and encouragement, Ms. Welch quickly moved forward in creating lessons for the computer lab. She continued to ask questions and design lessons that she wanted to use next year.

Team Three

During the first round of interviews with Mr. Mulder and Ms. Blue, the conversations were limited to only the topics they were comfortable sharing. Mr. Mulder and Ms. Blue did not openly share information regarding their work in the computer lab or on the computer. It was clear that Mr. Mulder and Ms. Blue were not comfortable talking about their successes and failures in the computer lab or talking about the steps they had taken to integrate computers into their curriculum. It was important to know the process that each of these teachers had made toward the completion of the SOL objectives for technology. A change in the dialog was necessary to proceed in that direction. Mr. Mulder and Ms. Blue were suspicious of change agents, especially after their lack of support from the CRT. Ms. Blue asked me about Ms. Welch's request for assistance, so I asked if she needed assistance as well.

During my interview with Ms. Blue, I asked what objectives she had not met with regards to computers as a way to gauge how much she would still need to cover. She knew that spreadsheets and multi-media had not been covered, and she could not see how she was going to fit that in with all the other things she needed to teach before May. I knew she used the electronic grading system the school provided and with the second quarter ending, we talked

about showing the kids how their grades were decided. She wanted them to see the value of a zero and how it truly affects their grades. There was excitement with the potential of connecting the lab to her role as a teacher. She wanted this lesson idea available for both classes and was not sure if Mr. Mulder would be willing to try this.

During my interview with Mr. Mulder we talked about the computer objectives he had to finish and his were very similar to Ms. Blue's list of spreadsheets and multi-media. I told him about the spreadsheeting idea and how it related to his class as well since he does grades for his students each quarter. The outcomes of zeros added in to the grade affects the students whether hand calculated or done on a computer program. He did like the idea in hopes of motivating his students to pull up their grades for the rest of the year.

After both initial interviews, we sat down as a team. Mr. Mulder and Ms. Blue wanted to cover the spreadsheet lessons first, so we began there. I went over basic parts of the spreadsheet program that the school system was providing, as a way of introduction for Mr. Mulder and Ms. Blue that they could, in turn, use with their students. Ms. Blue quickly took the lead in the meeting explaining to Mr. Mulder how she used the grading program and what occurred during the formula process. She decided what the students would enter into the cells, and they decided it should be fun, so no real grades or names would be used. They agreed upon doing 3 students and entering 5 grades. They asked for assistance in creating the formula portion for the grade average, so we went over the shortcuts to create a formula.

During the three lab lessons following this meeting, Mr. Mulder and Ms. Blue focused on the uses of spreadsheets and taught the required technology SOL and some of the math SOL's. It did not seem to concern either of them that it took three weeks to finish this lesson even though that concerned them when they were working in the lab by themselves. Both felt that the core curriculum SOL objectives they wanted to meet were achieved as well as the technology ones.

The conversations between Mr. Mulder, Ms. Blue and me reached a comfortable level after the presentation of the spreadsheet lessons. They began ask more questions about using computers. They did not change any of the things they were doing; they had not made a decision about adopting computers into curriculum. They were listening and trying to do things on the computer with the students they had not done before.

In February when talk began about creating multi-media projects, Mr. Mulder and Ms. Blue made a choice about what core curriculum objectives were going to be taught in conjunction with the multi-media. Mr. Mulder and Ms. Blue opted to continue working on the famous scientists the students were required to know by May. Each student would be required to create 12 slides of scientists. They would have to create storyboards for each scientist with the data Mr. Mulder and Ms. Blue would require about each one (i.e., date of birth, country of origin, invention).

As with the spreadsheets, Mr. Mulder and Ms. Blue sat down and learned the basic components of the multimedia package provided by the school system. Mr. Mulder and Ms. Blue liked the design templates that were available in PowerPoint™ and felt this would make it easier for the students to enter their information. We decided that storyboarding in the classroom

would be an effective way for the students to make decisions about their presentations and would be a place the students could begin to write down their information. Blank template sheets were printed out of PowerPoint™ and copied for the kids. The students would get their information and plug it in to their presentations. Mr. Mulder did a large portion of the storyboarding in his class for both groups because he could focus on writing skills and presentation of information.

The next part of the project was introducing PowerPoint™ to the students. The teachers used a similar introduction to the one I had provided them. At the end of this first class, they let each student choose a design template, and taught the students how to create the title slide. This portion gave the students a chance to see and touch and manipulate the information they had just learned. The second week was spent reminding students of the terms learned previously. Mr. Mulder and Ms. Blue showed the students how to create new slides. From there, they directed the students to begin working.

The next three weeks were student-driven as students worked at their own pace to finish all the text information that was required of them. Mr. Mulder and Ms. Blue were more relaxed in the lab because they could walk around helping individual students who had questions on the scientists. There were two volunteers in the lab during the lessons, a navy volunteer and the researcher, who were also available to handle computer questions. The teachers wanted to emphasize text more than pictures and sound and as a group, decided to put off those learning objectives until closer to the end to ensure completed reports. The last three weeks were spent on proofreading, inserting pictures, and inserting sound. Once all students were finished with text and someone had proofread the report, they were shown how to insert Clipart™.

When the projects were finished, the students were allowed to print them out. Many teachers on grade level had talked about sharing the presentations with other classes. The two science shows would be valuable to all students on fifth grade not just the ones who created them. However, with the SOL's in one week, Mr. Mulder and Ms. Blue picked two or three of the best from each class and made enough copies to share with other students as study guides for their science exams.

In the final interview with Mr. Mulder and Ms. Blue, I asked if things would be different next year when working in the computer lab and with computers. The computer resource teacher will be the same and will have the same philosophy so it will be up to the teachers to choose to do things differently. Ms. Blue felt that she was more prepared to work in the computer lab and has seen ways to work with the SOL's. Instead of feeling like she was losing 40 minutes a week, she could utilize that time to reinforce and practice lessons learned. She also appreciated having me present lessons to her, so she could see how someone else might teach a topic. Those presentations helped her feel more confident in front of her own students. Mr. Mulder did not express an opinion one way or another. He still wanted a computer resource teacher to teach, but saw how Ms. Blue and he could work together to achieve not only their own objectives but also the technology objectives. He would not say he was comfortable or that he would teach things differently. He just acknowledged that he knew it could be different in the lab.

Mr. Mulder did not want to teach anything he is not comfortable working with or doing. For Mr. Mulder the uncertainty about the new innovation remains. He has not been able to move

past his concerns. Ms. Blue may be helpful to him next year if she continues to utilize the lessons she started this year.

Summary

Team One was the first team to adopt the integration of computers into the curriculum. All three teachers, Ms. Cardinal, Mr. Harley, and Ms. Justice, had been designing and sharing computer lab lessons prior to the start of the research study. Ms. Justice and Ms. Cardinal had been using the computer to create tests, send letters home to parents, and to create lesson plans in addition to using the computer as a telecommunications tool. Mr. Harley started created tests on the computer during the study. The success of this team continued during the contact with the researcher change agent. The teachers became more comfortable with the software presented and expressed some hope that they would be able to continue teaching this information the following year.

The collaborative planning of Ms. Cardinal, Mr. Harley, and Ms. Justice created a close group who shared ideas and lessons. Ms. Cardinal is definitely a leader, but they all shared the same goals for student learning and the partnership and planning was supported by the administration. They were a successful team: organized, committed, and dedicated to a common purpose. Team One continually inquired about and analyzed their values and practices while sharing their experiences with each other (Lieberman & Miller, 1990). They include in their daily work several of the key components to successful partnerships and collaboration: talked about their teaching; joint work; planned, evaluated and developed teaching materials together; and taught each other the practice of teaching (Little, 1982).

Team Two, Mr. Lawson and Ms. Welch, had begun to implement the innovation by the end of the study. However, their roles as team members had shifted during the study. Mr. Lawson at the beginning was the early majority who had begun the process of integration the computer into his work and curriculum, and Ms. Welch was still lurking on the brink of the adoption process. Ms. Welch said, "If [the computer lab was] accessible to us at all parts of the day, every day, then I think we would be a whole lot more comfortable. One time or two times a week does not make [my] comfort level very high." After months of being able to ask questions and create lessons plans with assistance, she said, "I have some good ideas of what I am going to teach next year in the computer lab now that I have seen what I can do." She was moving in a direction towards complete implementation and using the computer with her classroom lessons. Mr. Lawson continued to work with the computer, but he did not appreciate being left out of the planning process for work his kids would be doing with him during computer lab. Team Two would continue to be successful in the following year. Both had designed, developed, and implemented lessons in the lab. They would need continued reassurances from other members of their social system for continued success using the innovation.

The collaborative efforts of Team Two was greater outside of working in the computer lab. Both had already created a collaborative relationship with the Gifted Resource Teacher and were comfortable in the processes of working together. They acknowledge that applying gifted concepts to their individual lessons was easier than planning a joint project in the lab. During the

investigation, Team Two did not believe this innovation fit into their practices, as did the goals of the gifted program. This innovation was an additional burden to implement.

Team Three, Mr. Mulder and Ms. Blue, was still working on the decision process at the end of the study. Their level of uncertainty had been reduced after opportunities to ask questions and receive answers. They reiterated on many occasions that they had not gone to school to be computer teachers and were intimidated by the amount of knowledge they did not have to teach their students. Ms. Blue was beginning to use her computer for more tasks than just telecommunications. She used the computerized grading program, and she was creating more class work, such as tests, on her computer. Mr. Mulder was still having problems creating simple documents and even sending emails. He would need continued support to help him past his levels of uncertainty. Both were successful with the support of the change agent, but their success in the following year would rely on Ms. Blue's continued advancements in using the computer.

Mr. Mulder and Ms. Blue were just beginning to work collaboratively. This was their first year teaching together and because he had so much more experience teaching than she, Ms. Blue was tentative about introducing ideas and plans. They did share beliefs and values about education and what their role should be for their students. Technology did not fit into their daily work and was not valued as a teaching tool. Computer integration was a burden and another piece to add to the day. They often felt that decisions made were made by the administrators, which left them without an opinion.

Mr. Clark began engaging in conversations with the teachers in May when the SOL exams were to be given. He provided them with some study guides for the students to use in preparation for the test, and he went over practice questions in the lab. He tried to give the practice questions for homework, so when the students came to the lab, only 10 or 15 minutes would have to be spent on going over the answers. Ms. Cardinal did not think this method would work for her students, so he provided her with the questions and answers, and she did something different. One week before the SOL exam, Mr. Clark gathered all fifth-grade students in the cafeteria, and they took a practice test. Mr. Clark would review the data to determine what areas were lacking and would need to be focused on next year.

Mr. Clark and I did talk about my interactions with the teachers. He did not understand why it seemed to go as well as it did in the lab. He asked what I had done, and I told him I only provided them with information on the software and what was available and should be used in each situation. I tried to explain to him that the teachers wanted to be in charge of their lessons but they needed help with computer integration. He said he could provide them with that; they just had to ask.

My role shifted almost immediately from one of observer to one of full participant. Once the teachers began to ask questions and once I answered them, I became a member of their environment. I became the computer-integration expert working with the teacher who was the subject-matter expert. I did not have any accountability for the situation and was able to focus on this fifth-grade team and provide them with all the support they requested. Unlike Mr. Clark,

I had the freedom and flexibility to move around the school and interact on a different level with the teachers.

Chapter Five: Conclusion

Introduction

The research presented in this study examined how teachers integrated computer technology and the extent to which collaborative efforts influenced the integration efforts from the perspective of the teachers who were adopting the innovation. This chapter contains a summary of the findings, conclusions, limitations, and suggestions for future research based on this study.

Summary

Computer Integration

The first question asked how did this grade-level team of teachers integrate technology into their curriculum. Success in integrating computer technology revolved around the teachers' innovativeness, their change agent contact, collaboration efforts, and the characteristics of innovations that affect the rate of adoption, such as compatibility, complexity, and operability, as discussed by Rogers (1983). The conclusions related to the collaboration efforts are elaborated with the summary of results related to the second research question.

Innovativeness. The innovativeness of an individual is the likelihood that person has of adopting an innovation at a certain point or time frame within the innovation. The innovativeness of these participants, ranging from the innovator to the laggard, did align with most of Rogers' (1983) theory, however, some unexpected observations emerged as well. These unexpected observations based on the participants time in their career focused on the following: opinion leadership, years of education, social status, and the amount of change agent contact.

Rogers (1983) surmised that participants who had more experience than others who were also adopting an innovation would adopt the innovation quicker, have more knowledge about an innovation based on their experience, and have more change agent contact. Upon entering the setting, I had expected different people to be in different innovativeness roles. For example, Mr. Mulder, Mr. Lawson, and Mr. Harley all had more experience teaching than the other four participants. I expected them to be more certain of their roles as educators, to have a greater understanding of the innovation, and to have greater contact with the change agent or CRT.

However, Mr. Mulder was a laggard and, even though he had been teaching at this school for more years and knew each teacher, he was the last to integrate the computer technology into his routine. Mr. Lawson was a former principal who had more social interactions not only in this school but also in the school division than any other teacher on the grade level and even stated that as a principal he encouraged computer technology integration. Yet, as a teacher he was in the early majority group to adopt. Mr. Harley was new to this school, and in his first interview he discussed how much interaction he had with computer technology. Being new he was not afforded the same amount of time as the others had to learn about the innovation and form any opinion. It was a part of the curriculum and he was expected to implement. Also, he did not have any social interactions outside this grade level. According to Rogers (1983) participants

need time to learn about an innovation before adopting, but because Harley had contact with Ms. Cardinal, he adopted quicker than others who had time to learn about the innovation and who had more contacts inside and outside the school.

I also expected Ms. Cardinal and Ms. Justice to be slower in the adoption process than they were. Ms. Cardinal had fewer years experience than Mr. Mulder, Mr. Lawson, and Mr. Harley, but she did have more social status than Mr. Mulder or Mr. Harley inside and outside of this school. I found that she had greater opinion leadership due to her quick integration of computer technology and her creation of opportunity for other members on the grade level to experience a "trial-by-others" (Rogers, 1983).

Ms. Welch and Ms. Blue were part of the late majority, and I expected them to be in this category. Ms. Blue was new to the grade level and to the school and was more involved in implementing the core curriculum, not the computer technology innovation. Ms. Welch did not circulate among the grade level or among the faculty at the school asking questions or looking for assistance. She preferred to stay within her team and utilize the assistance of the Gifted Resource Teacher.

They surpassed expectation, however, when they took the lead on their teams to work towards adoption. Ms. Welch became the decision maker over Mr. Lawson on Team Two, and she designed and developed the majority of lessons for their classes. I provided for Ms. Welch the same relationship she had with the Gifted Resource Teacher. She wanted to collaborate with someone and not feel lost in designing a lesson for her students. Once I answered questions for her and she knew she could ask, the questions continued and she began to implement successful and some unsuccessful computer integrated lessons. She needed a collaborative partner. Ms. Blue provided the same leadership over Mr. Mulder and designed the majority of lessons for their classes. He did not have any interest in sitting in front of a computer to design a lesson, and she had more experience working on computers. She also had the majority of subjects to teach and found it easier to incorporate a language arts objective into what she wanted to teach versus incorporating a science objective into a language arts lesson. In addition, both Ms. Welch and Ms. Blue had fewer years of teaching experience than either of their partners, Mr. Lawson and Mr. Mulder.

Rogers (1983) described the early adopter as having the greatest amount of opinion leadership. Because of the unexpected role changes, the original people I expected to have the greatest amount of opinion leadership were different. I found three different people in different categories of innovativeness to have a certain amount of opinion leadership. During this innovation, Ms. Cardinal, an early adopter, did have the greatest amount of opinion leadership within this team of teachers. She decreased the uncertainty of the innovation because she had adopted it, and "convey[ed] a subjective evaluation of the innovation to near-peers" (p. 249). Mr. Harley and Ms. Justice then worked toward adoption easily under the guidance of Ms. Cardinal. Ms. Cardinal influenced the work of the two newcomers to the innovation and increased their rate of adoption even though they did not have as much of a background in the process as others had.

In addition to Ms. Cardinal, Ms. Welch and Ms. Blue also established a small amount of opinion leadership within their teams. Mr. Lawson and Mr. Mulder followed the advice of their partners and implemented computer technology based on Ms. Welch and Ms. Blue's experiences. These two women led their team members in designing and developing lessons for the computer lab. This was an unexpected strength that emerged during the study from both Ms. Welch and Ms. Blue.

Change agent contact. Rogers (1983) also reported that contact with a change agent would increase the rate of adoption of an innovation. Because there had been a change agent (i.e., Mr. Clark, the CRT) in the setting for the duration of the innovation, I expected the teachers' contact with the change agent to be greater, thus the adoption rate of the innovation to be greater. The relationship with the CRT was more heterophilous as Rogers described, and he stated, "The nature of diffusion demands … some degree of heterophily" (p. 19). Mr. Clark was more technically competent than the teachers, and based on that and Rogers' statements I expected a complementary relationship with Mr. Clark sharing his knowledge of technology with the teachers who in return would share their knowledge of the subject matter. Unfortunately, Mr. Clark was unable to communicate effectively with the teachers and vice versa. They did not share a common language regarding education, came from different cultures, and had different goals for the students, and therefore, the teachers' were unable to express their needs, and the CRT was unable to empathize with the teachers' situation.

Mr. Clark believed in the innovation and supported the administration's goals to implement the innovation. What he understood his job to be and what the teachers understood his job to be were two different ideas. His focus was on the maintenance and not on designing lessons. He was doing the job he needed to do and the SOL scores for computer technology were very high. He did the job he was accountable for, but that job did not provide support the teachers expected. The teachers and Mr. Clark did not have the same beliefs, values, or expectations regarding the implementation of the computer integration.

As I entered the setting, I understood Mr. Clark's job description. I understood that I was not accountable for the SOL exam, and I interacted directly with these teachers. I was more "client-oriented" than "innovation-minded" (Rogers, 1983, p. 319). I did anticipate having greater success with the teachers to implement computer integration because I was able to become a member of their social group. They accepted me and shared with me their concerns and inhibitions about working with computers. I provided them with the tools and instructions on using the tools to alleviate their anxiety. I filled the requirements of a successful change agent according to Rogers (1983).

One factor that altered the rate of adoption for the participants was the comfort level and compatibility with the original change agent, Mr. Clark. The teachers had different values, beliefs, and educational backgrounds from Mr. Clark. He was only in his second year of teaching after completing 20 years in the military. The teachers did not agree with his interpretation of his job and did not try to communicate with him about their needs. He was not a member of the culture of the teachers that was created at the school. He did not empathize with their situation and maintained the stance that he was there as the technical expert, not as a teacher. This affected the interactions with the change agent and therefore adoption was not

occurring. And if it was, it was the individual, like Ms. Cardinal, who was influencing the decisions.

Innovation Characteristics. Finally, the innovation characteristics described by Rogers (1983) explained some of the success of the computer technology integration. Two factors appeared to have the most impact on adoption of the innovation: the comfort level of the participant with the innovation and the compatibility of the innovation with the participants' values, beliefs, and educational background. Rogers (1983) stated that the more positive the comfort level and compatibility to the innovation are the greater chance the innovation has to be adopted.

For Ms. Cardinal the personal computer was not a "new" item. She had been working with computers at home both with her children and with her husband as she helped him manage a business. She was very comfortable with using computers and easily made the transition to using one at school. She was able to create lessons at home and incorporate them at school. Her level of comfort with the innovation was high which enabled her to adopt the innovation quickly.

For others like Mr. Mulder, Ms. Blue, and Ms. Welch, the computer was an additional burden they had to use. Each stated they "did not go to school to teach computers" and were uncertain about using the computer as a classroom tool. Even Ms. Blue who had more experience using a computer at home was overwhelmed with using a computer at school because she was trying to grasp all of the information about the content she needed to teach. The comfort level with the innovation led to the different levels of adoption and innovativeness for the teachers.

The compatibility of the innovation with the teachers' beliefs, values and educational background also was a factor in the level of innovativeness. Mr. Mulder had been teaching for twenty years without the use of a computer and did not see any value in changing the way he had been teaching: "The children had not missed anything prior to the introduction of a computer, so why has it become so important now?" He did not value the experience for himself or for his students. Ms. Blue was struggling to learn all of the objectives for the curriculum she needed to teach the students and did not believe that "computers should be given more instructional time than core curriculum." She did not think it was fair to expect the teachers to learn as much about the computer to teach to the students as the teachers should about the subject matter the students need to be successful on the SOL exams. Her focus was on the subjects she taught and not with computer technology. Ms. Welch agreed with Ms. Blue and also felt that too much emphasis was being placed on using the computers when there was not enough time during the school year to teach the students all they needed for their exams. Because they did not value or believe that importance should be placed on the innovation, they did not immediately provide instruction to their students.

Only one of the teachers, Ms. Cardinal, really tried the innovation before making the decision to adopt or reject. The others observed her actions and made their decisions. This innovation had the potential to be easily described and communicated to other members on the grade level but was not immediately discussed until the other teachers were ready to openly talk about the innovation.

All of these factors affected the success of the integration of computer technology. One issue that is not discussed in Rogers' (1983) work is the inevitability of an innovation. This innovation has a greater chance of success because of the school division's investment in this project and the State mandate. In addition, the inevitability of the adoption of computer technology was examined through the teachers' efforts to work toward the SOL's that were administered in May.

Collaboration

The second question asked to what extent did collaboration facilitate the adoption of this innovation in the teams. Collaboration was another key to the successful adoption of computer integration. As Little (1982) reported, without collegial support, an adoption will linger. I expected collaboration to be a part of the communication between teachers as they worked in teams, and for the most part the teachers did collaborate on the core curriculum subjects, but they were not planning computer technology integration lessons together. The teachers were talking and sharing about ways to work Language Arts into Science and Social Studies, but they were not discussing how computer technology could be a part of the curriculum.

Linking collaboration to innovativeness, it appeared that the more comfortable the teachers were with using the computer the more likely they were to share ideas with other teachers. Ms. Cardinal was more comfortable using the computer and she had lessons that had worked for her in the computer lab so she was comfortable sharing her results with Mr. Harley and Ms. Justice. The more the teachers valued the use of computers and were comfortable using the computer the greater chances they had to collaborate with other members of the team or grade level.

The more these teachers talked about computer technology, shared plans of computer integration, and shared questions and concerns about computer integration the greater success each teacher had working in the computer lab. The more competent the teachers were in the computer lab, the higher their level of success and confidence teaching computer technology. Collaboration also afforded the teachers with the opportunity to "re-invent" the innovation to better suit their needs. The teachers were able to take away from each planning session ideas they could use and often would re-arrange to fit their lessons or objectives in the lab. The more collaboration there was more knowledge about the innovation was shared.

Collaboration provided the teachers with the opportunity to share ideas and discuss problems and concerns in a safe environment. Many were going through similar anxieties about working in the lab, and talking to each other about the issues increased their confidence. When they realized they did not have to change their curricular objectives and could maintain the lesson to connect to the classroom lesson, they opened up to each other with new ideas and suggestions.

Conclusions

In general, the research results from this study are consistent with the theoretical notions underlying them. The success of innovations depends mostly upon the innovativeness of the individual adopting and implementing the innovation. Participants adopting the innovation who were innovators and early adopters had less uncertainty and greater success in implementing the objectives of the innovation. Participants who were categorized as late majority or laggards had more uncertainty and fewer moments of success implementing the objectives. Considerations must be made when designing innovations that will assist not only the innovator, who will readily adopt the innovation, but also for the laggard, who will take longer to work through the adoption process (Fullan, 1993; Sarason, 1990).

The theories surrounding the importance of collaboration in an innovation were also supported through this research. Once the teachers began working together, planning together, and sharing information (Little, 1982) and lessons for the computer lab, the success of adopting the innovation increased. Opportunities for collaboration need to be built in to designing an innovation to allow teachers time to share, ask questions, and work together toward the common goal of adoption.

While some researchers warned against relying too heavily on the Rogers' theory (Charters & Pellegrin, 1972; Cohen & Bredo, 1975; Downs & Mohr, 1976), Rogers' ideas of innovativeness, the role of the change agent, and the characteristics of the innovation still applied in this study. Charters and Pellegrin (1972) stated that focusing only on the analytical model would cause the researcher to miss important aspects of the change process that occurs between individuals, but the individual and team interactions were observed during the study. Daily observations, interviews, and journal entries provided by the teachers highlighted the aspects of the change process through the teachers' perspectives. The secondary qualities discussed by Downs and Mohr (1976), compatibility, complexity, and comfort level, were also focused on and reported to support the data collected.

Limitations

It should be noted that this particular research study had three limitations with respect to the study of computer integration innovations.

The first limitation is this was a small case study of one group of fifth grade teachers in a larger school system. To enhance the possibility that this study may be informative in other contexts of similar makeup, I attempted to provide rich descriptions of the teachers and the daily events during the study, and attempted to provide descriptions of how each teacher compared with others within the study (Merriam, 1998).

A second limitation pertaining to the site of the study was the extent to which there was interaction with Mr. Clark, the CRT, and the principal. As the study progressed, the focus of technology integration became the teachers' perspectives on the innovation, and my interactions and observations of Mr. Clark were limited to only the beginning of the study prior to my role change and at the end of the study prior to the dissemination of the technology exam for students.

Another limitation of this study is that I became part of the research, as I was a full participant and not merely an observer to the teachers' efforts to adopt and implement this innovation. To avoid any threat to the trustworthiness of this research, I implemented the use of triangulation to support the results. I checked interpretations with the individuals interviewed or observed; I involved all participants in each phase of the research; I stayed on-site for a lengthy period of time; and I informed on how the study was conducted and how the findings resulted from the data collected (Merriam, 1998). Merriam stated that the "burden of producing a study that has been conducted and disseminated in an ethical manner lies with the individual investigator" (p. 219). I tried to remain conscious of ethical issues that might infuse the process and used the participants as often as possible to validate what was written.

A final limitation to this study is that time did not afford me the chance to see the implementation of the innovation from start to finish. The implementation of this innovation was still occurring with several of the participants in this study, and this study could have been strengthened by a longer time period in the setting. While the scope of this study was just of this group of teachers at this one school, had more time been available, it would have been valuable to observe other CRT's in their setting and view their interactions with teachers as well as observe other fifth grade teachers within this school division to see their adoption and implementation processes. These observations could have afforded me the opportunity to generalize the innovativeness of teachers and their approach to integration of computer technology as well as the affect of collaboration in more than one setting.

Future Research

After exploring and interpreting the data and acknowledging the limits of this study, more questions emerged to guide future research. This section contains ideas for future research within elementary schools, surrounding the notion of innovativeness, and on the impact of collaboration, and computer technology.

To continue to understand Stewart County School Division's implementation of technology, further research should survey all fifth grade teachers in the remaining elementary schools to determine the innovativeness and rate of adoption at their schools with regards to computer technology. This would provide some comparisons between the original site of fifth grade teachers and the other elementary schools' teams of fifth grade teachers within the division. Areas of interest might include adoption rate across teachers, qualities of quick or slow adopters, and the nature of adoptions across schools.

Also, innovativeness characteristics should be studied across other educational innovations within the school division to understand if Rogers' theory of adopter categories is generalizable across any innovation or does compatibility with an innovation play a larger role in the adoption of innovations. For example, further research should investigate whether or not an early adopter in this innovation that is compatible with their beliefs will be an early adopter in all innovations presented to the school system.

One concern these teachers had was that other CRT's were producing and participating in more computer integration in their schools. Future research should include looking at the

dissemination of information about an innovation and how similar people present the information to schools in similar ways or if the innovation is available for interpretation. If information is being presented the same way, why then do some schools adopt quicker than others or slower than others? If information is being presented differently, what effect does that have on the teachers who are adopting and what effect does that have on the success or failure of the innovation?

Collaboration was an important influence in the adoption of an innovation in this study. It is important to understand how teacher collaborative efforts at other schools within the school division shaped each individual's choice to adopt the innovation, and how quickly or slowly did the adoption efforts occur at other schools in the division. To coincide with other future research questions regarding collaboration: did the information disseminated by the CRT influence the collaborative efforts at each school? Did the role of the CRT support or hinder other efforts at other schools in the adoption process? What influence did the administration have on the adoption process at each school?

I believe this study adds to the literature surrounding instructional technology with a personal perspective about computer technology as a tool for education. This study attempted to go beyond the uses of the computer and the number available for teachers and students to describe in detail how the teachers were using computer technology and their concerns and issues with the tool as an end user. I hope this research provides some insight to planners of innovations in education as to the needs and concerns of teachers who are given the task of implementing every educational innovation approved by school boards.

Epilogue

I am a teacher. I thought I understood all that was required after you finished your degree and your student teaching. I would take all my skills and knowledge base and attempt to enlighten the students I taught. However, the introduction of an innovation to my job could easily alter everything about what I believe in, how I teach, and what outcomes are expected. I would have to learn a new program, curriculum, or procedure to teach my students. I would be off-balance until I became comfortable with the new innovation and uncertain of what objectives I needed to teach the students. I did not understand the complexity or uncertainty of the introduction of innovations into teachers' pedagogy until I became involved in the lives of these teachers.

I now have a position in a school similar to that of Mr. Clark's position of Computer Resource Teacher. All of the factors that influenced these fifth grade teachers and their attempts to implement computer technology are present in the teachers with whom I now work. My experiences with the participants have affected how I work with the teachers at my school. I try to empathize with the needs of the teachers and understand all they are asked to accomplish in a short period of time, while gently guiding them to implement computer technology. I make every attempt to provide them with support, either technical or educational, and plan with them as often as they need. It can be difficult to convince someone else to see a benefit of computer technology integration if he or she does not agree or understand the benefits. This study has changed the way I see my position and all the layers that are required in it especially when you are accountable for learning.

I believe collaboration and the innovativeness of individuals influence the adoption and implementation process during an innovation. I believe that if we better understand these two processes for teachers, we can better understand the process they encounter and go through to adopt and implement each innovation presented to them. If we encourage and support collaborative efforts, the individual teachers will positively support the adoption and implementation process.

On a final note, as several researchers (Cohen & Bredo, 1975; Fullan, 1982, 1993; Fullan & Hargreaves, 1992; Sarason, 1982, 1990) pointed out, roles in schools can change from year to year from the principal to the opinion leader. The school year after this study was completed one teacher had changed grade levels and two teachers left the school. In addition, the principal was asked to lead another elementary school and the school had an interim principal until a new one was hired. Only one team is still intact from the original study.

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Appendix A

Interview Questions

1. How many years have you been teaching?
2. How many years have you been teaching at this school?
3. What grade levels have you taught and at which schools (if others) did you teach the different subjects or grade levels?
4. Do you use a computer at home to do any work or only at school?
5. You said in one journal entry that you search the Internet each evening. What information are you gathering? What types of sites do you visit? Do you use the material in class?
6. Why do you think you and your partner teach different lessons in the computer lab? Have you ever shared an idea or a lesson for the lab with each other?
7. You said in one journal entry that the CRT does not do what he is suppose to do. What is your understanding of his job description? If you could write the job description for the CRT position what would it include? How different is the actual school job description from the one you created?
8. What is your greatest concern about using the computer technology?
9. What has been your greatest success in the computer lab?
10. As a new teacher at this school, how were you introduced to using the computer lab?
11. You said in one journal entry that you have found more collaboration in this school than in your last school. Is that collaboration with the members of your team, the members of your grade level, or with the faculty in general?
12. How do you incorporate the SOL's into the computer lab lessons? Do the technology SOL's guide the lesson or do the curriculum SOL's guide the lesson?
13. You asked for more training to be provided during one of your journal entries. What additional training would help you be more successful in the computer lab and using computer technology as a whole?
14. When we were in the lab last week, after the two computers froze and the kids were in different places you left the lab. Why did you leave the lab before the time was up?
15. Many journal entries pertain to Josten's™ math and I have been with you in the lab during these classes. How did Josten's™ come to your school as a pilot? How were you selected to pilot it with your class? Was there any training provided for you? Is there continued support for the program?

Appendix B

Coding Categories Table

Innovation Properties	IP
Objectives	IP-OBJ
Classroom Changes	IP-CC
Implied Changes - Pedagogy	IP-ICP
User Assessment	IP-UA
Initial	IP-UAI
During	IP-UAD
Final	IP-UAF
Classroom Management	IP-CM
Characteristics of User	IP-CU
Innovator	IP-CUI
Early Adopter	IP-CUEA
Early Majority	IP-CUEM
Late Majority	IP-CULM
Laggard	IP-CUL
Newcomer	IP-CUN
Adoption Process	AP
Chronology of Events	AP-CE
Initial Knowledge of Innovation	AP-CEIK
Computer Technology in Classroom	AP-CTC
Computer Technology in daily work	AP-CTD
Computer Technology Integration	AP-CTI
Motives	AP-M
Plan	AP-P
Comfort Level	AP-CL
Uncertainty	AP-CLU
Confident	AP-CLC
Site Dynamics and Transformations	SDT
Initial User Experiences	SDT-IU
Changes in Innovation	SDT-CI
Effects on Classroom Practice	SDT-CP
Implementation Problems	SDT-IP
Critical Events	SDT-CE
External Assistance	EA
CRT - change agent contact	EA-CRT
Researcher - change agent contact	EA-R

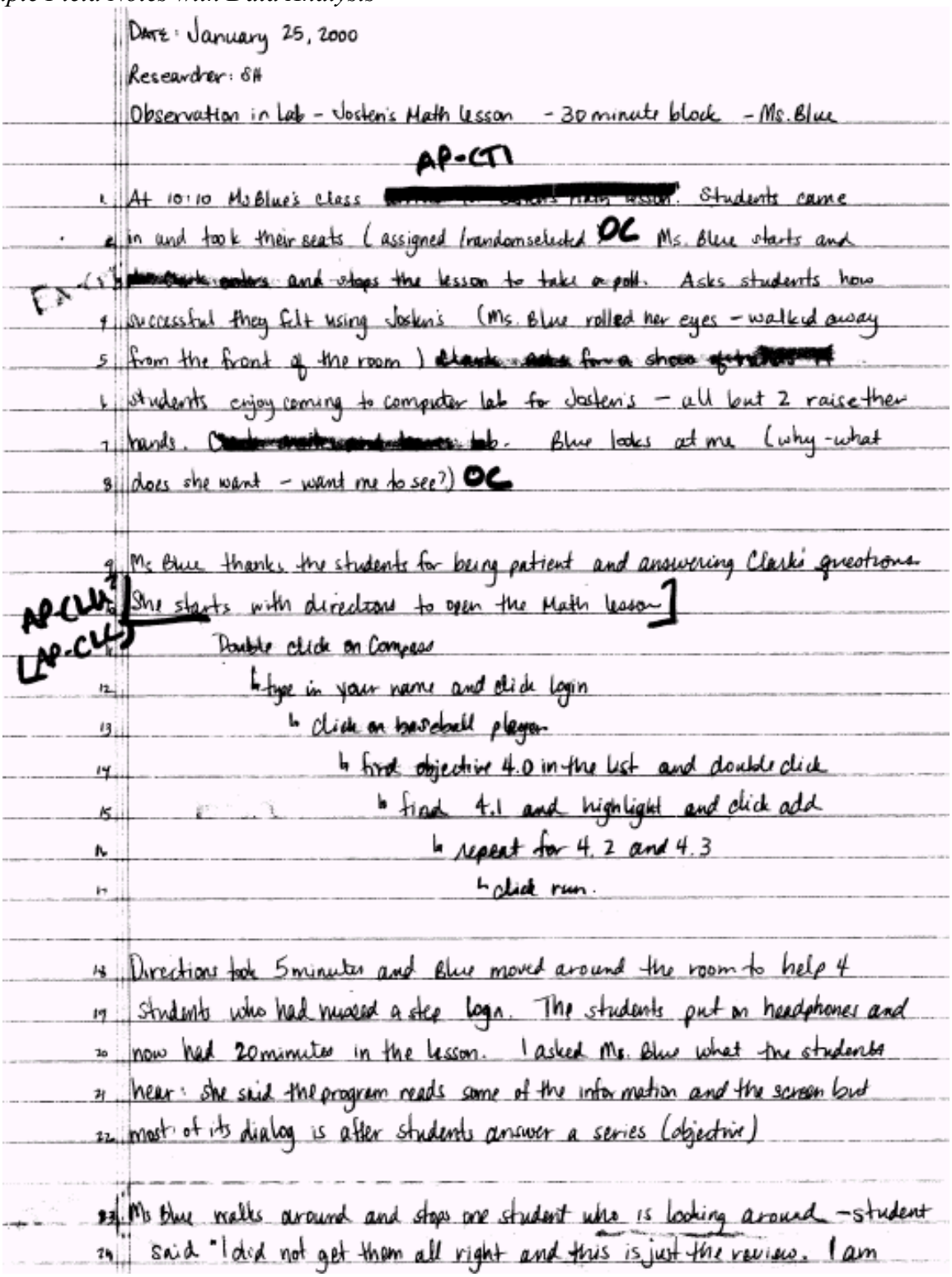
Change Agent Contact	EA-CAC
Help	EA-CACH
Planning	EA-CACP
Questions	EA-CACQ
Interview	EA-CACI
General dialog	EA-CACG

Collaboration Efforts	CE
Team Collaboration	CE-T
Grade Level Collaboration	CE-GL
External Collaboration	CE-E
Change Agent Collaboration	CE-CA

*Note: Coding Categories adapted from Miles & Huberman (1994, p. 59-60)

Appendix C

Sample Field Notes with Data Analysis



Date: January 25, 2000

Researcher: SH

Observation in Lab - Josten's Math lesson - 30 minute block - Ms. Blue

AP-CT

At 10:10 Ms Blue's class [redacted]. Students came in and took their seats (assigned / randomselected OC Ms. Blue starts and [redacted] and stops the lesson to take a poll. Asks students how successful they felt using Josten's (Ms. Blue rolled her eyes - walked away from the front of the room) [redacted] students enjoy coming to computer lab for Josten's - all but 2 raise their hands. [redacted] lab. Blue looks at me (why - what does she want - want me to see?) OC

Ms Blue thanks the students for being patient and answering Clark's questions. She starts with directions to open the Math lesson

AP-CLK

LAP-CLK

Double click on Compass

↳ type in your name and click login

↳ click on baseball player

↳ find objective 4.0 in the list and double click

↳ find 4.1 and highlight and click add

↳ repeat for 4.2 and 4.3

↳ click run.

Directions took 5 minutes and Blue moved around the room to help 4 students who had missed a step login. The students put on headphones and now had 20 minutes in the lesson. I asked Ms. Blue what the students hear: she said the program reads some of the information and the screen but most of its dialog is after students answer a series (objective)

Ms Blue walks around and stops one student who is looking around - student said "I did not get them all right and this is just the review. I am

1-25-00

page 2

Blue lab observation

25 waiting for next directions." (Blue looks at me)

26 10:35 Blue stops the students. Tells them to File/Quit the program and
27 return to the "blue screen". Students return to the desktop, hang
28 up headphones, wait for row to be called. They stood pushed in
29 chairs, lined up at door (routine) Class leaves. [redacted]
EA CA 30 [redacted]. "No."
31 she said and looked at me

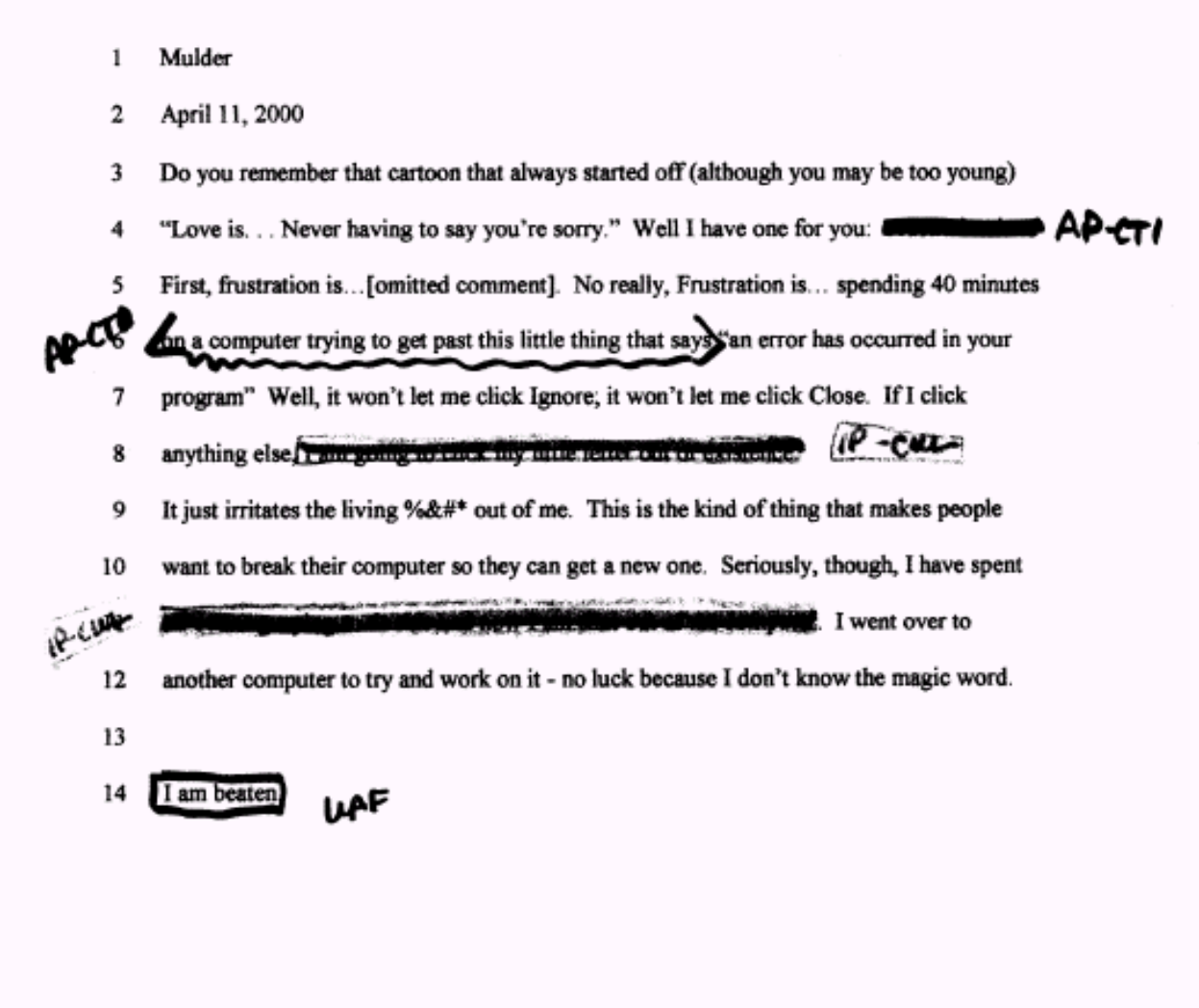
QA Questions: Did Clark poll other class? Why is he suddenly polling classes?
33 Need to see Welch in Josten's setting - student work. What did Blue want from
34 me - kept looking - did she want to know that I saw their exchange?

35 [redacted]. Clark not present to start or
36 stop. Class on task, organized, quiet.

37 * See Journal entry 1/23, 1/25 - Blue discussed Josten's
38 before this observation and after the observation *

Appendix D

Sample Journal Entry with Analysis



Mulder

April 11, 2000

Do you remember that cartoon that always started off (although you may be too young) "Love is. . . Never having to say you're sorry." Well I have one for you: [redacted] AP-CT1

First, frustration is…[omitted comment]. No really, Frustration is… spending 40 minutes on a computer trying to get past this little thing that says "an error has occurred in your program" Well, it won't let me click Ignore, it won't let me click Close. If I click anything else, [redacted] IP-CULT

It just irritates the living %&#* out of me. This is the kind of thing that makes people want to break their computer so they can get a new one. Seriously, though, I have spent [redacted]. I went over to another computer to try and work on it - no luck because I don't know the magic word.

I am beaten LAF

Appendix E

Sample Analysis of Interview

[redacted] Interview

Q: [A discussion preceded this interview in the hallway with two other teachers prior to us sitting down. This start was a continuation of that conversation and therefore, starts off awkwardly.] What has been your biggest weakness in the computer lab?

A: IP-UAI AP-CLU not fully understanding how to use all aspects of the computer. In my private life, I am still using the computer pretty much as a word processor and some communication through the Internet.

Q: I have noticed in your journals that you have really good uses for the Internet. Are you more comfortable with using the Internet than you are to use the software packages that would allow you to type letters, tests, etc. and that are the requirements for student SOL's?

A: It is. I have – I can't think of what all I have on my computer at home. To be IP-UAI truthful, I probably haven't explored 75% of its capability after 2 years of ownership and yet a week or so ago I was able to do some simple graphics and transfer them over into written text just to practice on my own. When I came into school to try it, the procedure IP was different. Different programs/different procedures. That is why yesterday after we AP-CEI [redacted] I had to come back and write myself a IP-ICP little note "KidPix look for little truck and magnet." It is little clues like that if I leave them all over the place and do it a few times, I will be able to remember and do this again. [redacted] AP-CTI [redacted] This was integrating slides, text, video and the written word into a presentation. I was successful IP UAI in the class, but in talking with some of the other teachers who participated in this same class they felt the same way. If you don't do it all the time, you begin to forget things. IP

Q: Do you feel that if you don't use the program all the time, you lose the terminology and the examples of how the software was taught?

A: Yet, by the same token, one of my students in class who is terribly disorganized, is always forgetting to bring the most essential things to class, can immediately solve any of my computer problems. I want to ask him, "How is it that you remember all of this but you can't bring your jacket in on a cold day?" He said, "I grew up on a computer." I thought about it for a moment and thought yes, he's exactly right. This is all he's known in his life. When I first started using computers in the classroom we were still with the Macintosh (the early Macs) and that was a big boom at that time. When we finally moved up to the big Macs (what I called the 5200 series) I really like it because I had the best of both worlds, the best of the IBM type with the Menu and still the nice aspect of the Macs. Then in the middle of the year they pulled out those Macs and put IBM's in our classrooms.

Q: In the middle of the school year?

A: Yes, we literally had a library with about 18 brand new 5200 series Macs still sitting in a box and they said don't give them out, we are going IBM. They pulled them right out of the schools, sent them back to the company, and 6 weeks later we had the IBM's in the classroom: totally different platforms in the middle of the school year with so much going on. Now we had to teach ourselves this new machine. I am still struggling and it looks like now it will be summer before I can get into the electronic gradebook. I had hoped to do it mid-term and use it for 2nd semester. I am not ready, I am afraid I would lose all of the information. I am sure once I learn it; it is going to make my life simpler. I have to be very comfortable with it before I run the risk of giving up all my grades and records to something that may not give it back to me.

Q: As a new teacher to this school what was done to introduce you to the computer lab or to using your classroom computers?

A: Well, it isn't just this school because actually I see more cooperation here than I did in my last school, I really think we almost need two people in there: one to do what the

[redacted]. So many of the staff here and at the last school I worked with, we are not comfortable with the computers. Several people now in education have retired from the military and they have [redacted] There are others like myself, now teaching 23 years, that we saw coming, but my own purposes, I didn't have a computer in my home until 2 years ago. There are the demands of the SOL standards and all that the teachers have to meet. It is almost like that is first and then if you get time you need to become a computer expert. Eventually it is going to happen. [redacted] access basis getting the teachers comfortable with using the computer.

Q: What would be an example of that for you?

A: One of the things I picked up recently was a children's book called "Internet for Dummies." No it was called "A child's guide to the Internet" I went through it and I had a better understanding of that aspect of the computer myself. [redacted] are like children again learning something new. It is one thing for me to get up in front of the class talking about tectonic plates and different kinds of rocks that I fully understand. It is another thing [redacted] the computer, which I don't fully understand.

Q: Did you get to participate in the training sessions provided by the CRT on Monday mornings?

A: We didn't get to very much, but the problem [redacted] money, receipts, and if it isn't in the office by [redacted] asking where this stuff is.

Q: If that time wasn't convenient, could you plan a different time individually?

AP-CT1

A: [redacted] has to get around to all grade levels, so someone has to be scheduled for Monday morning. I don't know there are any simple answers to this complex issue.

Q: You talked a little about how there is more cooperation in this school than in other schools you have been in. Is that because of your teaming with the other teachers that there is more cooperation or that just in general?

CE-CL

A: I think it is in general. It is seldom that Mrs. [redacted], Mrs. [redacted] and myself will discuss technology aspect of education. [redacted] is a lot more effective than the last computer person we had who lacked interpersonal skills but was very good with the computer. One of the things I like here is this school has Internet access within the school, so whether I have time or not I am checking my email. There are always messages from other teachers with suggestions on things to try and what buttons do neat things. Sometimes it is things I already know and once in a while it is new and different. That is how it becomes cooperative. Yesterday, another example was when Mr. Baird [redacted]. I found myself asking the kids next to me – what button do I hit? Where do I go from here? It is a learning curve just like it is for them.

CE-I

CE-E

IP-UA

AP-CTC

Q: What SOL's did you start with regarding the technology proficiencies?

A: [redacted] we went on to that. I surveyed my class and found out that about 70 % of my students have Internet access at home and 95% have computers at home. Last year there were only 3 students in my whole class who had computers at home. Then you have to think: just because it is there are the students using it effectively? Are they just getting on a playing Dungeons and Dragons over and over. Starting out it was primarily WP and integrating it with my writing. [redacted] I have to realize that

AP-CTP

N-CTC

these students are going on to middle and high school [redacted]

Q: Did you start with the technology SOL's right away? Was the lab available to you in September or did you have some time before you could use the lab?

A: I think we were 2 weeks into the school year before the lab was opened [redacted] the machines before Mr. [redacted] could open it up to the classroom. During the first couple of weeks we used the classroom computers.

Q: So you started right away getting into the computer.

A: Yes.

Q: do you feel like your students are missing any core curriculum skills because they've got to spend time in the computer lab? Or do you feel like their skills are being enhanced because the computer lab can increase skill practice?

A: I think ultimately what goes on in the computer lab is going to enhance all other areas of education in language arts we carry those skills over into science, social studies, and math. You can't pigeon hole one subject matter and think it doesn't cross into something else. I look over the SOL list that I don't understand for technology. I've watched instructors before try to teach subject matter they don't understand. It is not effective and I don't want to be like that for my kids. I don't want to be up there if I can't be effective. It is not an ego thing for me, but if I don't know what I am doing, I shouldn't be teaching.

Q: On some of your tapes you claim illiteracy and then you give examples of how you use technology and the Internet in your classroom. What are you basing the "illiteracy" on?

A: When I claim illiteracy, [redacted] I am a hunt and peck person who does 12 words a minute but I stay with it. In my private life there are many things I would like to know and I'll go on-line and discover search engines it was like having the city library suddenly in my office at home. This is what I want it to be like for the students. It is working. The students are brining in things for Social Studies and science that they are pulling off the Internet.

Q: What would be ideal situation in the computer lab for you?

A: Ideally, if I could design the computer lab to best suit my needs and well as what the classroom needs are, there would be someone in there teaching the computer skills like art and music is taught. Yet I do feel for my own self, it wouldn't be another planning period. The teacher would need to be in there with them becoming a student to learn the information as well. We need a CRT who teaches computer technology. The advances come so quickly that the average classroom teacher cannot keep up. It is frustrating and that is where the anxiety gets built up. There is a certain hesitation to take your kids into the lab because you don't know what you are going to do. [redacted]

Sharon L. Hoerup

507 25th Street
Virginia Beach, VA 23451
shoerup@vt.edu

Education

Virginia Polytechnic Institute and State University, Blacksburg, VA.
PhD in Curriculum and Instruction, December 2001.
Virginia Polytechnic Institute and State University, Blacksburg, VA
Master of Arts in Teaching and Learning, May 1997. GPA: 3.8/3.9
University of Massachusetts Dartmouth, N. Dartmouth, MA
Bachelor of Arts in English – Writing Option, June 1994. GPA: 2.8/3.2

Professional Experience

Computer Resource Teacher
Hermitage Elementary School, Virginia Beach, 2000-2001

Long Term Substitute – Computer Resource Teacher
Princess Anne Elementary School, Virginia Beach, March/April 2000

Graduate Assistant – Virtual Institute for the Advancement of Education-Historically Black Colleges and Universities (VITAE-HBCU)
Virginia Tech, September 1999 – May 2000

Student Trainer, Virginia Tech, ACA Project, Department of Teaching and Learning, Blacksburg, Virginia, Spring 1999

Graduate Assistant – Housecalls, Virginia Tech Department of Teaching and Learning, Blacksburg, Virginia, January – December 1999

Faculty Development, Winston-Salem State University and Fayetteville State University, August 1998 - Present

Student Teacher, William Fleming High School, Roanoke, January - May 1997

Professional Memberships

National Council of Teachers of English
Eastern Educational Research Association
Association for the Advancement of Computers in Education
International Society for Technology in Education
Virginia Society for Technology in Education

Conference Presentations

EERA 2000 Clearwater Florida February 16 – 19, 2000
Sharing Expertise at a Distance: A model for designing, developing, and implementing distance learning courses through collaboration

Personal

Hometown: Goshen, New York; Reside: Virginia Beach, Virginia

Licenses

Virginia Provisional Teaching License, 7-12, English through 2002