The relationship between a school districts perceived progress in implementing a school techology plan which uses internet access and on-line educational resources and a set of school district characteristics by Kirk J Miller

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University

Abstract:
The problem of this study was to determine the relationship between a school district's perceived progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics.

The sample consisted of superintendents and technology specialists, employed in school districts of the Northwest region (Montana, Alaska, Oregon, Washington, and Idaho) of the United States. These individuals were surveyed to obtain their perception of progress on implementing their school technology plan and the degree to which eleven independent variables were present in the plan.

Four major questions were answered as a result of this study. (a) To what degree do the characteristics identified contribute to the perceived progress in implementing a technology plan? (b) Is the variance in perception of progress a school district had in the implementation of a technology plan attributable to the degree to which the eleven independent variables are perceived to be present in the district's technology plan? (c) What are the collective and separate contributions of each characteristic to the perception of progress in implementing the technology plan? (d) Is there a difference between the perceived progress in implementing the technology plan of district superintendents and technology specialists.

Multiple linear regression was used to correlate the degree to which the characteristics were present in the plan with the perceived progress in implementing the plan. The t statistic was used to determine whether the identified characteristics provided a significant and unique contribution to the prediction of progress. And, a paired sample t test was used to test if a difference existed between the perception of progress of the superintendents and technology specialists in a given district.

It was concluded that the presence of the technology plan including a comprehensive professional development component, and the school district financial/budgetary matters related to technology being considered of high importance, were significant in increasing the perceived progress in implementing the technology plan. Further, a statistical, but not practically significant difference was found between the perception of progress of the superintendents and technology specialists in a given district.

By understanding which characteristics included in a technology plan led to perceived progress in implementing a technology plan which uses Internet access and on-line educational resources, educational policy makers should gain valuable insights as they begin to develop plans for their schools.

THE RELATIONSHIP BETWEEN A SCHOOL DISTRICT'S PERCEIVED PROGRESS IN IMPLEMENTING A SCHOOL TECHNOLOGY PLAN WHICH USES INTERNET ACCESS AND ON-LINE EDUCATIONAL RESOURCES AND A SET OF SCHOOL DISTRICT CHARACTERISTICS

by

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

The problem of this study was to determine the relationship between a school district's perceived progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics.

The sample consisted of superintendents and technology specialists, employed in school districts of the Northwest region (Montana, Alaska, Oregon, Washington, and Idaho) of the United States. These individuals were surveyed to obtain their perception of progress on implementing their school technology plan and the degree to which eleven independent variables were present in the plan.

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By understanding which characteristics included in a technology plan led to perceived progress in implementing a technology plan which uses Internet access and on-line educational resources, educational policy makers should gain valuable insights as they begin to develop plans for their schools.

CHAPTER 1

PROBLEM STATEMENT AND REVIEW OF RELATED LITERATURE

Introduction

"The president of the United States set as a goal in his 1996 State of the Union Address that 'every classroom in America must be connected to the information highway.'" (Cuban, 1996, p. 37). At an October 1,1996 event in Washington D.C., designed to recruit teachers, Secretary of Education, Richard R. Riley said, "Today's students still need to know the three R's, the old basics. But they also need to understand how to use the three W's -- the World Wide Web, and take advantage of the unsurpassed learning opportunities available on the Internet." (Belin, p. 1). Speaking at the October satellite town meeting, Secretary Riley outlined a national strategy to... "prepare America's students for the 21st century, which includes provisions that every classroom must be connected to the information superhighway; all teachers and student must have access to modern computers; and all teachers must have the training they need to help students benefit from the technology." (Belin, p.5).

Montana Governor, Marc Racicot, stated, "We've got to invest in Technology!" (Racicot), at a meeting of the Montana joint state Board of Education on October 31, 1996. The importance of technology, its use in the schools across the nation, and connection to online educational services are high priorities in current political and educational discussions.

The National Science Foundation (NSF) has developed the National Infrastructure for Education (NIE) program to build synergy between technology and educational researchers, developers and implementers in the use of network and telecommunications technologies in education. A particular focus of the NIE is the development of flexible, sustainable approaches to systemic educational network infrastructure. (NFS/NIE, 1995). The Network Montana Project (NMP) is a collaborative, systemic research and development project constituting Montana's response to NSF's/NIE request for proposal #94-05. The Network Montana Project involves a statewide collaborative effort with industry support to construct a scalable, sustainable network for Montana's educational needs. (Thomas, 1995).

The partners in NMP include teachers, administrators, and researchers from the state's educational system, leaders in state government, and individuals from a variety of community, professional and private sector organizations. Commitments of talent and resources from all partners are focused on the development of a lasting infrastructure capable of supporting the development of a variety of educational telecommunications services. (Thomas, 1996).

The ability to make progress in implementing a technology plan in the school environment is a concern for today's administrator's as they work to plan for the future. NMP co-directors, Dr. David A. Thomas and Dr. Lynn D. Churchill, have communicated interest in knowing what characteristics are determined to have greatest impact on the progress of implementing a technology plan which uses Internet access and online educational services in K-12 schools. This was the impetus for planning this study.

Statement of the Problem

The problem of this study was to determine the relationship between a school district's perceived progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics. By understanding which characteristics had greatest interaction in perceived progress in implementing a technology plan, educational policy makers should gain valuable insights as they begin to develop plans for their schools.

Need for the Study

The implementation of technology in the school setting has long been a topic of considerable discussion and research. Stanford professor Larry Cuban points out the vulnerability of schools in implementation of technology in the past.

> "Over the last century, public schools have modified their governance, programs, curricula, organization, and instruction in varying degrees. Moreover, critics often have pointed out how vulnerable schools have been to shifts in educational fashions. Fads, like changing hemlines and suit lapels, have entered and exited schools, yet these very same schools have been the targets of persistent criticism over their rigidity and resistance to reform. "It is easier to put a man on the moon," Massachusetts Institute of Technology professor Jerold Zacharias said in 1966, "than to reform public schools." (Silberman, 1971, p. 171). Almost two decades later, retired Admiral Hyman Rickover said, "Changing schools is like moving a graveyard." (Rickover, 1983, p.1). In the press

> toward improvement that has characterized most studies of public schools, few writers have noted that both constancy and change, entangled together, capture the complexity of schooling far better than the usual either/or dichotomy posed by reformers.
>
> Nowhere is this paradox more apparent than in the interplay between the classroom teacher and technology. Since the mid-nineteenth century the classroom has become home to a succession of technologies (e.g., textbook, chalkboard, radio, film, and television) that have been tailored to the dimensions of classroom practice. Yet the teacher has been singled out as inflexibly resistant to "modern" technology, stubbornly engaging in a closed-door policy toward using new mechanical and automated instructional aids." (Cuban, 1986, pp. 2-3).

Cuban points out the persistent interplay between constancy and change in the nation's classrooms. "In this process, perhaps respect can be restored for the notion that stability in teaching practice and the craft of instruction are positive forces in schools, maintaining a delicate balance amidst swiftly changing public expectations." (1986, p. 7).

Understanding the change process as technology impacts schools -- past, present and future is imperative. This establishes a need for this study and how technology fits into the overall school setting.

As stated in the introduction, the impetus for planning this study was the need, expressed by Dr. David A. Thomas and Dr. Lynn D. Churchill, to identify what characteristics are determined to have greatest impact on the progress of implementing a technology plan which uses Internet access and online educational services in K-12 schools.

The Network Montana Project (NMP) planning grant RED-9454691 provided the financial support and formal recognition needed to motivate, justify, and sustain the development of a state-wide coalition of academic,

government, and private sector partners through many months of intensive discussion, planning, negotiation and writing. In April of 1995, the resulting proposal was submitted to NSF for review and in September of 1995, the NMP was awarded a $2.52 million dollar three year grant, RED-9554251. (Thomas, 1995).

The goals of the Network Montana Project are to:

- Build and maintain a state-wide coalition of partners from academia, government, and the private sector responsible for directing a wide variety of K-14 educational networking activities during the period of NFS/NIE funding in subsequent projects;
- Support and enhance a number of nationally significant systemic mathematics and science education reform projects underway in Montana;
- Develop multimedia network-based materials and delivery systems integrating mathematics, science and technology to enhance access and usability of many scientific resources;
- Investigate adaptations of educational and informational telecommunications required to serve populations with special needs including those that may be visually or hearing impaired; and
- Develop a workable, rural, community networking model that promotes teleliteracy for rural citizens to enhance their involvement with lifelong learning, entrepreneurship and local/state governance. (Thomas, 1996).

The final goal of the project establishes the need to investigate other networking models established by educational institutions that successfully provide online educational resources to students.

Major issues of the NMP fall into four categories:

1. Access
2. Support
3. Training, and
4. Curriculum. (Thomas, 1995).

Access refers to working with the State of Montana to build a network capable of handling the increasing demands for multimedia, video

conferencing, and World Wide Web based information and access. *Support* is partnering with agencies and private industry to develop a comprehensive and systemic approach to network support and professional technical training needs of communities, school districts and libraries. *Training* refers to designing and assisting in training students, teachers, administrators, and community members in the use of educational networks. *Training* is a major focus of this project. Defining a *Curriculum* that can meet the needs of our evolving highly technologically-based information society will require the integration of telecommunications into the classroom in an effective and efficient manner. Nationally known centers and leaders in education are assisting NMP. (Thomas, 1995).

A major emphasis in establishing the survey instrument for the study was to consider how the four major issues affect the progress in implementing a technology plan utilizing online educational resources.

Finally, as stated in the introduction, technology planning and the use of on-line educational services are important at the state and national level. Research conducted by the National Center for Technology Planning (NCTP) revealed that fewer than 30 percent of America's schools possess a written technology plan that is integrated into the curriculum. Although an increasing number of schools are considering the preparation of technology plans, relatively few educators know how to implement a technology plan that ensures successful progress. Most school board members and district administrators confess to being confused about what strategic planning involves. (Peterson, 1989).

The NCTP, established in late 1992 for the express purpose of assisting schools throughout the United States in their technology planning efforts, has

amassed a large quantity of written technology planning documents. The documents, generally referred to as the "technology plans," vary widely in size, appearance, and scope of coverage. Certain essential principles exist, however, that serve as benchmarks to success. (Anderson and Perry, 1997).

As educators use acceptable procedures and practices to create and implement technology plans successfully, other professionals will seek advice for their plans. One goal of leaders in the field of planning is to ensure that the highest quality of information attainable is spread among schools. If this recipe for planning is followed, then disseminated throughout the country, students in our nation's schools will enjoy a richer, more challenging and rewarding educational experience. (Anderson and Perry, 1997).

The findings of this study will assist in further adaptation to the change process as strategies and methodology for use of online educational resources modify the culture of technology development in schools throughout the state of Montana. Fullan (1993) states that connection of the change innovation with the wider environment is critical for success. Hall & Hord (1987), in the assumptions underlying the Concerns Based Adoptions Model (CBAM) for change, state that understanding the point of view of the participants in the change process is critical. Further, the findings will add to the growing body of high quality information that can be used by schools to enhance the educational experience of our nation's children.

These underlying reasons established the need to determine the relationship between a school district's progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics.

Questions to be Answered

This study has attempted to answer the following major questions:

1. To what degree do the characteristics identified contribute to the perceived progress in implementing a technology plan?

2. Is the variance in perception of progress a school district had in the implementation of a technology plan attributable to the degree to which the eleven independent variables are perceived to be present in the district's technology plan?

3. What are the collective and separate contribution of each characteristic to the perception of progress in implementing the technology plan?

4. Is there a difference between the perceived progress in implementing the technology plan of district superintendents and technology specialists in a given district.

Dependent Variable:

Perceived progress a district is having in the implementation of a school technology plan which uses Internet access and on-line educational resources at all levels.

Independent Variables:

1. The technology plan is formalized and integrated into the school district's operations (Examples: budget, curriculum, and job descriptions).

2. The technology plan is part of a long-range, comprehensive plan addressing the goals, missions, and visions of the district through

organizational activities.

3. The technology plan includes a comprehensive professional development component.

4. The technology plan stresses the integration of technology applications to meet goals across the curriculum.

5. The technology plan includes an assessment of present technology status and future needs.

6. The technology plan indicates the ongoing need for assessment and evaluation of the plan implementation.

7. The technology plan is supported by key school staff (Superintendent, building administrators, teachers).

8. The technology plan is supported by key community members (students, parents, business community).

9. The technology plan is supported by the School District Board of Education (trustees).

10. The school district financial/budgetary matters related to technology are considered to be of high importance.

11. The school district has access to technical experts who can fix machines when they are broken and also provide technical assistance to teaching staff.

Definition of Terms

The following definitions were provided by the researcher or correspond to those used in other sources as indicated by citation and are to be considered operational definitions.

District Superintendent: That individual in a school district, given legal responsibility for the leadership, management and operation of the school system under the direction of an elected board of education.

District Technology Specialist: That individual in a school district delegated the responsibility for the coordination and planning of the use of technology in the district.

E-Rate: Also called the Universal Service Fund. The federal Telecommunications Act of 1996 offered federally funded discounts - termed the E-Rate - to schools, and libraries to purchase certain telecommunications services, internal connections and Internet access. The discounts range from 20 percent to 90 percent, depending on a school's or library's location and level of economic disadvantaged. Schools do not receive the money directly. They received discounted rates on telecommunications services provided to them. The amount available annually for the school and library discounts was scheduled to be about $2.25 billion. Montana libraries and K-12 public and nonpublic schools may apply for the discounts through the National Exchange Carrier Association (NECA), which was designated by the Federal Communications Commission to administer the E-Rate program. (Morton, 1998).

Network Montana Project (NMP): A collaborative, systemic research and development project constituting Montana's response to NSF's/NIE request for

proposal #94-05. The Network Montana Project involves a statewide collaborative effort with industry support to construct a scalable, sustainable network for Montana's educational needs. (Thomas, 1995).

Progress: For the purposes of this study, progress in implementing a school technology plan was the perception of the respondent indicating the degree to which they believe the objectives of the outlined plan are being met.

Subsample 1: A random sample of school districts in the Northwest region of the United States whose superintendents responded to the Technology Questionnaire.

Subsample 2: A random sample of school districts in the Northwest region of the United States (the same as subsample 1) whose technology specialists responded to the Technology Questionnaire.

Support: For the purposes of this study, support was defined as upholding, or serving as a foundation for; uphold, advocate, champion. (Webster's Dictionary, 1974).

Teleliteracy: To be literate (have understanding of) the use of technology tools (computer, Internet, interactive television, satellite transmission).

Technologist: A person on a school district staff considered to be an expert in technology either by training or perceived credibility given by others.

Technology Plan: Written document that represents the very best thinking accumulated in a particular environment (school building, district, state, etc.) for the purpose of studying technology infusion, then recommending direction for the future. (Anderson, 1997).

Technology Questionnaire: An attitudinal survey used as the instrument of data collection in the study.

Review of Related Literature

A review of the literature revealed that developing a well thought out implementation plan in a school district was multifaceted. This literature investigation included these components: a) a look at the historical development of organizational theory, b) change theory, c) supervision theory, and d) technology implementation in K-12 schools using Internet access and on-line educational resources. The purpose was to develop a conceptual framework and construct, through integration of the theories, to bring more insight into organization structure, the change process, supervision, leadership, and technology.

Organization Theory

Investigation of organization theory in contemporary management has developed through three theories of thought that can be categorized at different historical periods. The three theories are: a) classical, prevalent in the late 1800's to 1920's, b) social systems, prevalent from the 1920's to the 1950's, and c) open systems from the 1950's to present. Hanson (1991) presents a view of the theories through description of the behaviors and main emphases of thought during each period. Current theories have synthesized the thought of classical, social systems and open systems and created new descriptors for organization structure. Contingency theory is of major importance in the development of the construct for investigating the problem posed by this study,

so it will be reviewed in detail. Value is found in a brief overview of the classical, social systems, and open systems theories.

The classical theory is described as bureaucratic style using the scientific method to bring about decisions. Other descriptors include division of labor, span of control, hierarchy, goal definition, extrinsic rewards and formal rules . Classical theorists include Max Weber, Henri Fayol, and Frederick Taylor . In his work, The Theory of Social and Economic Organization, Max Weber, a German sociologist, described the bureaucratic structure from a sociological point of view (Weber, 1964). He defined ideal type bureaucracy. Ideal type acts help administrators where organizations are inefficient, so problems may be addressed and corrected. Weber's emphasis was focused at the top of the bureaucracy.

Henry Fayol, a French industrialist defined the precepts of the administrative process and the role the precepts should play in management thinking. (Fayol, 1949). Like Weber, Fayol also focused his attention at the top of the bureaucratic ladder and the role of management.

American industrial engineer, Frederick Taylor, contributed to the classical theory by defining the principles and practices of scientific management. (Taylor, 1911). In contrast to Weber and Fayol, Taylor's principles focused on the workers, or bottom structure of the bureaucracy. However, all three views believed in formal rules, span of control and extrinsic reward systems as characterized by the descriptors of the classical theory.

Classical thought was promoted in the public domain by the work of Luther Gulick and Lyndall Urwick, who gave definition to structures for efficiency in administration with the likes of the POSDCoRB (Planning, Organizing, Staffing, Directing, Coordinating, Reporting, Budgeting), delegation of authority,

and departmentalization. (Gulick and Urwick, 1937).

Though the classical theory began to lose its appeal in the 1930's and gave way to other theories of organization, much of the bureaucratic style of top down management, division of labor, and span of control are still prevalent in many of today's schools. The classical model drove industry, government and schools for many years and due to the entropy of schools as organizations, change came very slowly. It is only in recent years that schools have adopted views of other theories of organization.

Social systems theory developed in the 1930's from the work of Elton Mayo and his findings of the Western Electric Company's Hawthorne Works. (Mayo, 1933). Briefly, the characteristics of the social systems theory are human relations, informal groups, peer pressures, intrinsic rewards, psychological needs. (Hanson, 1991). The Hawthorne Studies discovered that employees (workers) developed their own set of informal groups and rules that were very powerful in directing productivity, even though the formal (classical) structure provided extrinsic rewards (wage incentives) for increased production. The findings of this study provided the impetus for the human relations movement that was prevalent in business and education. Employees of the organization should feel that they are a part of the company and take pride in their work toward company goals. They must also feel that the company's goals are worth their effort if production is to be high. For education, the concept of formal and informal organizations changed the way management was viewed with control spread throughout the organization, decentralization of decision making, free flow of communication, and mutual support of management and staff. (Hanson, 1991). Once again emphasis on the social systems theory is to build a knowledge base for understanding the different types of structures

observed in today's schools. Understanding the perspective of the theory allows planning for change or problem solving in a school district to be approached with as much knowledge as possible.

The open systems theory focused mainly on how organizations work, not how they should work. The perspective promoted by Richard Scott (1981) helps to solidify the concept of the open system theory in that the open system perspective does more than simply bring the external environment into the picture. It shifts attention from organization to organizing, from structure to process. (adapted from Hanson, 1991). Katz and Kahn have worked extensively with the notion of open systems, and they promote that, rather than a theory, it is a framework or approach, and a conceptual language for understanding and describing many kinds and levels of phenomena. (Katz & Kahn, 1966). Katz and Kahn also promoted the thought of diagnosing an organization's operation by examining input, throughput, and output characteristics rather than organization's formal goals. Hanson (1991) in adapting the input, throughput, and output concept from Katz and Kahn (1966) states, "... formal goals and rational purposes stipulate how an organization *should* [italics added] function, whereas open system theory concentrates on how an organization *actually functions* [italics added]." (adapted from Hanson, 1991).

Open systems theory characteristics include input-output, event cycles, environmental exchanges, information theory. (Hanson, 1991). For schools, the concepts of the open system allow leaders to view the school from the multifaceted perspectives, understand that the organization is complex, and possibly promote direction for change.

Contingency theory turns the focus of the open system to a situational

point of view. Hanson (1991) discusses three contingency theory frameworks that relate to education: a) organizational structure and the environment, b) problem solving in organized anarchies, and c) managerial work behavior. (adapted from Hanson, 1991).

Organizational structure and environment are studied so that uncertainty can be dealt with in a manner that reduces risks through intelligent forethought and planning. (p. 170). Hanson has developed a differentiated and integrated subsystem framework that offers a series of stages that deflect problems emerging from the school environment in any number of directions depending on the situation. (Hanson, 1979). This is an example of contingency theory in that it offers a variety of directions in which to proceed to a solution based upon the situation.

Problem solving in organized anarchies is based on the premise of an organized anarchy which contain three properties; ambiguous goals, technology of action is unclear, and fluidity of participation. (Cohen, March & Olsen, 1972). Cohen, March and Olsen promoted the garbage can model of decision making which emphasizes that decision making is the measuring of, 1) a constant flow of problems, 2) a constant flow of solutions, and 3) fluid participation, intermingled with a choice opportunity in the organization. (Adapted from Hanson, 1991, p. 163). Once again, a framework for problem solving is provided based upon situational constructs and choice.

Managerial work behavior research has been done by Henry Mintzberg in which he identified six characteristics of managerial work and ten roles utilized by managers to do their work. (Mintzberg, 1980). Again, the work presented by Mintzberg places the emphasis on the situational character of the management task. Adaptation of the managers role is necessary as conditions

shift. (Adapted from Hanson, 1991, pp.166-168).

Contingency theory also contained the concept of loosely coupled systems. Karl Weick uses the term 'loose coupling' to describe the way schools convey the image of coupled events that are responsive, but each event retains its own identity and separateness. (Weick, 1976). Departments (math, science, art) in schools can collaborate on cross content projects, but each also retains their individual identity when working on specific learner outcomes for their field. Mintzberg (1983) identified five ways organizations bridge gaps in an attempt to tighten the coupling: (1) mutual adjustment, (2) direct supervision, (3) standardization of work, (4) standardization of outputs, and (5) enculturation. (Adapted from Hanson, 1991, p. 157). These principles provide insight into how school organizations work to loosen or tighten the couple between events to promote change or adaptation.

In the perspective of this researcher, contingency theory, allowed for the greatest degree of flexibility in understanding a school in the context of organizational theory.

A final organization framework that helps to establish the construct this researcher will utilize in planning change or solving problems came from the work of Hersey and Blanchard in Management of Organizational Behavior: Utilizing Human Resources. (Hersey & Blanchard, 1988). Hersey and Blanchard have developed a comprehensive theory of leadership style in response to group characteristics known as situational leadership. (Adapted from Glickman, Gordon, & Ross-Gordon, 1995). Glickman, et al., promote the concept that effective leadership is a function of the leader, the follower and the situation; EL = f(L,F,S). They have developed a diagram that is divided into four quadrants and helps to determine the style of leadership based on the

relative emphasis of task and relationship (person) behavior. Leadership suggestions are given for encountering:

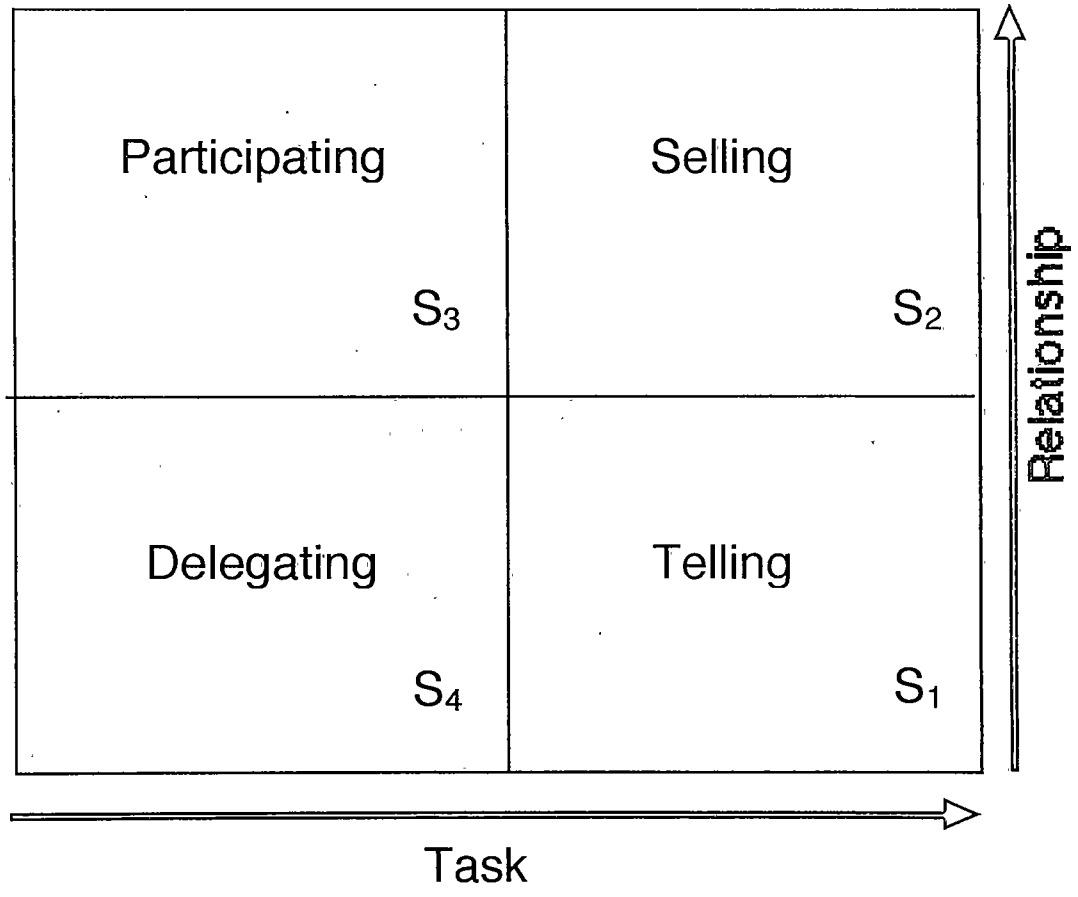
a) Style 1: Telling -- High task, low relationship,

b) Style 2: Selling -- High Task, high relationship,

c) Style 3: Participating -- High relationship, low task, and

d) Style 4: Delegating -- Low relationship, low task..

(Hersey & Blanchard, 1988). The work of Hersey and Blanchard, once again, provides insight when dealing with changing situations in a changing environment. The leader must understand the relationships between effective styles of leadership and the level of maturity of the followers -- the appropriate matching of leader behavior with the maturity of the group or individual.



Classical theory, social systems theory, open systems theory, contingency theory, and situational leadership are portions of the framework to be used in decision making related to organization theory. The understanding of the theories and ability to identify characteristics related to the theories, provide the strong conceptual background necessary to make informed decisions in situations encountered in the organization. The review of literature continues with change theory, supervision theory, and technology infusion, to show how these areas can be integrated with organization theory to bring even more insight into the problem of this study.

Change Theory

This researcher's framework was established through the work of several authors and models of change. A brief description of some of these works are included so that the reader can understand the basis of this researcher's construct of change.

Michael Fullan (1991) has extensive work with recent change theory. "Change must always be viewed in relation to the particular values, goals and outcomes it serves" (Fullan, 1991). Sources of educational change, meaning of educational change, causes and processes of initiation, causes and processes of implementation and continuation, and planning, doing and coping with change, frame the work that Fullan has brought to the change literature. (Fullan, 1991).

Gene Hall and Shirley Hord have provided the overview that best establishes the views the researcher has adopted for change processes. Their book, Change in Schools: Facilitating the Process, shows the change process

through the viewpoint of Concerns-Based Adoption Model (CBAM). (Hall & Hord, 1987). Concrete discussion of the CBAM model which was a research project for the Research and Development Center for Teacher Education at the University of Texas at Austin, and distributed by the Southwest Educational Development Laboratory in 1986, allowed this researcher to develop a framework to approach the change process.

The assumptions that underlie the CBAM process are: 1) understanding the point of view of the participants in the change process is critical, 2) change is a process, not an event, 3) it is possible to anticipate much that will occur during a change process, 4) innovations come in all sizes and shapes, 5) innovation and implementation are two sides of the change process coin, 6) to change something, someone has to change first, and 7) everyone can be a change facilitator. (Hall & Hord,1987). The main premises of the CBAM conceptual framework include: a) a change facilitator who can utilize a resource system to provide insight into the innovation, b) change facilitators are responsible for using informal and systematic ways to probe individuals and groups to understand them, c) diagnosis can be accomplished through the use of stages of concern (SoC), levels of use (LoU), and innovation configurations (IC), d) understanding interventions, e) understanding the context in which the change takes place, and, f) the change facilitator should be adaptive and systemic in his/her thinking. (Adapted from Hall & Hord, 1987, pp. 11-16).

Constructivism applies to the change process. The basic tenets of constructivism are: 1) knowledge is constructed from experience, 2) learning is a personal interpretation of the world, not a shared reality with others, 3) learning is an active, rather than passive experience, 4) meaning is negotiated through a collaborative work with others and from differing perspectives,

5) learning should occur in real-world settings, and 6) student assessment should be integrated into the learning process, not seen as as separate activity. "These assumptions provide for the basic premise that *learning is a journey, not a destination* [italics added]." (Merrill, 1991). Change process theory parallels this idea in that the process is constantly changing and a good understanding of change requires that adaptations be made as the process evolves.

The last two areas of research that have provided input into this researcher's framework for the change process are the fidelity perspective and mutual adaptation. Fidelity was the dominant perspective underlying curriculum implementation and was promoted by Fullan and Pomfret in 1977. (Snyder, Bolin, & Zumwalt, 1992). Assumption is that innovations are created, designed and developed by experts outside of the organization, and through a linear process the implementation is in the hands of those in the organization. An example of this would be some of the teacher proof curriculums that were developed in the 1970's. The fidelity approach allows a very structured game plan to be made for implementation, that must be followed for successful change. This approach is still in use and has merit in various situations.

Mutual adaptation grew out of the final results of the Rand Change Agent Study and suggests that schools change as new practices gain support, are adapted to the local situation, and become integrated into the regular operation of the organization. (Hall & Hord, 1987). Mutual adaptation bases implementation on change in the innovation as it progresses through the process. Negotiation and flexibility on the part of both the designers and practitioners are inputs into the process.

In most situations in education, this researcher believed the mutual adaptation approach to change would bring about better results. Recognizing

the literature on change gave an expanded perspective upon which to base decisions.

Supervision Theory

The work of Carl Glickman in developmental supervision has provided the greatest background and direction for this researcher in developing a construct for supervision over the past eight years. A prime source for review of the supervision literature is Glickman, Gordon, and Ross-Gordon's book, Supervision of Instruction: A Developmental Approach. (Glickman, et al., 1995). The authors defined supervision as, "... the school function that improves instruction through direct assistance to teachers, curriculum development, staff development, group development, and action research" (Glickman, et al., 1995). The authors went on to state their belief that, "... the key to successful supervision is thoughtful practice based on viewing teachers as developing adults" (Glickman, et al., 1995). Thus the term developmental supervision indicated the work of improving student instruction through assistance to teachers, helping them to move to higher levels of development. As described in the book, supervision for successful schools required the prerequisites of knowledge, interpersonal skills, and technical skills. The supervisor has educational tasks that enable teachers to evaluate and modify instruction. Those tasks are direct assistance, group development, curriculum development, staff development and action research. By understanding how teachers can grow in the environment, the supervisor plans tasks of supervision that unify organizational goals and teacher needs into improved student learning. (Glickman, et al., 1995). This framework was the impetus of developmental

supervision.

Direct assistance to help teachers improve instruction is a key element of the supervision process. Clinical supervision is a recognized structure for assistance that has been well researched. Edward Pajak, in his book, Approaches to Clinical Supervision: Alternatives for Improving Instruction, examines each of the most popular approaches to clinical supervision. (Pajak, 1993). Pajak described four categories of classroom supervision. First, were the original clinical models, occurring from the 1960s to early 1970s, supported by the writings of Goldhammer, Mosher & Purpel and Cogan. The major principles were collegiality and mutual discovery of meaning. Second, were the humanistic/artistic models, from the mid 1970s to early 1980s; Blumberg and Eisner were the main contributors. Major principles are positive and productive interpersonal relations with holistic understanding of classroom events. Third, are the technical/ didactic models, occurring from the early to mid 1980s. Acheson & Gall, Hunter, and Joyce and Showers were contributors. Major principles are effective teaching strategies, techniques, and organizational expectations. Fourth, were the developmental/reflective models, occurring during the mid 1980s to early 1990s, supported by the work of Glickman, Costa & Garmston, Schon, and others. Major principles are teacher cognitive development, introspection, and discovery of context - specific principles of practice. (Glickman, et al., 1995). These models give structure to the clinical supervision process as it develops.

Another very important task of the developmental supervision process is staff development. Glickman, et al. (1995) state:

> "Staff development must be geared to teacher's needs and concerns. Research on successful staff development programs has shown an emphasis on involvement, long-term planning, problem-

> solving meetings, released time, experimentation, and risk-taking, concrete training, small-group activities, peer feedback, demonstration and trials, coaching, and leader participation in activities." (Glickman, et al., 1995).

Attention must be paid to staff development if the developmental supervision process is to be successful.

Joyce & Showers (1988) have provided research of student achievement through staff development. They believe student achievement can be significantly improved through changes in the instructional behaviors of teachers, classroom environment and effective school improvement programs that include well designed and implemented staff development. (Joyce & Showers, 1988). A major contribution by Joyce & Showers (1988) was the concept of coaching in which the major purpose is the implementation of innovations to the extent that determination of effects on students are possible. The work of Joyce and Showers matched the need that is created by the innovation (regarding staff development) of the problem in this study.

A final comment on supervision theory is to distinguish between the terms evaluation and supervision. Evaluation is the contractual need to judge and rate teacher abilities in the classroom. The process of evaluation does little to improve teaching. Supervision, as stated previously is focused at improving instruction through direct assistance to teachers. Careful thought and communication must be addressed if the administrator is both the evaluator and supervisor.

Developmental supervision literature and supervision theory presented another part of the picture that is necessary to develop a conceptual framework and construct, allowing better insight into organizational structure, change theory, supervision, leadership, and technology.

The final prerequisite in developing the literature review for the problem of this study was the technical skill dimension. Technical supervisory skills are needed when working with teachers to assess, plan, observe, research, and evaluate the instructional program. (Glickman, et al., 1995). This prerequisite is what allows the supervisor to enter the classroom and collect information that will help the teacher to develop and become self directed and autonomous. In the area of technology, the supervisor must have the technical skills, interpersonal skills and knowledge to effectively help teachers to develop and improve student learning.

Technology

Feedback related to the use of technology in the classroom has limited research support. One study by Bailey & Lumley (1991) describes the new roles for school administrators in supervising teachers who are using integrated learning systems (ILS). An ILS is a complex, integrated hardware/software management system that utilizes computer-based instruction. The authors discuss the issues faced by supervising administrators; everything from the integration of ILS's in school/teacher culture, to research on varied-ability students. However, the authors did not offer suggestions on how to address these important issues. Lack of research conducted to date, indicates that these issues would be strong topics for future research.

Another difficulty lay in developing the building administrator's ownership for the use of technology concept, and finding time to complete this vital task while still completing all other duties on a daily basis. The

ownership factor affects the daily routine and attitude of principals as they perform their jobs.

Several studies have addressed supervision in relation to technology. For example, Austin, et al. (1993) addresses staff development issues related to technology. The authors suggest that computers in schools have three uses; administrative, instructional, and research. (Austin, et al., 1993). The instructional component views the computer as a tool. A major portion of the description focuses on staff development. The authors say, "If the staff is involved in setting the goals for the inservice, designing the inservice, and (to the extent feasible) actually conducting the inservice, it will have a very good chance of being successful." (Austin, et al., 1993). They go on to write, "... a good inservice typically has multiple sessions spread out over a period of time,with opportunity to implement the new ideas between the inservice sessions." (Austin, et al., 1993). Other necessary items included support available to staff members (a responsibility of the administrative team), and continued follow-up support following the inservice consisting of team teaching, coaching, individual help, or further group inservice.

Training is available in a variety of forms, to help schools develop a comprehensive technology plan. George Luginbill and Associates (Luginbill, 1994) provide such training for school districts. The main focus is developing a vision and goals which help establish priorities to be addressed. A portion of the training relates to the change process and supervision process as mentioned above.

Recent research reveals an underlying theme of schools working to use the full potential of technology in the school environment. Many such studies are stressing that policy makers and the public are beginning to

demand evidence that their investments in technology are making a difference.

On February 1, 1999 -- The Gordon S. Black Corporation, who conducts survey research for education, announced "according to survey results, although computers have made their way into the nation's public schools, they are not yet fully-integrated into the learning process." (Black, 1999). Some of the highlights of the study of more than 85,000 students, teachers, and parents include:

- Use of computers is sporadic and varies by district. About half (48%) of high school students report using a computer at school once a week or less.
- More high school students report using the computer to surf the web (64%) than to do homework or research (42%). Further, just 20% of the teachers reported that they require students to use the computer to do research.
- Although there is strong agreement among teachers that computers support and extend the teaching process (85%) as well as the learning process (88%), just 61% of the teachers felt that computers were integrated into the curriculum.
- Teacher training continues to be an important challenge. While most teachers (88%) agree that their district allocates enough funding for technology, and 84% feel that they have access to training, just seventy percent (70%) feel that they are adequately trained on the computer.
- Students are more skeptical about their teacher's computer skills than the teachers are. Just 57% of high school students feel that their teachers are adequately prepared to teach them on the computer.
- Parents agree that computers are an integral part of the learning process. 90% believe that school computers help in the education of their child.

(Black, 1999).

The study shows that students, teachers and parents are all in agreement that computers have the power to make substantial improvements in the education of children.

"School districts throughout this country have invested millions in computer technology, and it is only going to be a matter of time before school boards and the public insist that this investment has paid off," said John Geraci, Vice-President of Educational Research. "Integrating technology in the classroom involves a fundamental shift in the way we educate children, and while these data show that a lot of progress is being made, it also shows that it takes a lot more than hardware to support and extend the learning process with computers." (Black, 1999)

In the October 1998 Technology Counts edition of Education Week, author Andrew Trotter states, "Twenty years and billions of dollars since the first personal computers were plugged into the nation's schools, policy makers and the public are finally starting to demand evidence that their investments have been worthwhile." (Trotter, 1998, p. 6). Trotter cites Stanford University education professor . . . "The obligation is for educators, practitioners, educational policy makers to think clear about what they're after. Only with clear goals can educators be intelligent about how much they want to spend for what purpose, and under what conditions." (Trotter, 1998, p.8). These statements once again express the need for school districts to develop and technology plan.

In addition to the accountability for the dollars spent theme emphasized in this study, emphasis on teacher training is a constant theme in current technology literature. Recommendations for state policy makers in the Technology Counts '98 issue of Education Week stress that states

should require incoming teachers to have technology training or expertise to obtain a teaching license. Also, states should create opportunities for teachers to learn how to use technology. (Zehr, 1998, p. 69).

Summary

This literature review established a background in the historical development of organizational theory, change theory, supervision theory and technology that further clarified the need to answer the problem statement of this study. Current technology literature emphasizes development a technology plan, being accountable for the funding used for technology, and providing teacher training (professional development) to effectively use technology. Determining the relationship between a school district's progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics, will provide critical knowledge for school districts embarking on implementing such programs in their school district.

CHAPTER 2

DESIGN OF THE STUDY

Conceptual Framework

The conceptual framework for this study was to assist in further adaptation to the process of planned change, organizational framework, and supervision of instruction in utilizing technology in the K-12 education environment. The findings of this study will increase the body of knowledge available to K-12 educators, as strategies and methodology for use of online educational resources modify the culture of technology development in schools throughout the nation. Further, the findings will add to the growing body of high quality information that can be used by schools to enhance the educational experience of our nation's children.

Also, the findings of this study, as outlined previously, are important at the state and national level. Political figures, from the President of the United States, to the U.S. Secretary of Education and Governor of the state of Montana, have voiced the need to place technology in the hands of our children in schools to enhance their ability to learn. The co-directors of the NMP, Dr. David A. Thomas and Dr. Lynn D. Churchill, have expressed interest in, and can use the results of, this study to further enhance the NMP.

Chapter 2 begins with a description of the population and sampling procedure used and is followed by the questions to be answered expressed in

hypothesis form. The investigative categories are defined and measures to control contaminating variables are discussed. Next, the methods of data collection are outlined along with measures to ensure accuracy of the data. Then, the research design is discussed with explanation of data analysis techniques to be employed. Chapter 2 concludes with a discussion of the limitations and delimitations on the study.

Population Description and Sampling Procedure

The population of the Investigative Study consisted of district superintendents and district technology specialists, in those districts that had them, employed in Northwestern United States, grade K-12 school districts. The Northwestern United States included those school districts served by the Northwest Regional Education Laboratory, encompassing the states of Montana, Idaho, Oregon, Washington, and Alaska. To be included in the population, the superintendent and/or technology specialist must have been employed in school districts that had implemented technology plans utilizing Internet access and on-line educational services. Internet searches, contact with the Northwest Regional Educational Laboratory (NWREL) in Portland, Oregon, and contact with state departments of education were utilized to identify those school district superintendents and technology specialists that met the criteria established by the population definition. A total of 866 school districts were included in the population for this study.

The sample for the study consisted of randomly selected members of the population in an attempt to receive 220 responses, based on an N of 20 for each of the 11 independent variables under consideration. (Kerlinger,1992).

Three hundred in the sample would require a return rate of approximately 73% to meet the demands of 220 surveys returned.

Superintendents in each of the 866 school districts were alphabetized by last name and the list was numbered from 1 to 866. A random number generator called Randomizer 5.5 was downloaded from the Internet. Instructions were given to Randomizer 5.5 to provide 300 random numbers from a total of 866. The 300 random numbers generated provided the superintendents and school districts that were included in the sample. The technology specialist in the same districts as selected superintendents generated the list of technology specialists in the sample.

The researcher surveyed the perception of the superintendent and technology specialist, in those school districts that had the position. The sample was split into responding district superintendents, and responding district technology specialists. These subsamples were defined as: (a) Subsample 1, district superintendent responses; (b) Subsample 2, district technology specialist responses. The Technology Questionnaire was utilized to collect data from the superintendents and technology specialists identified in the sample. The Technology Questionnaire is included in Appendix A.

Technology Questionnaires were sent to 300 superintendents and 300 technology specialists. The *Total Design Method* promoted by Dillman was utilized for the questionnaire distribution and follow-up in an attempt to meet the return rate requirements. (Dillman, 1978). The *Total Design Method* suggests that a cover letter and survey be sent to members of the sample with a stamped return envelope. A postcard follow-up to all members of the sample followed one week later thanking early respondents and reminding others of the importance of completing the survey. A second follow-up cover letter and copy

of the survey were mailed with another stamped return envelope. The second follow-up was sent three weeks after the original mailing. A third follow-up cover letter and survey with return envelope was sent five weeks after the original mailing to those who had failed to respond.

Test - retest reliability for stability over time of the characteristics in the study required a retest survey to be sent to 75 members of the sample respondents. Members of the retest group were selected randomly, as in the method explained above.

Table 1 shows the sampling return rate information for both the test and retest.

Table 1. Sample Return Rate Statistics - Test and Retest

Test	Questionnaires Sent	Questionnaires Returned	Percent Returned
Superintendents	300	214	71.3%
Technology Specialists	300	148	49.3%
Total	600	362	60.3%

Retest	Questionnaires Sent	Questionnaires Returned	Percent Returned
Superintendents	60	54	90.0%
Technology Specialists	15	11	73.3%
Total	75	65	86.7%

As shown in Table 1, superintendents return rate of 71.3% adequately

meets the demands of the return rate required of the sample given the 11 independent variables in the study. The technology specialist return rate of 49.3% was below the originally established level of acceptability. Given the student enrollment of a number of the school districts in the sample, it was evident that many districts did not employ an individual specifically responsible for technology as outlined in the definition of technology specialist. In the judgment of the researcher, this accounts for the lower response rate for technology specialists. The author believes for the reason cited above that the responses received adequately allow for the inclusion of the technology specialist subsample in the findings of the study as outlined in Hypotheses 2 A and 2 B.

Sources of Evidence and Authority

The dependent variable (variable Y) in this study was the perception of the superintendent or technology specialist (in district's employing a specialist) of the school district's progress in implementing a school technology plan which uses Internet and on-line educational resources. Progress was defined as the degree to which the respondent believed the district was meeting the objectives outlined in the technology plan.

Perception was established by asking the superintendent or technology specialist to what degree identified characteristics were present in the school district technology plan, or, a part of their school district. For each characteristic, the respondent was asked to choose from six choices; (1) fully developed, fully

implemented, (2) fully developed, partially implemented, (3) fully developed, not implemented, (4) partially developed, partially implemented, (5) partially developed, not implemented, (6) not developed, not implemented.

The identified characteristics (variables X_1 - X_{11}), are the independent variables. They are identified below:

Identified Characteristics (Independent Variables X_1- X_{11}):

X_1 The technology plan is formalized and integrated into the school district's operations (Examples: budget, curriculum, and job descriptions).

X_2 The technology plan is part of a long-range, comprehensive plan addressing the goals, missions, and visions of the district.

X_3 The technology plan includes a comprehensive professional development component.

X_4 The technology plan stresses the integration of technology applications to meet goals across the curriculum.

X_5 The technology plan includes an assessment of present technology status and future needs.

X_6 The technology plan indicates the ongoing need for assessment and evaluation of the plan implementation.

X_7 The technology plan is supported by key school staff (Superintendent, building administrators, teachers).

X_8 The technology plan is supported by key community members (students, parents, business community).

X_9 The technology plan is supported by the School District Board of

Education (trustees).

X_{10} The school district financial/budgetary matters related to technology are considered to be of high importance.

X_{11} The school district has access to technical experts who can fix machines when they are broken and also provide technical assistance to teaching staff.

Statistical Hypotheses Tested

To determine the relationship between a school district's perceived progress in implementing a school technology plan which uses Internet access and on-line educational resources, and a set of school district characteristics, several null hypotheses were tested. Hypotheses 1 A and 2 A were tested using Multiple Linear Regression. Hypotheses 1 B and 2 B used the t-statistic to determine whether the regression coefficients (b) differed significantly from zero.

Null Hypothesis 1 A: There is no significant R^2 between progress in implementing a technology plan (variable Y) as perceived by the district superintendent, and the set of independent identified characteristics (variables X_1- X_{11}).

H_{01}: $R^2_{y,x_1 \ldots x_{11}}=0$.

Null Hypothesis 1 B: None of the identified characteristics (variables X_1- X_{11}) provide a significant and unique contribution to the

prediction of the superintendent's perceived progress in implementing a technology plan (variable Y) when all other independent variables have been taken into account.

Null Hypothesis 2 A: There is no significant R^2 between progress in implementing a technology plan (variable Y) as perceived by the district technology specialist, and the set of independent identified characteristics (variables X_1- X_{11}).

H_{02}: $R^2_{y,x_1...x_{11}}=0$.

Null Hypothesis 2 B: None of the identified characteristics (variables X_1- X_{11}) provide a significant and unique contribution to the prediction of the technology specialist's perceived progress in implementing a technology plan (variable Y) when all other independent variables have been taken into account.

Additionally, the data was subjected to a stepwise multiple regression. Variables were added to the model one at a time as long as the increase in R^2 from the previous step was significant at the 0.05 level. The inclusion of each of these variables significantly increased (alpha = 0.05) the value of R^2, which is the amount (percentage) of variability of Y that is accounted for by the included independent variable.

Hypothesis 3 was tested using a Paired Sample t Test. For purposes of Hypothesis 3, progress in implementing the technology plan was measured by the response of the superintendent or technology specialist when questioned

about their perception of progress defined as the degree to which they believed the district was meeting the objectives outlined in their plan. Hypothesis 3 sought to answer whether there was a difference between the perceived progress in implementing the technology plan (variable Y) of district superintendents and technology specialists. The superintendent and technology specialist responses were paired by district.

Null Hypothesis 3: There is no significant difference between superintendent mean perception of progress and technology specialist mean perception of progress in a given school district.

Respondents included 119 school districts where both the superintendent and technology specialist returned the questionnaire. In 104 school districts, both the superintendent and technology specialist completed Section II of the questionnaire indicating their perception of progress as defined.

Investigative Categories

Determining the relationship between a school district's progress in implementing a school technology plan which uses Internet access and on-line educational resources, and which school district characteristics interact with this implementation was the focus of the study. For this purpose, a survey tool (Technology Questionnaire) was developed and distributed to both district

superintendents and those district's in the sample that had technology specialists; allowing the samples to be divided into two subsamples. These subsamples are defined as: (a) Subsample 1, district superintendent responses; (b) Subsample 2, district technology specialist responses. Each survey received was placed in the appropriate subsample as outlined above.

The variables identified were defined given the following descriptions. The dependent variable (Y), the perception (superintendent or technology specialist) of a school district's progress in implementing a school technology plan which uses Internet access and on-line educational resources, was based upon the survey respondent's perception of the degree to which they believed the district was meeting the objectives outlined in the plan. A percentage from 0% to 100% was used for the respondent to rank his/her perception.

The independent variables (X_1 - X_{11}) were a measure of the degree to which the respondent believed the characteristics (independent variables (X_1 - X_{11})) were present in their school district technology plan, or, part of their school district. For each characteristic, the respondent was asked to choose from six choices; (1) fully developed, fully implemented, (2) fully developed, partially implemented, (3) fully developed, not implemented, (4) partially developed, partially implemented, (5) partially developed, not implemented, (6) not developed, not implemented.

Further, the respondent was requested to rank the top three characteristics in order of perceived importance, regardless of whether they were part of their school technology plan or not. The respondent was requested to indicate which characteristic they believed was most important, second most important, and third most important in making progress in implementing a technology plan.

The independent variables used in this study were selected through a review of action research and best practices in implementing technology plans. A preliminary survey instrument was developed which identified 80 characteristics predominantly present in the literature. This preliminary survey was administered to a panel of five educational technology experts. The preliminary survey instrument is in Appendix B. The results, established by the panel of technology experts, determined the eleven characteristics (independent variables) used in this study.

The panel of experts who completed the preliminary survey instrument were selected for their known expertise in the area of educational technology and, an effort was made to balance the collection of input between experts with experience at the local school district level, the state and university level, and the regional level. The panel of experts consisted of:

- Dr. Lynn D. Churchill, Co-Director of the Network Montana Project and Professor at the University of Montana in Missoula, Montana.
- Mr. Gary Graves, Senior Technology Associate at the Northwest Regional Educational Technology Consortium in Portland, Oregon.
- Ms. Libby Henneberry, Technology Specialist at Townsend Public Schools in Townsend, Montana.
- Mr. Dennis Parman, Technology Specialist and Assistant Superintendent at Havre Public Schools in Havre, Montana.
- Dr. David A. Thomas, Co-Director of the Network Montana Project and Professor at Montana State University in Bozeman, Montana.

Methods of Data Collection

An attitudinal survey, called a Technology Questionnaire, was the instrument of data collection in this study. The Technology Questionnaire is included in Appendix A. The researcher developed the survey instrument. The validity of the instrument was established using the following criteria: (a) research of literature to discover comparable tools that had questions similar to those required to be asked, for incorporation into the survey instrument; (b) establishment of research based characteristics (variables) using the results of the preliminary survey of educational technology experts to determine the characteristics for the survey instrument; and (c) authoritative based validity was established by the committee of five educational technology experts review of the design of the survey instrument.

The reliability of the instrument was established using item by item test - retest reliability to determine the stability of the items over time. Further, total score reliability of the eleven characteristics was used to determine stability over time reliability for all variables considered in the model.

Initially, the Technology Questionnaire (test) was distributed through the U. S. mail to the sample population. The respondent was requested to complete the questionnaire and return it to the researcher in a return envelope. After a passage of five weeks, the Technology Questionnaire was re-administered (retest) to 60 superintendents and 15 technology specialists randomly chosen.

As outlined above, item by item test-retest was used to determine the stability of the items over time. Pearson correlation coefficients were used as the measure of this reliability. A reliability coefficient less than 0.60 caused a given item to be analyzed for its contribution and possible removal from the

analysis. Further, a test - retest correlation between the totals of characteristics X_1 - X_{11} were used to analyze the stability over time of the total instrument.

Table 2 shows the Pearson correlation coefficients for each of the the eleven independent variables.

Table 2. Reliability Coefficients for the Eleven Independent Variables

Variable	N	Pearson r	Sig. r
X_1	65	0.418 *	0.001
X_2	65	0.620	0.000
X_3	64	0.675	0.000
X_4	64	0.583 *	0.000
X_5	65	0.343 *	0.005
X_6	65	0.479 *	0.000
X_7	65	0.730	0.000
X_8	64	0.646	0.000
X_9	65	0.761	0.000
X_{10}	65	0.792	0.000
X_{11}	65	0.760	0.000
Total Score	63	0.715	0.000

Variables X_1, the technology plan is formalized and integrated into the school district's operations (Examples: budget, curriculum, and job descriptions); X_4, the technology plan stresses the integration of technology applications to meet goals across the curriculum; X_5, the technology plan includes an assessment of present technology status and future needs; and X_6, the technology plan indicates the ongoing need for assessment and evaluation of the plan implementation, marked with an *, are correlation coefficients that

did not meet the 0.60 demand suggested as criteria for item by item test-retest stability over time. The total score reliability indicated that the test - retest correlation between the totals of characteristics $X_1 - X_{1.1}$ in the test and $X_1 - X_{1.1}$ in the retest was 0.715. This correlation meets the criteria established for stability over time reliability for all variables considered in the model.

Variability of the data using the 1 to 6 rating scale is limited. Because only six choices are available for rating the independent variable, variability of the responses is restricted. This limiting feature (variability) contributed to the low correlation coefficient for these four variables. The maxmincon principle stresses that the research design maximize variability of the variables under consideration, control the variance of contaminating variables, and minimize the error variance. (Kerlinger, 1992, p. 330). This principle requires the author to consider that the restrictions on variability of responses due to the limited scale may have attributed to four variables not meeting the item by item test-retest stability over time criteria. Caution was taken when drawing conclusions that used any of the four variables.

Tables 3 and 4 show the descriptive statistics for each of the eleven independent variables by subsample.

Table 3. Descriptive Statistics for the Eleven Independent Variables by Subsample 1 - Superintendents

Variable	N	Mean	Std. Deviation
X_1	208	2.3894	1.1947
X_2	208	2.3942	1.2349
X_3	206	2.6699	1.3207
X_4	208	2.6731	1.1667
X_5	208	2.1731	1.2074
X_6	208	2.4471	1.3250
X_7	207	1.5990	0.8915
X_8	206	2.2864	1.3254
X_9	207	1.5942	0.9551
X_{10}	207	1.9903	1.1363
X_{11}	207	1.9855	1.3052

Table 4. Descriptive Statistics for the Eleven Independent Variables by Subsample 2 - Technology Specialists

Variable	N	Mean	Std. Deviation
X_1	144	2.6042	1.1780
X_2	144	2.5000	1.4093
X_3	143	2.9091	1.4187
X_4	143	2.7413	1.3093
X_5	144	2.2569	1.3262
X_6	144	2.4583	1.4718
X_7	144	1.9028	1.2534
X_8	141	2.5461	1.5742
X_9	144	1.7986	1.2548
X_{10}	142	2.2465	1.3272
X_{11}	143	1.8671	1.1882

The means represented in Tables 3 and 4 were based on the six point scale used by the respondent to rate each characteristic as outlined previously. [(1) fully developed, fully implemented, (2) fully developed, partially implemented, (3) fully developed, not implemented, (4) partially developed, partially implemented, (5) partially developed, not implemented,a (6) not developed, not implemented.] For both subsamples, the means tend to indicate that on average, superintendent and technology specialists rated the characteristics fully developed, and at various stages of implementation, from not implemented to fully implemented. However, the indicated standard deviations causes the author to put little emphasis on this analysis, because of the possibility that in the standard deviation range, some of the variables may move out of the fully developed category and into the partially developed category.

Variable Controls

Precautions were taken to control irrelevant and/or contaminating variables. Precautions taken to maximize the systematic variance of the independent variables included internal validity of the research design. Regarding the ten potential threats to internal validity outlined by Cook, Campbell and Stanley, the researcher considered history as potentially impacting internal validity. The researcher dealt with this threat as follows.

The history threat was considered because of the E-Rate's influence on the ability of school districts to implement technology plans which use Internet

access. The E-Rate is a federal program subsidizing funding for certain types of wiring, connections and equipment used by schools to connect to the Internet. Receiving funding during the time in which superintendents or technology specialists were completing the Technology Questionnaire may have influenced the internal validity of the design. The history threat was minimized by administering the Technology Questionnaire during a time in which the U.S. Congress had already acted upon the E-Rate, but had not distributed the funding, so no school districts in the sample had received funding.

The questionnaire was distributed on December 14, 1998 with first follow-up postcard occurring one week later. E-Rate funding was allocated in waves during that time period. No schools in the sample had received funding from the E-Rate during the time span of the administration of the questionnaire, minimizing the history threat.

However, in addition to affecting the internal validity of the design, the time span between the administration of the Technology Questionnaire and the re-administration of the questionnaire to the random sample in the reliability group, may have influenced the reliability of the instrument. The followup questionnaire was distributed to the reliability group on January 21, 1999, approximately five weeks after the original administration of the questionnaire. Some schools in the sample may have received notice of funding by that time, potentially affecting their response to the followup questionnaire. Ultimately, this may help explain the previously cited concerns about reliability of some of the items.

The validity of the design was established using the following criteria: (a) research of literature to discover comparable tools that had questions similar to those required to be asked, for incorporation into the survey instrument; (b)

establishment of research based characteristics (variables) using the results of the preliminary survey of educational technology experts to determine the characteristics for the survey instrument; and (c) authoritative based validity was established by using the author's doctoral committee to review the design of the survey instrument. Authoritative based validity was established through the development of a researched based preliminary survey administered to a panel of five educational technology experts for their input. The results established by this panel of experts determined the characteristics (independent variables) that were used in the Technology Questionnaire instrument.

The researcher worked to control the history interaction over time threat to external validity. Technology changes so rapidly, it effects the generalizability of what is found today, to the future. The researcher has minimized this threat by testing a sample that measured school district progress in implementing a technology plan based upon the perception of the superintendent (or technology specialist) in meeting the objectives of the plan. The objectives outlined in the plan by the local district, allow generalizability of progress made today, to drive what is to happen in the future. The researcher worked to complete the results of this study in a time efficient manner, so the results were generalizable based upon the current state of technology.

Analytical Techniques and Research Design

This study determined the relationship between a school district's perceived progress in implementing a school technology plan which uses

Internet access and on-line educational resources, and a set of school district characteristics. The data was analyzed using four methods of statistical inference: (a) Multiple Linear Regression, (b) t Test of Significance, (c) Forward Selection Stepwise Multiple Regression, and (d) Paired Sample t Test.

According to Kerlinger (1992, p. 531), multiple linear regression is used to determine the collective and separate contribution of two or more independent variables to the variability of a dependent variable. This study sought to account for the variance in perception of progress a school district had in the implementation of a school technology plan by identifying to the what degree the eleven independent variables were perceived to be present in the district's technology plan as indicated by the superintendent or technology specialist. The multiple correlation coefficient R^2 indicates the amount (percentage) of variability of the dependent variable that is accounted for by knowledge of the independent variables. While the focus of this study was perception of progress, the study attempted to discover the most efficient regression model by employing a stepwise regression analysis.

For each of the two subsamples, superintendents and technology specialists, a linear regression model, was constructed by the stepwise method as outlined in Appendix C.

The value of R^2 represented the proportion (percentage) of variability of the dependent variable that was accounted for by knowledge of the independent variables in the regression model. The adjusted R^2 value was the expected degree of fit of the regression model to the total population represented by the sample data. Stated differently, the adjusted R^2 reflects the expected percentage of variability of the dependent variable Y explained by

knowledge of the independent variables when the model is applied to the full population. Shrinkage, is defined as the difference,

$$\text{Shrinkage} = R^2 - \text{adjusted } R^2$$

Shrinkage can be lessened by increasing the ratio of sample size to variables in the regression model (Ferguson, 1981). This is the reason an N of approximately 20 was chosen for each of the eleven independent variables in determining the sample size.

A t Test of Significance was used to test hypotheses' 1 B and 2 B, where t was used to determine if the regression coefficients (b) differed significantly from zero. (Glass, 1996, p. 299). Since the eleven independent variables, X_1 - X_{11}, used a scale that included 6 measures to determine the degree to which the respondent believed the variables were part of the school district technology plan, or, part of the school district, it was difficult to determine the relative importance of each variable on the basis of raw-score (b value) coefficients alone. Since the relative contribution of each variable was of interest, standardized regression coefficients (beta weights, β_i) were calculated. Each beta weight value indicates the incremental contribution of the corresponding independent variable in the presence of the other included variables. That is, β_i indicates the unique contribution of X_i (or Z_i) to the variance of the dependent variable Y. Therefore, performing a t Test of Significance on β_i was a means of evaluating whether X_i (or Z_i) made a significant contribution with the influence of the other included independent variables controlled. At each step in the process, an F Test tested the significance of R^2, against the null hypothesis,

$$H_0 : R^2 = 0.$$

At each step in the process, a t Test of Significance for each beta weight in the model tested the null hypothesis,

$$H_0 : \beta_i = 0.$$

Rejection implied that X_i provided a significant and unique contribution to the prediction of Y after the other included variable(s) were taken into account.

The Technology Questionnaire required the respondent to measure the independent variables using a scale from 1 to 6 (with 1 indicating fully developed and fully implemented, and 6 indicating not developed and not implemented). Therefore, small number rankings indicated more progress than the larger number rankings. As a result of the scale used on the Technology Questionnaire, a negative (-) ß indicated the significant presence of the independent variable contributed a greater amount to the dependent variable. Vice-versa, a positive (+) ß indicated the significant presence of the independent variable contributed a lesser amount to the dependent variable.

Hypothesis 3 utilized a Paired Sample t Test. Subsample 1 and subsample 2 were aligned by school district so that a comparison could be made between the superintendent perception and technology specialist perception from the same responding school district. A Paired Sample t Test was utilized to determine if a significant difference existed between the superintendent mean perception of progress and technology specialist mean perception of progress as aligned by school district.

Analysis of Data

The hypotheses were tested using Multiple Linear Regression, t Test of Significance, Forward Selection Stepwise Multiple Linear Regression, and Paired Sample t Test. The analysis of data was completed in an identical manner for each subsample. The consequence of rejecting a true null (Type I error) was the possibility of concluding that there is a greater link between progress in implementing a technology plan and the district characteristics, than actually existed. The consequence of a Type II error (retaining a false null hypothesis) was the possibility of failing to recognize an important link between the district characteristics and progress in implementing the technology plan. A Type II error could cause a district to neglect looking at a district characteristic when the characteristic could benefit the implementation of the the technology plan. Since the consequence of Type II error was of greater importance in this study, the level of significance was set to 0.05 rather than 0.01. This increased the likelihood of a Type I error, but reduced the chance of a Type II error. (Ferguson, 1981).

Limitations and Delimitations

Limitations of this study include:

(a) District characteristics were chosen through research of the current literature on technology, completion of a research based preliminary survey by a panel of experts, and discussions with authorities in the field; but the eleven identified characteristics may not be all inclusive