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DECISION MAKERS' THINKING DURING THE DESIGN AND IMPLEMENTATION OF A K-5 HIGH-COMPUTER-ACCESS (HCA) PROGRAM

by

Constance Dianne Gutknecht

A dissertation submitted to the Doctoral Studies Faculty in partial
fulfillment of the
requirements for the degree of

Doctor of Education
In Educational Leadership

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Table of Contents

List of Tables and Figures

Tables

Figures

Abstract of the Dissertation

Decision Makers' Thinking During the Design and Implementation of a K-5 High-Computer-Access (HCA) Program

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As present trends in education indicate, learning with technology is increasingly being considered as a means of instructional delivery for K-12 learners. Educational leaders must be informed of how to provide the experiences, skills, and knowledge required of the learners for whom they are responsible.

This qualitative study examined the conceptualization of a school district's attempt to design and implement a high-computer-access (HCA) program. Research methodologies included interview, observation, and analysis of related documents. The results comprised the thinking of the HCA program designers and how they viewed learning theory and effective instruction principles in relationship to the HCA environments they were creating.

The findings from this study indicated that designing and implementing an HCA program into a school district involves several

issues. These issues were organized into the following themes: (a) goals and assumptions; (b) appropriation; (c) transformative teaching; (d) child-centered instruction; and (e) logistics.

The goals and assumptions theme addressed the participants' thinking about the organization's and the designers' goals that evolved during the design phase. The appropriations theme encompassed the use of computer as a learning and teaching tool.

Reported changes in instructional planning and delivery are represented in the transformative teaching theme. The child-centered instruction theme resulted from participants' numerous references to learning theory. The fifth theme, logistics, included the procurement, maintenance, and knowledge acquisition inherent in HCA environments.

Further investigation of these themes may assist educational leaders who would choose to implement HCA environments into their schools.

Chapter 1
Introduction

Education is on the cusp of a major transformation into a more collaborative, facilitative, technological, and communications-based pedagogy. Current trends in the U.S. economy, in business, and in industry encourage and demand this transformation. Many citizens argue if the learners of today are to become the productive citizens of tomorrow, educators must acknowledge and embrace this transformation of pedagogy. One educator, Chris Dede (2002), reflected this assertion in a recent interview: "One of the things I've been heard to say is that, within my lifetime, people who don't teach with multiple interactive media will be guilty of professional malpractice" (p. 14). This study examined the conceptualization and implementation of one public school district's attempt to embrace such a transformation.

Present trends in education indicate that learning with technology is quickly becoming commonplace in higher education (Ackoff, 1999; Davis & Botkin, 1994; Drucker, 1993; Schlechty, 1990; Wheatley, 1999) and is increasingly being considered as a means of instructional delivery for K-12 learners as well (Cassidy & Lane, 1996; DeVries, 1996; Dunn, 2000; Dwyer, 1994; Filipczak, 1995; Gutknecht & Gutknecht, 1999). Advances in the delivery of technology (such as real-time, or synchronous, video conferencing and web-based electronic communications options, as well as delayed communication or asynchronous options, including email and web-based courses) make teaching and learning with technology a viable option for advancing traditional methods of teaching and learning.

The move by schools and other learning organizations to embrace technologically enhanced instructional delivery corresponds to the changing face of the modern workplace. Today, workers from all parts of the country regularly communicate via the World Wide Web and interpretative software, and collaborate, research, and complete assignments and projects utilizing technology. In addition to its use in K-12 schools, technologically enhanced instructional delivery is also fast becoming the method of choice for large corporations' training and development programs. An example is the General Motors Corporation, which recently hired a distance learning firm to provide its managerial employees access to an online Master of Business Administration degree.

To compete in this communications and technology-based workplace, learners (i.e., employees) need to be familiar with, and be able to successfully function within, the new learning paradigm (Ackoff, 1999; Davis & Botkin, 1994; Drucker, 1993; Schlechty, 1990; Wheatley, 1999).

Some public school projects that currently are validating these new learning environments include Apple Classrooms of Tomorrow (ACOT, Dwyer, 1994), Utah Educational Technology Initiative (ETI, Mergendoller, Sacks, & Horan, 1994), the District Six Laptop Project (Peterson, 1999), and the West Virginia Story (Mann, Shakeshaft, Becker, & Kottkamp, 1999). While these projects are taking different approaches to the utilization of technology, the provision they have in common is providing computer access for students and teachers in or out of the classroom. The degree of computer access utilized in these projects may best be described as high-computer-access (HCA).

A great deal is known about technologically enhanced learning programs in K-12 educational settings in general (e.g., Cassidy & Lane, 1996; DeVries, 1996; Dunn, 2000; Dwyer, 1994; Filipczak, 1995; Gutknecht & Gutknecht, 1999), but currently there is a paucity of information about HCA programs and their design and implementation. The primary difference between technologically enhanced learning and high-computer-access programs is the degree to which the technology is available for students and teachers. Technologically enhanced learning programs utilize some form of technology some of the time. By contrast, HCA programs have computers available for students at all times in and out of the classroom. These differences are discussed later in more detail.

While considerable literature exists that describes the structure, implementation, and outcomes of a wide variety of technology enhancement programs (Chute, Sayers, & Gardner, 1998; Dede, 1997; Dunn, 2000; Dwyer, 1994; Mergendoller, et al., 1994), little is known about the explicit thinking of those who design and implement these programs. Even less is known about designers' conscious attempts to base the development and implementation of HCA programs on principles of learning and effective instruction.

Purpose

The general purpose of this study was to explore the thinking of one group of school professionals as they designed and implemented an HCA project. More specifically, the research was designed to examine how the project related to various theories of learning and principles of effective instruction. The study was designed to address one overarching idea: "What was the thinking of those who conceptualized, designed, and implemented the HCA program?"

Specifically, the study had four research objectives. The chief objective was to examine the thinking of the persons who designed and implemented a K-5 HCA program. The second and third objectives were to examine the ways in which the designers' thinking may have included attempts to base the development and implementation of HCA programs on principles of learning and on the current research on effective instruction. A final objective was to examine the relationship between the design of the program and its implementation.

Because the overarching research goal of the present study was to focus on the thinking of one group of HCA project designers, a descriptive case study was selected as the most appropriate research design. This design was selected, in part, because it provided a valid conceptual framework for observing, interviewing, and reviewing project documents to support an investigation into the design and implementation of the project of interest (Merriam, 1998). This design was also selected in the belief that the qualitative nature of a descriptive case study could provide a pathway toward understanding the thinking of the project's decision makers and toward ascertaining whether the decision makers did or did not purposefully include principles of learning and effective instruction in the design and implementation of the program.

Definition of Terms

Some of the common terms and concepts germane to the present study include: HCA, thinking, learning theory, effective instruction, decision-maker, and educational leader. As key elements of the present study, their definitions follow.

HCA

HCA consists of the utilization of computers, peripherals, and software for in- and out-of-classroom instruction and learning. In HCA settings, computers provide wireless access to the Internet via AirPorts in the classroom. AirPorts are devices connected to a Local Area Network (LAN) by wire and transmit signals through the air to a receiving device installed in the computer, enabling the user to move about. The computers are loaded with various software packages. Some commonly used applications are word processing, spreadsheet and database, keyboarding practice, and graphics software. The computers used in the project examined for the purposes of the present study were Apple iBooks provided for each child in 10 project classrooms and included each of the above applications plus Internet access firewall and children's browser software.

Thinking

Some researchers have admitted that thinking is difficult to define. Fundamentally, thinking is what goes on inside a person's mind. In this study, the program designers' thinking was viewed as cognitive thought processes that are composed of ongoing action and prior personal experience, including self-reflection, decision-making, and prioritizing (Clandinin & Connelly, 1987; Clark & Peterson, 1986; Prawat, 1992).

In an extensive review of literature on teacher thinking, Clark and Peterson (1986) reported that the "ultimate goal of research on teachers' thought processes is to construct a portrayal of the cognitive psychology of teaching" (p. 255). This body of research "holds in common the idea that a teacher's cognitive and other behaviors are guided by and make sense in relation to a personally held system of beliefs, values, and principles" (p. 287). Their conclusions include:

> (a) the research shows that thinking plays an important part in teaching; (b) teachers do plan in a rich variety of ways, and these plans have real consequences in the classroom; (c) teachers do have thoughts and make decisions frequently during interactive teaching; and (d) teachers do have theories and belief systems that influence their perceptions, plans, and actions. (p. 292)

In response to Clark and Peterson's (1986) review, Clandinin and Connelly (1987) made the point that "most studies conceive of teacher thought in cognitive terms" (p. 499). Although Clandinin and Connelly (1987) discussed the affective aspects of teacher thinking, the present study was focused on the cognitive aspects.

Therefore, for the purposes of this study, thinking is defined as cognitive thought processes that are composed of ongoing action and prior personal experience, including self-reflection, decision-making, and prioritizing, and are guided by a personally held belief system (Clandinin & Connelly, 1987; Clark & Peterson, 1986; Prawat, 1992). This definition assisted in guiding data collection and analysis throughout the present study.

Learning Theory

There were several relevant components of learning theory and research. They included constructivism, information processing, and effective instruction research.

Constructivism has been defined as the "process whereby new meanings are created by the learner within the context of her or his current knowledge ... and is to some degree both personally and culturally relative" (Yakimovicz & Murphy, 1995, p. 203). In a constructivist view of learning, "a learner actively constructs an internal representation of knowledge by interacting with the material to be learned" (Sherry, 1996, p. 4). The terms *active, interactive, created, meaningful, contextual, and social* are common to most definitions of constructivism. Eggen and Kauchak (2001) identified several principles of constructivism: learners construct their own understanding; new learning depends on current understanding; learning is facilitated by social interaction; and meaningful learning occurs best within authentic, real world learning tasks.

In addition to constructivism, information processing theory contributes to the architecture of thinking. Information processing is "a cognitive theory that examines the way knowledge enters and is stored in and retrieved from memory" (Eggen & Kauchak, 2001, p. 258). One component of information processing is the cognitive processes component. Cognitive processes are the "intellectual actions that transform information and move it from one store to another" and include "attention, perception, rehearsal, encoding and retrieval" (p. 259).

Effective Instruction

Issues of effective instruction were also applicable to the present study. According to Eggen and Kauchak (2001), "essential teaching skills are teaching behaviors that promote student learning and contribute to productive learning environments" (p. 512). Research-based effective instruction indicators include: teacher efficacy, use of time, organization, communication, review and feedback, and interaction and questioning (Bloom, 1976; Brophy & Evertson, 1976; Brophy & Good, 1986; Coker, Lorentz, & Coker, 1976; Good & Beckerman, 1978; Good & Grouws, 1979; Kounin, 1970; Maddox & Hoole, 1975; McCutcheon, 1980; Medley, 1977; Pompi & Lachman, 1967; Rosenshine, 1983; Smith & Cotton, 1980; Solomon, Rosenberg, & Bezdek, 1964; Stallings & Kaskowitz, 1974; Weasmer & Woods, 1998; Wright & Nuthall, 1970).

Decision-Maker

A decision-maker, as defined for the purposes of this study, is a person in a school or district who makes decisions in the design and implementation of an HCA program. Decision-makers can include superintendents, technology coordinators and directors, teachers, and district-level personnel.

Educational leader

Educational leaders need to make informed decisions regarding the implementation of HCA programs. An educational leader, in this study, was a person within a school or district who makes official decisions which impact the learning process. Educational leaders included principals, curriculum directors, superintendents, media specialists, technology coordinators or directors, teachers, or members of site-based management teams.

Limitations of the Study

The present study was impacted by limitations arising from specific goals and the site used for the study as well as general limitations normally associated with any research design, procedures, and methodology employed. The study did not attempt to exemplify effective HCA programs and was limited to describing one K-5 HCA program's design and implementation from the perspective of the designers of the HCA program. Consequently, the study was conducted within the context of a particular school district's HCA program and may have restricted generalizability.

In addition, the present study utilized the researcher's *self as instrument role*, as interviewer, observer, and analyst. Conversely, my extensive knowledge of HCA environments brought depth and an ability to see situations from several points of view, qualities of value within qualitative modes of inquiry. Because the study utilized qualitative research methodology, it is important to note that a characteristic of most qualitative studies is the use of oneself as a data collecting instrument. According to Eisner (1998),

> The self is the instrument that engages the situation and makes sense of it. This is done most often without the aid of an observation schedule; it is not a matter of checking behaviors, but rather of perceiving their presence and interpreting their significance.... Both sensibility and schema provide the means through which we make sense of a complex qualitative array. Sensibility alerts us to nuanced qualities and the schema relevant to a domain, the significance of what to seek and see. Without sensibility the subtleties of the social world go unexperienced. (p. 34)

Eisner (1998) has stated that the self as instrument role can be assumed based upon the researcher's "connoisseurship [that includes] high levels of qualitative intelligence in the domain in which [the researcher] operates" (p. 65) and that provides "the means through which we come to know the complexities, nuances, and subtleties of aspects of the world in which we have a special interest" (p. 68).

Research Questions

The purpose of the present study was to examine the thinking involved in the design and implementation of an HCA program via a qualitative case study. While a qualitative case study framework for research does not lend itself to highly structured research hypotheses, without some schema to guide data collection and analysis, no method for determining significance of the findings is possible. Consequently, answers were sought for the following questions:

- What was the thinking of those who designed an HCA program?
- In what ways did the designers of an HCA program purposefully think about principles of learning?
- In what ways did the designers of an HCA program purposefully think about principles of effective instruction?
- How did an HCA program, as implemented, reflect the thinking of the program designers?

Given the nature of qualitative research, these questions were refined during the study as patterns and themes developed in the data gathering and analysis processes (Marshall & Rossman, 1995; Merriam, 1998; Seidman, 1998).

Significance of the Study

Learners today must have the knowledge base and skills to communicate and work via technology. Indeed, the service and retail businesses that will employ the majority of high school and college graduates require technology skills (Ackoff, 1999; Davis & Botkin, 1994; Drucker, 1993; Schlechty, 1990; Wheatley, 1999). Traditional instructional delivery models, such as lecture-recitation-seatwork, are not and will not be the only means of preparing our learners in the future.

The use of technology is likely to become increasingly important as an alternative or additional instructional delivery system.

Because of the likelihood of the increased role of technology within the educational process, educational leaders need information about the design and implementation of HCA programs so they can make informed decisions when faced with implementing technology into their schools or classrooms. Further, because learning is an internal process where learners actively construct meaning, how the design of HCA programs takes this principle into account is also important if the goal is to enhance learning.

The extensive research conducted by the National Research Council and reported by Bransford, Brown, and Cocking (1999) echoed the above assertion by recommending that "extensive research be conducted through both small-scale studies and large-scale evaluations, to determine the goals, assumptions, and the uses of technologies in classrooms and the match or mismatch of these uses with the principles of learning and the transfer of learning" (pp. 239-240).

Similarly, the 2000 report of the Web-Based Education Commission recommended additional research and development to establish a pedagogical base for the effective use of Internet learning:

> Technology can support what we now know to be more effective learning environments. Interactive applications linked to the Internet can provide environments better matched to support learner-centered Instruction, knowledge-centered, community-centered, and assessment-centered conditions for learning. New technological tools and applications allow for expanded forms of communication, analysis, and expression by students and teachers. These innovations support new forms of teaching and understanding built on the early findings of learning research. (p. 59)

Central to both of the above-mentioned reports was a call for additional research into the match between technology use in classrooms with principles of teaching and learning, making the present study appropriate and critical.

Significance to Educational Leadership

As stated in the previous section, educational leaders need research results that examine the design and implementation of HCA programs and will allow educational leaders to make informed decisions when considering implementation of an HCA program. Learning with technology is increasingly being considered as a viable, and soon to be necessary, means of instructional delivery for K-12 learners (Ackoff, 1999; Davis & Botkin, 1994; Drucker, 1993; Schlechty, 1990; Wheatley, 1999). The intention of this study was to provide educational leaders with information designed to assist in making sound and workable decisions when considering technology implementation into their schools' curriculum and instruction.

Summary

HCA will soon be commonplace in K-12 arenas. The presence of technology in schools has increased dramatically, and this trend is predicted to accelerate (Bransford, et al., 1999; Dede, 1997). Technology enhancement, in the form of Internet learning, is not just a fad that will go away and be replaced by another. In fact, if educational leaders wait to implement Internet-based learning technologies, they will be taking a grave risk. Indeed, Dede (1997) has noted, "Our greatest risk, if we consider the future of virtual communities for learning, is to do nothing at all" (p. 4).

Another risk would be to ignore the design process of HCA programs. How HCA programs are conceptualized within the framework of what is widely accepted as good pedagogy - constructivist approaches to teaching and learning - is an important consideration (Bransford, et al., 1999; Cassidy & Lane, 1996; Eggen & Kauchak, 2001; Sherry, 1996; Yakimovicz & Murphy, 1995). This study furthers the research base in the area of HCA curriculum design and implementation as it relates to learning theory and research.

Organization of the Study

The present study is organized into five chapters. The first chapter has summarized the purpose and significance of the study, provided definitions of important terms, and proffered research questions for investigation. Chapter 2 provides a review of relevant literature related to the history, development, implementation, and current applications of HCA programs. Chapter 3 overviews the methods and procedures used to conduct the study, and chapter 4 presents the results and findings of the study. The study concludes with chapter 5, which provides a general discussion of the findings along with implications and suggestions for further research.

Chapter 2

Review of the Literature

Technology applications are becoming increasingly commonplace in educational practice. Therefore, educational leaders need data that provide information to match technology programs with best pedagogical practice. Current research in the areas of learning theory and technology infusion was relevant to, and provided the basic foundation for, the present study. The overarching research question for the present study asked: "What was the thinking of those who designed a high-computer-access (HCA) program?" The sub-questions as noted in Chapter One focused upon the ways in which the HCA designers took learning theory and effective instruction principles into consideration when designing and implementing the HCA program. To provide a framework for addressing these questions, this chapter provides a historical perspective of technology infusion and HCA programs as well as a review of current research in learning theory, effective instruction, and K-12 HCA programs.

Learning Theory

Constructivism

Eggen and Kauchak (2001) have noted that constructivism is a view of learning and human development that emphasizes the active role of the learner in building understanding and making sense of the world. This conceptualization of constructivism was utilized for the present study because it is relevant to technology enhanced and HCA environments.

A constructivist learning theory approach has been found to be an effective means of teaching learners in a high-computer-access environment as constructivist theory provides learners with the skills they will need in tomorrow's workplace. Integrating this approach into an HCA paradigm appears to be the consensus among researchers. Cassidy and Lane (1996) reported that students in HCA environments "learn by constructing their own knowledge and sharing that process with others in their classroom and across networks by instructors who have become effective facilitators of learning" (p. 2). Likewise, Sherry (1996) noted that an effective HCA design approach is:

> based on constructivist principles, in which a learner actively constructs an internal representation of knowledge by interacting with the material to be learned.... Successful distance education

> systems involve interactivity between teacher and students, between students and the learning environment, and among students themselves, as well as active learning in the classroom. (pp. 4-6)

Previous research findings indicate (e.g. Dwyer, 1994; Mergendoller, et al., 1994; Peterson, 1999) that the introduction of HCA into the classroom leads to changes the teacher's role. Specifically, the teacher's role in the 21st century is progressively being characterized by "decreases in teacher-directed activities and a shift from didactic approaches to a constructivist approach" (Ringstaff, Sandholtz, & Dwyer, 1991, p. 2). Dwyer, Ringstaff, and Sandholtz reported that teachers involved in the ACOT project, a longitudinal study focused on constant access to computers by students and teachers, became "more disposed to view learning as an active, creative, and socially interactive process than they [the teachers] were when they entered the program" and viewed knowledge "more as something children must construct and less like something that can be transferred" (1990a, p. 9). Constructivism supports the notion that active learning is more effective than passive learning and plays an important role in the development of understanding.

Authentic Tasks

Providing the learner access to contextually relevant "real life" experiences is inherent to a constructivist approach of teaching. Palloff and Pratt (1999) reported:

> In order to actively engage learners in the online learning process and to facilitate the meaning-making process that is a part of the constructivist approach through which this learning occurs, the content of the course should be embedded in every-day life. The more that participants can relate their life experiences and what they already know to the context of the online classroom, the deeper their understanding will be of what they learn. (p. 116)

Discovering how designers of HCA programs take various constructivist principles into account is a focus of this study. Constructivist principles include promoting automaticity, developing metacognition, discovering preexisting knowledge, and providing authentic learning tasks (Bransford, et al., 1999; Eggen & Kauchak, 2001). Automaticity reflects the ability of a learner to perform mental operations with little conscious effort. Metacognition is a system of thinking that involves a learner's self-monitoring and prediction of performance on various mental tasks. Preexisting knowledge is knowledge learners bring to a new learning situation. Authentic tasks are learning situations which the learner views as personally meaningful and useful (Eggen & Kauchak). These constructivist principles are discussed in greater detail in the following sections.

Active Learning and Information Processing

Active learning occurs when people take control of their own learning and is recognized as being important for the development of understanding. Activities that support active learning have been studied under the term "metacognition," which has been defined as "people's abilities to predict their performances on various tasks [e.g., how well they will be able to remember various stimuli] and to monitor their current levels of mastery and understanding" (Bransford, et al., 1999, p. 12). Teaching practices which facilitate metacognition include those that focus on "sense-making, self-assessment, and reflection on what worked and what needs improving" (p. 12).

Another important element for the development of understanding is preexisting knowledge, or what learners bring with them to a learning situation. According to Bransford, et al. (1999), this preexisting knowledge "greatly influences what they [learners] notice about the environment and how they organize and interpret it. This, in turn, affects their abilities to remember, reason, solve problems, and acquire new knowledge" (p. 10). Preexisting knowledge is greatly influenced by how well the learner can remember what was previously learned.

Memory, particularly "working memory," plays a powerful role in learning. A component of information processing is "expert and novice" theory (Eggen & Kauchak, 2001). This theory includes the concepts of working memory and automaticity and is important to knowledge acquisition. Working memory is defined as the "information store that retains information as the person consciously works with it" (p. 261). Experts, after many hours of practice with a given task, attain highly organized structures [schemas] for ordering, or "chunking," information. Working memory "is enhanced when people are able to chunk information into familiar patterns" (Bransford, et al., 1999, p. 21). This ability frees working memory, permitting its more effective use. Novices are not able to chunk unfamiliar information, and subsequently working memory is over-extended. The expert has practiced a knowledge base of skills to a level of "automaticity - mental operations that can be performed with little awareness or conscious effort" (p. 262). Automaticity frees working memory so new information can be learned more readily.

Procedural Knowledge Acquisition

According to Eggen and Kauchak (2001), procedural knowledge is "knowledge of how to perform tasks," as opposed to declarative knowledge - "knowledge of facts, definitions, procedures, and rules" (pp. 263-264). Therefore, "declarative knowledge can be determined directly from a person's comments, whereas we infer procedural knowledge from the person's performance" (p. 264). Hence, developing procedural knowledge involves three stages:

- declarative knowledge - learners acquire knowledge about the procedure;
- associative knowledge - learners can perform the procedure but must think about what they are doing;
- automatic knowledge - learners can perform the process with little conscious thought or effort. (p. 268)

Additionally, Eggen and Kauchak emphasized the importance of context in acquiring procedural knowledge: "To become proficient, students [and teachers] should practice using procedural knowledge in a variety of contexts, which involves embedding problems and exercises in a variety of realistic settings" (p. 269). The present study concerns teacher proficiency, therefore procedural knowledge acquisition as it applies to teaching was deemed relevant.

One goal of this study included discerning the ways in which the designers of the program thought about issues of effective instruction during the design and implementation process of an HCA program. Several effective instruction principles may impact HCA designers' thinking and are addressed in the following discussion.

Effective Instruction

It was projected that issues of effective instruction would be applicable to the present study. There have been many exhaustive reviews of studies on the impact of teacher effectiveness (Bransford, et al., 1999; Brophy & Good, 1986; Eggen & Kauchak, 2001; Florida Department of Education, 1983; Weasmer & Woods, 1998). The extant research has indicated various specific teacher behavior indicators which either positively or negatively influence student achievement. Some of the effective instruction indicators include: teacher efficacy (Weasmer & Woods), use of time (Bloom, 1976; Brophy & Evertson, 1976; Coker, et al., 1976; Good & Beckerman, 1978; Medley, 1977; Stallings & Kaskowitz, 1974), organization (McCutcheon, 1980), communication (Kounin, 1970; Maddox & Hoole, 1975; Pompi & Lachman, 1967; Smith & Cotton, 1980), review and feedback (Brophy & Good; Eggen & Kauchak; Good & Grouws, 1979; Medley; Rosenshine, 1983; Wright & Nuthall, 1970), and interaction and questioning (Solomon, et al., 1964). Many of these indicators apply to HCA programs. Therefore, the need to examine how the HCA designers consider these and other effective teacher behaviors, or if they consider them at all, is important.

Teacher Efficacy

According to Weasmer and Woods (1998), teacher efficacy can be defined as "the perceived degree of effectiveness of instruction on learning" (p. 245), noting that teaching efficacy can exist on two levels: general teaching efficacy and personal teaching efficacy. General teaching efficacy is similar to outcome expectancy, such as when a person believes that "this [goal or objective] can be done," whereas personal teaching efficacy "is an individual teacher's belief in *her or his own* [emphasis added] effectiveness, a perception that may be situation specific" (p. 246). Eggen and Kauchak (2001) indicated "high-efficacy teachers believe that they can increase both motivation and achievement" among their students. In contrast, "low-efficacy teachers are less student-oriented, spend less time on learning activities, 'give up' on low achievers, and use criticism more than do high-efficacy teachers" (pp. 436-437).

Use of Time

Time on task is generally accepted by researchers as a precursor to student achievement. The effective teaching research base evokes this principle: If the teacher is efficient in the use of class time, then students will spend a high proportion of class time engaged in academic tasks, and achievement will likely be higher. Many researchers have found a strong correlation between time on task and student achievement (Bloom, 1976; Brophy & Evertson, 1976; Coker, et al., 1976; Good & Beckerman, 1978; Medley, 1977; Stallings & Kaskowitz, 1974). But, at least two conditions must accompany a task or activity if it is to be successful. The task must be appropriate for student capability, and it must be relevant to the learning task.

Organization

McCutcheon (1980) offered several effective teaching principles which address the importance of organization:

- If teachers attend to content, instructional materials, activities, learner needs, and goals in their instructional planning, then the resulting preparedness [can] increase the probability of effective classroom performance.
- If teachers plan, then they [can] experience more confidence, direction, and security in their performance in the classroom.
- If teachers attend to elements such as arrangement of the physical setting, selection of basic texts and materials, and familiarity with social and academic development of their

> students early in the year, then a framework for future planning is established for the year. (p. 18)

The effective teaching research base noted that planning is a means of organizing instruction and is also a source of psychological benefit to teachers (McCutcheon). For example, McCutcheon found that "planning functions as a means of organizing instruction and a source of confidence, security, and direction for teachers" (p. 19).

Communication

One entire domain in the Florida Performance Measurement System, a system for assessing specific areas of teacher competence, was devoted to communication (Florida Department of Education, 1983). The communication principles derived from the FPMS research base (e.g., (Kounin, 1970; Maddox & Hoole, 1975; Pompi & Lachman, 1967; Smith & Cotton, 1980) include:

- Teacher discourse that is thematically connected, vague terms minimized and questions asked singly and exactly will increase student achievement.
- Zestful teacher behavior which challenges the students when moving from one task to another will encourage students to become more work oriented and less disruptive.

- Positive non-verbal communication exhibited by teachers may increase student achievement and can be conducive to favorable student reaction.

Discovering whether or not, or how, communication principles influence the HCA program's design, was relevant to the present study.

Review

Review of lessons at various intervals has been shown to increase retention of subject matter and the amount of learning. According to several research studies, reviews at the end of a lesson are positively related to achievement, as are reviews at the beginning of new lessons. These studies further substantiate weekly and monthly reviews to sustain daily learning (Good & Grouws, 1979; Medley, 1977; Rosenshine, 1983; Wright & Nuthall, 1970).

Feedback

The ability of learners to generalize and discriminate among stimuli is vitally important for appropriate responses and for learning to take place. Feedback is "information learners receive about the accuracy or appropriateness of a response" (Eggen & Kauchak, 2001, p. 471). For feedback to be effective, it should be immediate and specific, provide corrective information, and have a positive emotional tone (Brophy & Good, 1986).

Interaction

In addition to the interaction of providing feedback, discourse among teachers and students can include questioning, explanations, clarification of concepts, and rephrasing. Feedback, questioning, explanations, clarification of concepts, and rephrasing have been shown to increase student achievement (Solomon, et al., 1964).

Summary

Many of the foregoing elements of effective instruction were applicable to the present study. Among the effective instructional indicators reviewed were teacher efficacy, use of time, organization, communication, review and feedback, and interaction and questioning. Because many of these indicators applied to the HCA project central to the present study, it was important that the present study examine how the designers considered them.

HCA Programs

Much information is available about technology enhanced programs. The literature addressed the explosion of online courses offered by colleges and universities and within the contexts of business and industry training programs (Chute, et al., 1998; Dede, 1990; DeVries, 1996; Dunn, 2000; Foell & Fritz, 1998; Macphearson & Smith, 1998; Palloff & Pratt, 1999; Thompson & Chute, 1998). Fewer technology enhanced programs were reported in the K-12 area (Cassidy & Lane, 1996; Dede, 1997; Dwyer, 1994; Filipczak, 1995; Mergendoller, et al., 1994). Fewer still were defined and reported as HCA programs. Upon examining the findings of the various HCA studies of this type (Dwyer; Dwyer, et al., 1990a, 1990b; Mergendoller, et al.; Ringstaff, et al., 1991; Sandholtz, Ringstaff, & Dwyer, 1994), several common themes became apparent: student achievement, student engagement, change in teacher beliefs about teaching and learning, and change in teacher and student roles.

Student Achievement

A landmark program designed to illustrate K-12 HCA applications and their effects on student achievement was the Apple Classrooms Of Tomorrow (ACOT) study (Dwyer, 1994). ACOT students and teachers had constant access to computers and other technology at home and at school, and could work on assignments or plan and conduct research on a flexible schedule in different settings.

Begun pre-World Wide Web in 1986, the ACOT study focused on the computer as the key change variable to increase student achievement. At the site in Memphis, Tennessee, the computers were used purposefully to raise student test scores. "Two years in a row the district reported that ACOT students had significantly higher scores on the California Achievement Test than students in non-ACOT classrooms in vocabulary, reading comprehension, language mechanics, math computation, and math concepts and application" (Dwyer, 1994, pp. 5-6).

A study similar to ACOT was the Utah Educational Technology Initiative (ETI). The Utah Legislature committed to educational technology with the "belief that such technology has the potential to increase student achievement, improve school functioning, influence curriculum change, contribute to teachers' professional growth, and help create an informed, capable, and productive work force" (Mergendoller, et al., 1994, p. 1). Using fifth grade scores from the 1993 statewide tests, the relationship between the duration of computer - assisted instruction in different subject areas and student achievement was examined.

ETI's results indicated a "mild but statistically reliable relationship ... between time spent doing math on a computer and 1993 math achievement test scores. More time learning math using a computer was associated with higher 1993 mathematics achievement test scores" (Mergendoller, et al., 1994, p. 5). As a result of ETI implementation for at least one semester, reading and math scores improved above expectations in lower performing elementary schools in the state during the school year reported. As indicated by the results of the ACOT and ETI studies, longer periods of time working on the computer contributed to higher student achievement. Student engagement was also a contributing factor to the increase of student achievement in the research results.

Student Engagement

Student engagement has been difficult to define operationally. Sandholtz, et al. (1994) have noted that student engagement has been linked to student achievement and other learning outcomes. In their report of the ACOT study, they conceptualized student engagement more broadly than the traditional definition of time-on-task by also considering "initiative, self-motivation, independent experimentation, spontaneous collaboration and peer coaching, enthusiasm or frustration, and time on projects both in and out of the classroom" (p. 3). Both positive and negative changes in student engagement were also noted.

Positive results, early in the ACOT project (Sandholtz, et al., 1994), included student enthusiasm and motivation when working with the computers. An elementary teacher reported that students requested a make-up session for a day when a field trip caused them to miss a computer club session. Another teacher noticed differences in students' journal entries: one student described spelling as "fun" and another declared, "A computer a day keeps the blues away" (p. 8). Another positive result was increased time spent on assignments and projects. When given free time, the students chose computer activities over other activities. They came in before and after school and during recess and lunch periods to work with the technology.

In addition to increased time spent on the computer, the students' on-task behaviors increased. One teacher reported: "This was probably the first time I've ever seen a whole group of students with actually every student on task and excited about their learning" (Sandholtz, et al., 1994, p. 9). Teachers also noted that students "who did not do well in a typical setting frequently blossomed when working with the technology" (p. 10). The teachers involved also reported that student initiative increased as a result of the project.

Sandholtz, et al. (1994) noted two ways that student initiative increased as a result of the ACOT project. First, basic assignments were extended by the students without teacher urging. For example, students in a first-grade classroom "independently decided to compile their stories into an illustrated book" (p. 10). Secondly, students "explored new applications and developed skills ... independently" (p. 11). Students created spreadsheets for keeping track of baseball cards and paper-route billings, and a group of boys formed a mystery story - writers group. As a result of this extended learning, some teachers encouraged these students to formally instruct their classmates and other teachers. With their newfound expertise, the students became more willing to take risks and experiment with the technology. Through this experimentation and risk-taking, the ACOT students learned to work independently, make their own discoveries, and share their knowledge with others.

The negative outcomes of the ACOT experiment included student frustration, time tradeoffs, increased student distractibility, setting assignment boundaries, and disruption of teacher plans. Students became frustrated with some software programs because the programs were either too boring or too restrictive (i.e., the software was too structured and did not allow for experimentation). Further, the featured computer software was too difficult for some students and too easy for others. Problems also occurred in the area of time management. Certain students spent an inordinate amount of time choosing fonts or graphics and not enough time on content. The noise and increased movement associated with a technology infused classroom distracted some students. One teacher removed all game software because the students became noisy and excited when using it.

Teachers experienced varying degrees of difficulty with students wanting to go beyond the requirements of assignments. Some teachers encouraged independence, while others felt that they had to "hold them [students] back a little bit" (Sandholtz, et al., 1994, p. 14). Disruption of classroom plans challenged many of the ACOT teachers. Several students were so eager to finish certain problems or assignments they ignored others. This was viewed by a few teachers as a significant problem, while other teachers saw it as a real opportunity for learning.

Change in Teacher Beliefs About Teaching and Learning

The process of change was not easy or simple in most cases. Changing one's beliefs about teaching and learning can be extremely difficult, if not impossible, for some teachers. The study completed by Dwyer, et al. (1990a) as part of the ACOT project reflected this difficulty. According to Part I of the Dwyer, et al. (1990a) study, "the process [teaching with HCA] is ridden with self-doubt, subject to external influence, exhausting, and never unidirectional" (p. 2). As one teacher reported: "You start questioning everything you have done in the past, and wonder how you can adapt it to the computer. Then, you start questioning the whole concept of what you originally did" (p. 2). This questioning of one's beliefs about teaching and learning provoked explorations into new strategies for instruction.

The direction of the changes in teacher attitudes was "towards a child-centered rather than curriculum-centered instruction; towards collaborative rather than individual tasks; towards active rather than passive learning" (Dwyer, et al., 1990a, p. 3). Each of these changes brought conflict within the participating teachers' deeply held beliefs about traditional schooling. For many of the teachers involved, a result of these conflicts was a gradual revision of their beliefs about teaching and learning.

In describing the patterns of change among teachers in the study, Dwyer, et al. (1990a) identified "the stages of evolution" of the change process: Entry, Adoption, Adaptation, Appropriation, and Invention" (p. 4). They defined these stages within the context of the ACOT experiment based on data obtained through teacher observations, teacher journals, and teacher interviews.

The entry stage included introducing computers and other technology into a traditional classroom that was previously text-driven and lecture-recitation-seatwork-based. The physical environment was radically transformed as computers, laser disk and CD ROM players, extension cords, wiring, and computers invaded the classroom. Instruction in this new environment found experienced teachers faced with "1st - year teacher problems: discipline, resource management, and personal frustration" (Dwyer, et al., p. 5).

During the adoption stage, teachers accommodated the technology to support traditional text-based practices. Although the physical environment changed, the instruction showed little change. Change in the adaptation phase occurred in several areas. Productivity emerged as a major theme, with students completing district-required curriculum in lesser amounts of time than before the technology infusion. Also, change in student engagement increased, as did students' enthusiasm for writing. These two stages prepared the teachers to move into the appropriation phase.

Appropriation was defined by Dwyer, et al. (1990a) as "the point at which an individual comes to understand technology and use it effortlessly as a tool to accomplish real work" (p. 6). It has been reported that this stage was difficult to find outside the ACOT study because there were very few classrooms with constant access to technology (Becker, 1987). The most important aspect of this phase as reported by the researchers was the increasing tendency of the participating teachers to "reflect on teaching, to question old patterns, [and] to speculate about the causes behind changes they were seeing in their students" (Dwyer, et al., p. 8). The invention stage was deemed to be a place - holder for further development by the ACOT teachers and the new learning environments they would create in the future.

Overall, the ACOT teachers "have become more disposed to view learning as an active, creative, and socially interactive process than when they entered the program. Knowledge tends to be viewed more as something children must construct and less like something that can be transferred" (Dwyer, et al., 1990a, p. 9). In addition, the ACOT research study advanced the notion that teachers' use of the computers was strongly correlated with their belief about technology effectiveness and that changes in this belief occur gradually and over time (Dwyer, et al.; Mergendoller, et al., 1994).

Change in Teacher and Student Roles

After four years, the ACOT classrooms were found to utilize a mix of traditional, lecture – recitation - seatwork, and nontraditional instruction. Teachers were interacting differently with their students, encouraging more collaboration among students and setting up their classrooms and daily schedules to permit more time for projects.

In the adaptation stage described previously, teacher and student roles began to shift noticeably. Teachers adopted team teaching, project-based collaborative instruction, and self-paced instruction at most sites. These adaptations provided the teachers opportunities to kid watch, and what they saw included students highly skilled with technology, able to learn on their own, and more collaborative than competitive in their approach to work. Student role changes precipitated the teachers' role to become more of a facilitator than a dispenser of knowledge, the ultimate mentor, the person who both challenges and nurtures (Ringstaff, et al., 1991; Web-Based Education Commission, 2000).

To document changes in teacher and student roles in a technology enriched school environment, the Ringstaff, et al. (1991) 5-year investigation utilized data from 32 teachers in five schools in four states.

Both Ringstaff, et al. and Web-Based Education Commission substantiated that students shifted naturally from roles of learner to those of mentor, teacher, leader, student expert, and subject-matter expert. Also noted were two important issues related to peer tutoring and collaboration. First, the more academically advanced students were not always the best classroom technology experts. Second, sharing of the expertise exhibited by student technology experts was not limited to their peers. Other teachers, administrators, parents, and community members also benefited from this expertise.

Summary

The information and research available about HCA programs provide a foundation for understanding the explosion of online courses offered by colleges, universities, and business and industry training programs (Chute, et al., 1998; Dede, 1990; DeVries, 1996; Dunn, 2000; Foell & Fritz, 1998; Macphearson & Smith, 1998; Palloff & Pratt, 1999; Thompson & Chute, 1998). But, there have been relatively fewer HCA programs documented at the K-12 level (Cassidy & Lane, 1996; Dede, 1997; Dwyer, 1994; Filipczak, 1995; Mergendoller, et al., 1994; Ringstaff, et. al, 1991; Sandholtz, et al., 1994).

Common issues that guided the design and development of HCA programs included cognitive and non-cognitive learner outcomes, student engagement, changes in teacher beliefs about teaching and learning, and change in teacher and student roles (Dwyer, 1994; Dwyer, et al., 1990b; Mergendoller, et al., 1994; Ringstaff, et al., 1991; Sandholtz, et al., 1994). This is not to imply that there are not other issues that could influence the design of HCA programs. What has not been found are empirical research studies that specifically addressed the thinking of those who design and implement HCA programs.

As stated previously, the goals of the present study were to: (a) examine the thinking of individuals who designed K-5 HCA programs, (b) examine in what ways the designers' thinking may have included purposeful attempts to base the development of HCA programs on principles of learning and effective instruction, and (c) examine how the design related to the implementation of an HCA project.

Few published reports have focused on the planning and implementation processes for K-12 HCA programs. No report or research has been found which solely examines the thinking of HCA program designers. As discussed and documented throughout this chapter, technology enhancement can be considered a common component in the realm of higher education. Currently, technology enhancement is becoming more prevalent as a means of instructional delivery in the K-12 arena. Therefore, obtaining an understanding of how learning theory research and effective instruction principles impact the design and implementation of these programs substantially elevates the present study's significance.

Chapter 3 provides a discussion of methods and procedures used to conduct the study. This discussion will be followed by a presentation of the results and findings of the study in chapter 4. Chapter 5 will conclude the study by providing general discussion of the findings, implications, and suggestions for further research.

Chapter 3

Methods and Procedures

This study sought to answer the overarching research question, "What was the thinking involved in the design and implementation processes of high-computer-access (HCA) programs?" The focus was upon one innovative HCA program. To accomplish this task, a case study was conducted on an HCA project implemented in a medium-size school district in the northeastern part of Florida.

This chapter describes the research methodology and procedures employed to address this question and the study's sub-questions, including: (a) in what ways did the participants take learning theory principles into account during the design and implementation of an HCA project; (b) in what ways did the participants take principles of effective instruction into account during the design and implementation of an HCA project; and, (c) did the implementation of the HCA project reflect principles of learning theory and effective teaching? This chapter describes the phenomena studied, the setting and participants, the research design, and the data collection methods.

Phenomena Studied

The specific project selected for this case study was chosen for several reasons. First, the project was considered by its developers and those responsible for its implementation to be an innovative HCA project. The project, begun in the summer of 2000, provided each child in 10 elementary classrooms in five schools a laptop computer with wireless remote access to a server. Access was accomplished by utilizing AirPort™ technology. AirPorts™ are devices that are wire-connected to a LAN and that transmit signals between the computer and the LAN; this process enables the HCA user to move about the environment. The purpose of the project was to provide wireless Internet and LAN accessibility to all students in these 10 classrooms.

Second, the project was a K-5 program, and was projected by the program developers to significantly impact teaching and learning. Future plans for this particular HCA project included broadening the wireless radio frequency access to the homes of each student. This was projected by developers to be accomplished by the placement of omni-directional radio frequency towers throughout the school district. Little of the literature reviewed contained information about technology enhancement in the K-5 arena, particularly at this level of sophistication; hence, the project was worthy of investigation.

Third, the design team for this project was unique because it consisted of both the normal administrative team plus the 11 teachers piloting the program. This team was responsible for the design and implementation of the project. The uniqueness of this teacher-led design team, along with the fact that the team had been given a high degree of autonomy in designing and implementing the program, was another reason this project was chosen. Documentation of the thinking processes evolved as team members designed and implemented an HCA program into their classrooms.

Fourth, the project's availability and the willingness of district administrators to share information about the project's design and implementation with the researcher contributed greatly to its being chosen.

Setting and Participants

The school district piloting the HCA project is located in northeastern Florida. The district encompasses an entire county, as do all school districts in the state, normally enrolling about 20,000 students overall. Approximately 9,000 (45%) of these students were in Grades K-5. The students participating in the HCA project, the focus of this study, were enrolled in five schools, ranging in student populations from 632 to 1,007 (Florida School Indicators Report, 2001).

The district student population socioeconomic status varied, ranging from lower socioeconomic status to upper-middle-class. Overall, the school district population average income was considered upper-middle-class, as indicated on district cost differential statistics provided in the Florida Department of Education's 2001-2002 funding summary report.

The administrative and faculty team members who planned and implemented the HCA project were the participants in the study. This team included a district administrative group who spearheaded the piloting of the program and who selected several teachers to participate in the program. In addition, other teachers were chosen by school-based administrators. The criteria used to choose the teachers who participated in the project were not overtly specified, except for the administrative team's desire to place the computers in a variety of elementary schools in a variety of grade levels. Five elementary schools housed teachers who participated in the project.

Some outside funding in the form of grants was used to support the project in the area of purchasing hardware and software. Additional outside funding was sought, but not obtained during the 1st year of implementation.

The HCA project's design team began meeting in the summer of 2000 and planned the project for 8 days over a 2-week period. Those who agreed to participate included five teachers and two school district administrators. Of the five teachers, one taught fifth grade, two taught fourth grade, one taught third grade, and one taught first grade. All but one teacher had at least one other participating teacher at the same school site.

Focus of the Study

The study had four research objectives: (a) to examine the thinking of the persons who designed and implemented a K-5 HCA program, (b) to examine the ways in which their thinking may have included attempts to base the development and implementation of HCA programs on principles of learning, (c) to examine the ways in which their thinking may have included attempts to base the development and implementation of HCA programs on the research of effective instruction, and (d) to examine how the design of the program related to its implementation. The research objectives were met by observing, interviewing, and reviewing related project documents of the decision-makers during the design and implementation phases of an HCA program within the framework of a qualitative, descriptive case study design.

Within the framework of case study design, interpretation of the data focused on finding patterns in order to understand the thinking of the decision-makers. Of particular interest was how the patterns reflected the thinking processes the decision makers did or did not purposefully follow to include principles of learning and effective instruction in the design and implementation of the program.

Research Design

The goal of this study was to investigate the thinking of those involved in the design and implementation of an HCA project. Thinking, as previously defined, implies beliefs and attitudes. Marshall and Rossman (1995) stated that if a study's research question includes ascertaining the salient behaviors, events, beliefs, attitudes, structures, and processes occurring in a phenomenon, then descriptive case study research is appropriate. According to Merriam (1998), a descriptive case study in education

> is one that presents a detailed account of the phenomenon under study ... [and is] useful in presenting basic information about areas

> of education where little research has been conducted. Innovative programs and practices are often the focus of descriptive case studies in education. Such studies often form a database for future comparison and theory building. (p. 38)

The descriptive case study method is useful in studies focusing on understanding a phenomenon of interest. Hence, case study methods are similar to methods employed in phenomenology. According to Merriam (1998), the characteristics of phenomenology include a concern with the essence or basic structure of a phenomenon, and the use of data that are the participant's and the investigator's firsthand experience of the phenomenon. Similarly, the aim of a case study is to produce a detailed and supported interpretation of the behavior and perspectives of others. Merriam stated that the two types of research, case study and phenomenology, can be combined, because both types focus on the essence or structure of an experience (phenomenon).

Detailed case studies of teaching using a variety of observational and interview procedures have frequently resulted in well-documented and insightful accounts of teachers' thoughts and practices (Calderhead, 1996). A renowned example of case study research was the Smith and Geoffrey (1968) study. Here, the contextual casting of the research question, data interpretation within the authors' own explicit perspectives and points of view, and the overall purpose of the study, to make sense of life in an urban classroom, necessitated a case study design.

Because the present study's primary purpose was to understand the thinking of technology enhancement designers, the interview method of data collection was appropriate. The interview method provides information that is "in and on someone else's mind" (Merriam, 1998, p. 71). Discovering what went on in the minds of the HCA designers was the focus of this study, so interview methodology was a suitable means of answering this question. Seidman (1998) described the usefulness of the interview method, noting that

> every word that people use in telling their stories is a microcosm of their consciousness ... [and] individuals' consciousness gives access to the most complicated social and educational issues, because social and educational issues are abstractions based on the concrete experience of people.... [A]t the root of in-depth interviewing is an interest in understanding the experience of other people and the meaning they make of that experience. (pp. 1-3)

Making sense of the phenomena being studied is the role of the observer in qualitative research. Eisner (1998) stated that "by being self-conscious of our own experience and its relationship to the phenomenal world, to make sense of the complex social scene in which we live, ... observations profit from a special kind of perception" (p. 182). The description of the observer's role corresponds with Eisner's definition of research "connoisseurship ... [that are] high levels of qualitative intelligence in the domain in which [the researcher] operates" (p. 65) and "the means through which we come to know the complexities, nuances, and subtleties of aspects of the world in which we have a special interest" (p. 68).

A defining characteristic of most qualitative studies is the self as an instrument. This characteristic is useful in that it alerts the researcher to nuances of the phenomena, allows for spontaneous generation of schema relevant to a domain, and serves to determine the significance of what the researcher should seek and focus upon. Without the identification of schema, no sorting of what is observed into categories of greater or lesser significance is possible (Eisner, 1998). The self as instrument role can be adequately assumed if the researcher has an adequate background suitable to the development of connoisseurship.

Having taught in an HCA environment for more than 5 years during the 1990s, I brought a personal perspective to the self as instrument role. The third and fourth grade students in my classroom had access to 13 computers, 2 networks, 2 Internet lines, a laser disk player, video projection, TV, VCR, and computer connections, and numerous software packages. As I struggled to learn and implement this myriad of technology into instruction, my view of teaching and learning began to change. I also discovered changes in my students' attitudes that affected their learning. Because of these previous experiences and the knowledge gained, I brought to the self as instrument role in the present study a sophistication and connoisseurship which assisted my endeavor to discover the designers' thinking while planning and implementing an HCA program. This role also brought to the study a depth of knowledge and the ability to see situations from several points of view with personal experience.

The self as instrument role can affect the validity and reliability of observations in qualitative studies. Seidman (1998) addressed qualitative research validity by concluding that

> the goal of the process is to understand how our participants understand and make meaning of their experience. If the interview structure works to allow them to make sense to themselves as well as to the interviewer, then it has gone a long way toward validity. (p. 17)

Internal validity of the findings rests upon what counts as evidence. Eisner (1998) likened qualitative studies to legal situations, noting that certainty is not required, but “only that there be no reasonable doubt about the validity of the verdict” (p. 109). His approach to ascertaining validity includes three sources of evidence in which educational criticism meets reasonable standards of credibility - structural corroboration, consensual validation, and referential adequacy. If the evidential criteria are met, then validity can be substantiated. Chapter 4 provides an explanation of these sources of evidence and how they assisted in the data analysis.

The present study's external validity was enhanced by triangulation of multiple sources of data. Data gathered and analyzed from interviews, observations, and documents strengthen the study's usefulness for other settings (Marshall & Rossman, 1995). Additionally, qualitative data analysis (QDA) software was utilized to extend the external validity. The Ethnograph™v5.08 software package assisted in coding, organizing, and clarifying the collected data. A detailed description of the QDA, the developer's research philosophy, and how the software package assisted in the data analysis are discussed in the following section.

The plan for data collection and analysis adhered to the concepts and models provided by learning theory, educational criticism, and the literature reviewed.

Data Collection Methods

A two-week planning workshop during the summer of 2000 provided an opportunity to observe and document data for the present study. A one-day observation visit was arranged during the two-week HCA project's planning workshop, with subsequent visits scheduled after the project's initial implementation.

After observing at the initial planning meeting, permission was obtained from a school district administrator to conduct in-depth interviews with the project's designers and observations of team meetings and classrooms. The HCA planning and implementation team consisted of 11 teachers and several school district administrators. Three administrators were more directly involved than the rest, and two of the three agreed to participate. Of the five teachers who agreed to participate, one taught first grade, one taught third grade, two taught fourth grade, and one taught fifth grade. There were five schools involved in the HCA project, and plans were made to visit as many schools and teachers as agreed to participate in the study.

Interviews and classroom observations were planned for the second semester of implementation, during a four-month period from January 2001 to May 2001. This timeline was utilized to allow for initial project implementation. Interview data were gathered during face-to-face interviews held at participating schools. Data were recorded via audio-tape and subsequently transcribed into a word processing format. Word-processed data provided manipulative ease for further analysis using QDA software. QDA software was utilized for data analysis purposes, and various packages were investigated for suitability. The data gathered from interviews, observations, and documents were then analyzed according to the data analysis plan that follows this section.

Descriptive case study design traditionally includes three data gathering methods and techniques - interviews, observations, and examination of artifacts and documents - to gain an in-depth understanding of the situation and its meaning for those involved (Merriam, 1998) and to provide a means for cross validation (i.e., triangulation of the data gathered). These three data sources were utilized for the present study and can be viewed in Table 1.

The process for gathering and analysis data was accomplished in three phases, as indicated in Table 1. Phase one included scheduling appointments for interviews and observations, recording the data either in audio or note form, and having the data transcribed into word-processed format. Hard copies of all the collected data were then printed.

Table 1

<u>Overview of Data Gathering and Analytic Procedures Across 3 Phases of the Study</u>

		METHODOLOGY EMPLOYED		
Data Source	Research Question(s) Addressed	Phase 1	Phase 2	Phase 3
Interview	Questions 1, 2, & 3: • "What was the thinking of those who designed an HCA program?"(1) • "In what ways did the designers purposefully think about learning theory <u>and</u> effective instruction principles?"(2, 3)	• Schedule face-to-face interviews • Conduct interview • Record interview on audio tape • Transcribe interview data onto disk and print hard copy	• Read and reread transcripts, utilizing ocular scanning • Notice "interesting" passages • Bracket "interesting" passages (Seidman) • Look for recurring ideas and concepts • Label ideas and concepts	• Place related ideas and concepts on map • Organize data on cognitive map • Utilize Ethnograph v5.08™ software • Code and sort data
Observation	Questions 2, 3, & 4: • "In what ways did the designers purposefully think about learning theory <u>and</u> effective instruction principles?"(2, 3) • "How does the HCA project design relate to implementation?"(4)	• Schedule workshop and classroom observations • Observe • Record field notes • Transcribe field notes data onto disk and print hard copy	• Read and reread transcripts, utilizing ocular scanning • Notice "interesting" passages • Bracket "interesting" passages (Seidman) • Look for recurring ideas and concepts • Label ideas and concepts	• Place related ideas and concepts on map • Organize data on cognitive map • Utilize Ethnograph v5.08™ software • Code and sort data

		METHODOLOGY EMPLOYED		
Data Source	Research Question(s) Addressed	Phase 1	Phase 2	Phase 3
Program Documents	Question: 4 • "How does the HCA project design relate to implementation?" (4)	• During observations and interviews, obtain document data • lesson plans • planning charts • professional development materials • Print program web site documents • Copy gathered documents' data onto disk and print hard copy	• Read and reread transcripts, utilizing ocular scanning • Notice "interesting" passages • Bracket "interesting" passages (Seidman) • Look for recurring ideas and concepts • Label ideas and concepts	• Place related ideas and concepts on map • Organize data on cognitive map • Utilize Ethnograph v5.08™ software • Code and sort data

Phase two of the data gathering and analysis process consisted of carefully reading and rereading the printed transcripts, e.g., ocular scanning, and noticing interesting passages, bracketing the passages, and determining recurring ideas and concepts (Seidman, 1998). Once the ideas and concepts were determined, they were labeled with a term that represented shared meaning.

After labeling the concepts and ideas gleaned from the data, the labels were organized on a concept map to reflect relationships between the concepts and to address the present study's research questions. The interview data were determined to be related to research questions one, two, and three (see Table 1). Observation data were sought to answer questions two, three, and four, and program documents data related most closely to question four.

In phase three of the data gathering and analysis process, the Ethnograph™ v5.08 software was utilized to code passages in the word-processed data files. The codes were derived from the labels previously assigned during phase two. After all the data files were coded, they were sorted by code. The sorted files were then printed into hard copies for additional reading and cross-referencing.

Table 1 provided an explanation and sequential order of the data gathering and analysis process. The interview, observation, and document analysis methods of data gathering are discussed singularly and in greater detail next.

Interview Method

Marshall and Rossman (1995) listed several strengths of the interview, including: (a) that it is a useful way to obtain data; (b) when more than one person is interviewed, the process gathers a wide variety of information across a larger number of participants; and (c) immediate follow-up and clarification of what is said is possible. Some weaknesses of interviewing noted by Marshall and Rossman include:

> (a) interviewees may be unwilling or uncomfortable sharing all that the interviewer hopes to explore, (b) the interviewer may not ask questions that evoke long narratives due to lack of skill, and (c) interviewees may not respond to the questions properly because they did not comprehend them. (p. 81)

These strengths and weaknesses were addressed during and after the interview process, data analysis, and interpretation with the following assurances.

To overcome the weaknesses listed by Marshall and Rossman (1995), general, open-ended questions and subsequent probing questions were developed. A conscious effort was made to elicit examples and specifics that illustrated the general descriptions the participants offered. Ross, Roberts, and Kleiner's (2000) *Protocols for Improved Inquiry* assisted in the development of carefully worded questions that helped "make their [the participants'] thinking processes visible" (p. 220). These protocols included questions such as: "What leads you to say that? Can you help me understand your thinking? What is the significance of that?" (p. 220). The general, open-ended questions used were similar for each participant, but did not follow a pre-determined order.

The interview questions were used to trigger a conversational exploration of the participants' views of teaching and learning in an HCA environment. Rubin and Rubin (1995) referred to the participant as a "conversational partner." This term "has the advantage of emphasizing the link between interviewing and conversation, and the active role of the interviewee in shaping the discussion" (p. 11). They also noted that the idea of the conversational partner infers "a congenial and cooperative experience, as both interviewer and interviewee work together to achieve the shared goal of understanding" (p. 11).

Extensive personal experience in an HCA environment provided me with expertise and understanding of the environment. Therefore, empathy, expertise, and understanding of the participants' experiences assisted in the development of a congenial and cooperative interview process. Sample questions, along with other probing questions, are provided in Appendix A. As previously noted, each interview was tape recorded and transcribed for later analysis. Ethnograph v5.08™ software was utilized to code and sort data. Interesting passages were indicated and recurring ideas and concepts were noted.

Observation Method

Observations of planning and development meetings and classroom implementation were also conducted. Field notes were constructed based on those observations. Observation as a research tool is a primary source of data collection. Just as interviewing as a tool is much more than having a casual conversation with someone, observation is much more than routine, day-to-day unconscious and unsystematic viewing of events. Observation becomes a research tool when it "(a) is planned deliberately, (b), is recorded systematically, and (c) is subjected to checks and controls on validity and reliability" (Kidder, 1981, p. 264).

Observations were also useful as a means of triangulating the study's findings. In conjunction with interviewing and document analysis, observations were useful in corroborating findings, thereby increasing validity. Through observation, the researcher learns about behaviors, with the assumption that behavior is purposive and expressive of deeper values (Marshall & Rossman, 1995). The researcher sees and hears firsthand in an observational setting, instead of relying completely on "once-removed accounts from interview" (Merriam, 1998, p. 96). This type of data gathering has a real time component not available with document analysis or interviewing; hence, observation permits the researcher to view behaviors firsthand within a context.

The observation method also provides contextual knowledge and reference points useful in planning and conducting subsequent interviews. Questions can be asked, such as: What were you thinking when you did or said so and so during the meeting? During interviews team members may not want to discuss dissensions or difficulties that may have occurred during meetings. Without first-hand observations, such information would not be known.

Observation provides a more holistic, three-dimensional view of what has been reported in one-dimensional interviews or in document analysis. For the present study, observations were done in participating classrooms over a two-month period during several regular school days. QDA was used to sort the data.

Based upon Eisner's (1998) four dimensions of educational criticism (i.e., description, interpretation, evaluation, and thematics), interview data and observation field notes were transcribed and analyzed. Therefore, observation provided a vital data gathering mechanism for the study.

Documents

Documents are a ready - made source of information are typically easy to obtain for analysis. Documents relevant to the study at hand encompassed a wide range of material, including lesson plans, scope and sequence charts, vision and mission statements, and web pages (Merriam, 1998). Document data can be used in a similar manner as interview and observation data. The data collected from documents should be guided by the research questions, the researcher's knowledge and experience of the content, and emerging findings.

Document analysis and archival data analysis are unobtrusive procedures that can be used for triangulation. Marshall and Rossman (1995) reported that as a supplement to interviews, "non-reactive research" can be used without arousing notice and can be collected with relative ease. For the purposes of the present study, document data, including planning and design notes, lesson plans, the project's web site, literature consulted by the team, and informational web sites utilized by the team were used.

Risk to Participants and Informed Consent

Due to the focus of the present study, the risks to participants were deemed to be minimal. Risks were discussed at the initial meeting with a school district administrator. The school district implementing the project required that the researcher be granted permission prior to conducting research in the district's schools and with district employees. A district-level administrator provided access to the project and employees after review of the research proposal. With such access, permission was granted to interview the persons responsible for the project's design and development, to observe design meetings and classroom implementation, and to view related documents utilized during the design process.

Participant risks were deemed minimal for a number of reasons. Such as, this was a public school district project and most of the planning and implementation were documented and could be easily accessed by any citizen. A letter of informed consent delineating the purpose of the study, possible outcomes, what could be expected, and a description of risks to and protections afforded the participants was drafted and provided to participants. A copy of the letter of informed consent appears in Appendix B.

As a condition for the study's approval, the University of North Florida Institutional Review Board advised that the Control Document - Confidential Data/Information form be utilized. (See Appendix C.) A person other than myself transcribed data from audio tapes, therefore the Control Document - Confidential Data/Information form was an appropriate measure to further ensure confidentiality.

Data were coded to simultaneously enable analysis and assist in protecting the identity of the participants. When transcribing interviews, initials and pseudonyms were used for all names so that if a casual reader were to come across the transcript, the identity of the participant would be protected. Confidentiality was discussed with the transcriber, the Control Document - Confidential Data/Information form was signed, and after transcription, the original audio tapes, transcripts, and computer disks containing the transcriptions were stored in a secured file accessible only to the researcher.

Data Analysis Plan

The data analysis plan was governed by two concepts: educational criticism and cognitive mapping. Educational criticism (Eisner, 1998) provides a structure for data analysis and includes four dimensions: description, which allows the reader to visualize context and process; interpretation, an explanation of the meaning behind what has been observed and heard; evaluation, value judgements as to what has been observed and heard; and thematics, identification of embedded themes which are then organized in a meaningful way. All the dimensions require a researcher who is a connoisseur and who therefore has the ability to discern and appreciate complex and subtle qualities. Cognitive mapping provides a mechanism to visualize what cannot be directly observed and can be used to organize important ideas, themes, and concepts derived from data analysis (Eggen & Kauchak, 2001; Eisner, 1998). Both concepts, educational criticism and cognitive mapping, are discussed in greater detail below.

Educational Criticism

To "illuminate a situation or object so that it can be seen or appreciated," the present study's data analysis process employed Eisner's approach to educational criticism (1998, p. 7). Included in this approach is the researcher's connoisseurship. Eisner defined connoisseurship as “the ability to make fine-grained discriminations among complex and subtle qualities” and as “the art of appreciation” (p.

63). Classroom environments are fertile places – filled with subtleties, interactions, and details. A connoisseur must attend to all that is relevant to a specific educational aim, in this case the thinking involved in the design and implementation of an HCA program.

Connoisseurship is the foundation for the process of educational criticism. According to Eisner, "anyone who is highly perceptive in some domain" is a connoisseur of that domain (1998, p. 7). Making the connoisseur's perceptions "seen and appreciated," that is, "provid[ing] connoisseurship with a public face," is the aim of educational criticism (pp. 85-86).

Based upon my own connoisseurship and upon ideas gleaned from relevant literature, particularly the ACOT study (Dwyer, 1994), I bracketed interesting passages and ideas and included margin notes in the transcripts as they were read and reread several times. From these bracketed passages and margin notes, repetitions and commonalities were marked and sorted into categories (Merriam, 1998; Seidman, 1998). The names of the categories were derived from the literature reviewed and my 5 years of teaching experience in an HCA classroom environment.

Merriam (1998) delineated several guidelines to determine the efficacy of categories, namely: that categories should reflect the purpose of the research; are the means for deriving answers to research question(s); and should be exhaustive, mutually exclusive, sensitizing (as sensitive as possible to what is in the data), and conceptually congruent, (that is, the same level of abstraction should characterize all categories). My connoisseurship and the information gleaned from reading related literature assisted in determining what I noticed during data analysis. The bracketed or underlined phrases were then sorted into categories based upon the participants' thinking during the HCA project's design and implementation. The categories, principles, concepts, and related participants' comments can be viewed in Appendix D.

The process I used for determining categories was similar to the process discussed by Seidman (1998). Seidman reflected on his own experiences in deriving categories:

> [categories] arise out of the passages that I have marked as interesting [and] when I reflect on the types of material that arouse my interest, it is clear that some patterns are present, that I have certain predispositions I bring to my reading of the transcripts.... The repetition of an aspect of experience that was already mentioned in other passages takes on weight and calls attention to itself. I notice excerpts from a participant's experience that connect to each other as well as to passages from other participants. Sometimes excerpts connect to the literature on the subject. They stand out because I have read about the issue from

a perspective independent of my interviewing. (p. 109)

The categories derived from this study's data were reflective of the literature reviewed and predispositions brought by my HCA experiences. To answer the present study's research questions, all data were analyzed using the above process. Notes and documents collected were also analyzed in this manner.

As stated previously, one purpose of educational criticism is to give connoisseurship a public face. The process of educational criticism includes four dimensions: description, interpretation, evaluation, and thematics.

Description. Description assists the reader in visualizing what a research setting or process is like. The description of the setting or process should enable readers to "participate vicariously in the events described" and to help the readers know how a situation feels or looks (Eisner, 1998, pp. 89-90). The descriptions of the research settings and processes included in the study were based upon interview and observational data. These descriptions can assist the reader in gaining insights into the complexities and nuances of the participants' environments.

Interpretation. Placing what has been described in a context and explaining its meaning are the goals of the interpretation dimension of Eisner's (1998) approach to educational criticism. Awareness of qualities is a hallmark of connoisseurship and is necessary for interpretation. Eisner noted that "what one can interpret depends initially on awareness. Without awareness interpretation is not possible" (p. 97). Interpretation depends upon researchers' ability to "distance themselves from the scene in order to explain its meanings and to account for what has been described" (p. 97).

Interpretation of the accumulated data included my connoisseurship, interpretative screens derived from the literature reviewed, and organizational assistance from a QDA software package, the Ethnograph™ v5.08. The software accommodated and posted coding for various phrases and passages that I determined were of interest and importance.

QDA. The Ethnograph v5.0™ was a viable QDA tool to assist in the data analysis. First, the software accommodated and organized the data according to my direction; the software did not discover or choose categories but rather merely reflected and assisted in the data interpretation. Second, the software provided a swift and accurate means of sorting, sifting, searching, and comparing the coded data files. This process was accomplished by the program's ability to automatically import and number, code, and search for segments within data files.

According to the Ethnograph v5.0™ developer, John V. Seidel (1998), the software was designed in alignment with his interpretation of QDA "as a process of noticing, collecting, and thinking about interesting things" (p. 1). He noted that the process has several characteristics, namely:

- It is iterative and progressive ... because it is a cycle that keeps repeating. For example, when you are thinking about things you also start noticing new things in the data. You then collect and think about these new things. In principle, the process is an infinite spiral.
- It is recursive ... because one part can call you back to a previous part. For example, while you are busy collecting things you might simultaneously start noticing new things to collect.
- It is holographic ... in that each step in the process contains the entire process. For example, when you first notice things you are already mentally collecting and thinking about those things. (p. 2)

These characteristics also reflect the thinking of several qualitative data analysis experts, namely, that QDA is a complex, recursive, iterative, and holistic process (Eisner, 1998; Marshall & Rossman, 1995; Merriam, 1998; Seidel, 1998; Seidman, 1998).

At this juncture, it should be noted that the complex, recursive, iterative, and holistic processes mentioned above are the researcher's processes, not processes determined by the developer of the QDA software. The process of noticing, collecting, and thinking about important things is strictly the domain of the researcher. It is from these processes that the researcher determines what data will be coded and how the data will be organized. The QDA software is simply a time and effort saving tool to assist in these endeavors. A sample page of a coded and sorted data file can be viewed in Appendix E.

Secondly, the QDA tool, Ethnograph™ v5.08, facilitates coding, sifting, organizing, and comparing data by providing an accurate, electronic means of manipulating the coded data. Because code words are embedded in the data file, the researcher can work back and forth between the parts and the whole of the data. Also, the researcher can readily review and reread the coded segments contextually. In addition to schema generated via use of the QDA software and my connoisseurship, interpretative screens from the literature were employed to assist in organization and data interpretation. Specifically, the concepts of thinking, learning theory research, and effective instructional research were considered standards for judging the worth of data interpretations; hence these concepts were utilized as interpretive screens.

Evaluation. Educational criticism's evaluation dimension involves making value judgments or comparing the interpreted data against one or more standards. As noted in chapter 2, concepts germane to the present study included thinking, learning theory, and effective instruction. In chapter 1, thinking was defined as cognitive thought processes composed of both ongoing action and prior personal experience, including self-reflection, decision-making, and prioritizing. Best practice in the form of learning theory research and effective instruction principles also provided standards to use in the evaluation phase of the educational criticism process. These standards functioned as interpretative screens during the fourth phase of educational criticism, thematics. They were chosen as standards because they assisted in answering the study's overarching question: "What was the thinking of those who design and implement an HCA program?"

Thematics. The fourth dimension of educational criticism is thematics. Eisner (1998) reported that the "theme, embedded in the particular situation, extends beyond the situation itself" and can be applied to other situations through a process known as "naturalistic generalization" (p. 103). The results of the process are "recurring messages that pervade the situation about which the critic writes" and are the "dominant features of a situation" (p. 104). The themes generated from the present study's data analysis, interpretation, and evaluation in effect summarized the essential features of the designers' thinking.

Cognitive Mapping

In order to visualize what cannot be directly observed, a model, or cognitive map was designed to organize important ideas, themes, and concepts derived from the data. According to Eggen and Kauchak, organization is the "process of clustering related items of content into categories or patterns that illustrate relationships" (2001, p. 274). Cognitive mapping provides a visual, organized means of connecting ideas and concepts. Therefore, a plan was devised for the utilization of cognitive mapping in an effort to bring order, structure, and meaning to the collected data.

To further facilitate the cognitive mapping process, Inspiration ® (Inspiration Software, Inc., 2002) computer software was used. The software permits the user to move, rearrange, and change concept maps with ease. Ideas, themes, and concepts can be typed in outline form and the software automatically organizes the outlines as concept maps. A detailed explanation of the software and how it assisted in the cognitive mapping process is discussed in chapter 4.

Limitations of the Research Design

Chapter 1 provided a discussion regarding limitations of qualitative research design, in particular descriptive case study. General limitations of qualitative research include utilization of small samples, lack of comparative groups, or lack of feasibility for replication. Despite these limitations, much can be learned from a descriptive case study, particularly one framed with Eisner's (1998) educational criticism analysis design. The following discussion further addresses the general limitations accorded qualitative research design.

A qualitative study's transferability, or generalizability, is frequently noted as a weakness. Merriam (1998) reported that part of the difficulty lies in thinking of generalizability within qualitative settings in the same way as investigators perceive of generalizability within experimental or correlational designs, where the ability to generalize to other settings or people is purportedly assured through a priori conditions. But, even within these quantitative design structures, generalizations are typically made within specified levels of confidence.

Merriam (1998) also argued that "applying generalizations from the aggregated data of enormous, random samples to individuals is hardly useful" and "a single case or small nonrandom sample is selected precisely because the researcher wishes to understand the particular in depth, not to find out what is generally true of the many" (p. 208). Donmoyer (1995) reiterated this opinion by observing that:

> Those who study research utilization ... indicate that all research, even research that works with large, randomly selected samples, must always be used heuristically. Because of the idiosyncracies that shape people, places, and events, research can never provide prescriptions for practice. Rather ... it serves a problem-posing function, not a problem-solving one. Research can raise new and interesting questions, provide novel perspectives, and suggest issues that may not have come into focus before. (p. 77)

Marshall and Rossman (1995) have stated that qualitative researchers can overcome the above mentioned challenges by

> referring back to the original theoretical framework to show how data collection and analysis will be guided by concepts and models. By doing so, the researcher states the theoretical parameters of the research. Then those who make policy or design research studies within those same parameters can determine whether or not the cases described can be generalized for new research policy and transferred to other settings, while the reader or user of specific research can see how research ties to a body of theory. (p. 144)

In other words, a study's internal validity is paramount to its transferability and application to other situations.

As stated in chapter 1, the role of self as a research tool was determined to be a limitation for this study. However, by functioning within the typical guidelines of case study research and adhering to these conventions during the process, this limitation was lessened.

Summary

This study focused on one innovative HCA program with a goal of discovering the thinking involved in the design and implementation processes of HCA programs. To achieve this goal, a case study design was chosen. The aim of a case study design was to provide detailed and supported interpretation of others' behaviors and perspectives. Detailed case studies of teaching, using a variety of observational and interview procedures, have frequently resulted in well-documented and insightful accounts of teachers' thoughts and practices (Calderhead, 1996). Because case study design generally includes three data collection methods and techniques, (namely interviews, observations, and examination of artifacts and documents) each of these approaches to data collection was included in the study. Data interpretation and analysis proceeded with the use of two concepts: cognitive mapping and educational criticism. Chapter 4 presents how these concepts influenced data interpretation and analysis. The study concludes with Chapter 5, which provides a general discussion of the findings, implications, and suggestions for further research.

Chapter 4

Data Presentation, Analysis, and Interpretation

The purpose of this study was to describe the thinking involved in the design and implementation of an HCA program in elementary school settings. The overarching research goal was to examine the thinking of the persons who designed and implemented a K-5 HCA program. Research goals included: (a) examining ways in which the designers' thinking may have included attempts to base the development and implementation of the HCA program on principles of learning; (b) examining ways in which the designers' thinking may have included attempts to base the development and implementation of the HCA program on effective instruction research; and (c) examining the continuity between the conceptualization of the program as expressed by the designers thinking and the actual implementation of the program in the classroom.

The presentation of data has been organized into several sections including: (a) data analysis strategies; (b) participants; (c) Phase 1 –

category development; (d) Phase 2 -- theme development; and (e) Phase 3 - outcomes, conclusions, and results.

Data Analysis Strategies

As described in the previous chapter, the strategies used for data analysis included cognitive mapping, the application of qualitative data analysis software, connoisseurship, and Eisner's (1998) sources of evidence used in educational criticism.

In order to visualize complex processes that cannot be directly observed, a model, or cognitive map, was designed to organize important ideas, themes, and concepts gleaned from the data. Next, hand drawn maps were constructed for each participant's interview transcripts. The method of connecting ideas and concepts has been effectively used as a qualitative technique and was selected to facilitate the organization of the data and to provide a strategy for initial data analysis.

Another strategy for data analysis was the utilization of a QDA software program, the Ethnograph™ v5.08. This program permits the user to identify passages deemed important, using key words for future sorting. The software was used to search the transcribed interview text for key concepts and themes identified by the review of the literature and related research.

A third strategy used for analysis of the data might be best described as connoisseurship. Connoisseurship is an ability to recognize the nuances and subtleties of a phenomenon based on expertise and experience. One of the reasons for selecting this topic for study was my experiences and expertise in HCA environments.

Finally, Eisner's sources of evidence used in educational criticism: structural corroboration, consensual validation, and referential adequacy, were utilized for data analysis (1988). Eisner defined these sources of evidence as follows: (a) structural corroboration as the "means through which multiple types of data are related to each other to support or contradict the interpretation and evaluation of a state of affairs"; (b) consensual validation consists of "an agreement among competent others that the description, interpretation, evaluation, and thematics of an educational situation are right"; and (c) referential adequacy as "the expansion of perception and the enlargement of understanding" (pp. 110-113).

A visual representation of these four strategies - cognitive mapping, the application of qualitative data analysis software, connoisseurship, and Eisner's sources of evidence used in educational criticism - can be viewed in Figure 1.

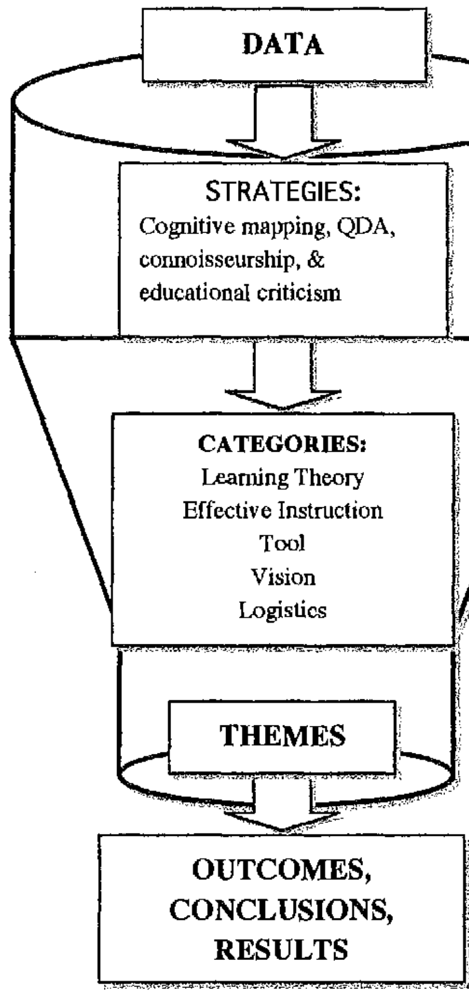

Figure 1. Illustration of data analysis strategies.

Participants

The participants in the present study were 14 members of the design team of an HCA project in a medium-size school district in northeast Florida. From this group, five teachers and two school district administrators agreed to participate in the study. Of the five teachers, one taught fifth grade, two taught fourth grade, one taught third grade, and one taught first grade. All but one teacher had at least one other participating teacher at the same school site. Both of the district administrators were actively involved in the development and implementation of the project and were highly experienced in the utilization of instructional technology.

As described previously, a validated interview protocol consisting of several open-ended questions was used to elicit responses from the participants (see Appendix A). The responses were tape recorded, transcribed into computer format, and served as the primary source of data.

Throughout the presentation of data, pseudonyms were used in lieu of the names of the actual study participants. The use of pseudonyms in discussing the data disguises gender, job title, and the participants' position in order to provide some measure of confidentiality. The pseudonyms selected were Zach, Nancy, Leah, Ronnie, Chris, Jamie, and Victor. These pseudonyms furnish organizational reference points for the reader while providing a measure of participant confidentiality.

Phase 1 Data Analysis: Category Development

The process used for determining categories was similar to the process discussed by Seidman (1998), who said,

> I notice excerpts from a participant's experience that connect to each other as well as to passages from other participants. Sometimes excerpts connect to the literature on the subject. They stand out because I have read about the issue from a perspective independent of my interviewing. (p. 109)

Within the study, the recurrent and connecting participants' passages, literature reviewed, learning theory research, effective instructional research, and my own personal experiences in HCA environments influenced how categories for data analysis, interpretation, and theme formulation were processed.

Because the overarching purpose of the present study was to determine the thinking of HCA program designers, the first step in the data analysis process was to begin the development of an initial cognitive map that could illustrate the designers' thinking (see Figure 2). The label of *designer's thinking* was placed in a circle at the center, representing the participants' articulations. Circles were placed around this concept to represent categories derived from the data.

Categories gleaned from data analysis and interpretation included: (a) computer as a teaching or learning tool, (b) concepts from learning theory research, (c) concepts from effective instruction principles, (d) logistics, and (e) vision.

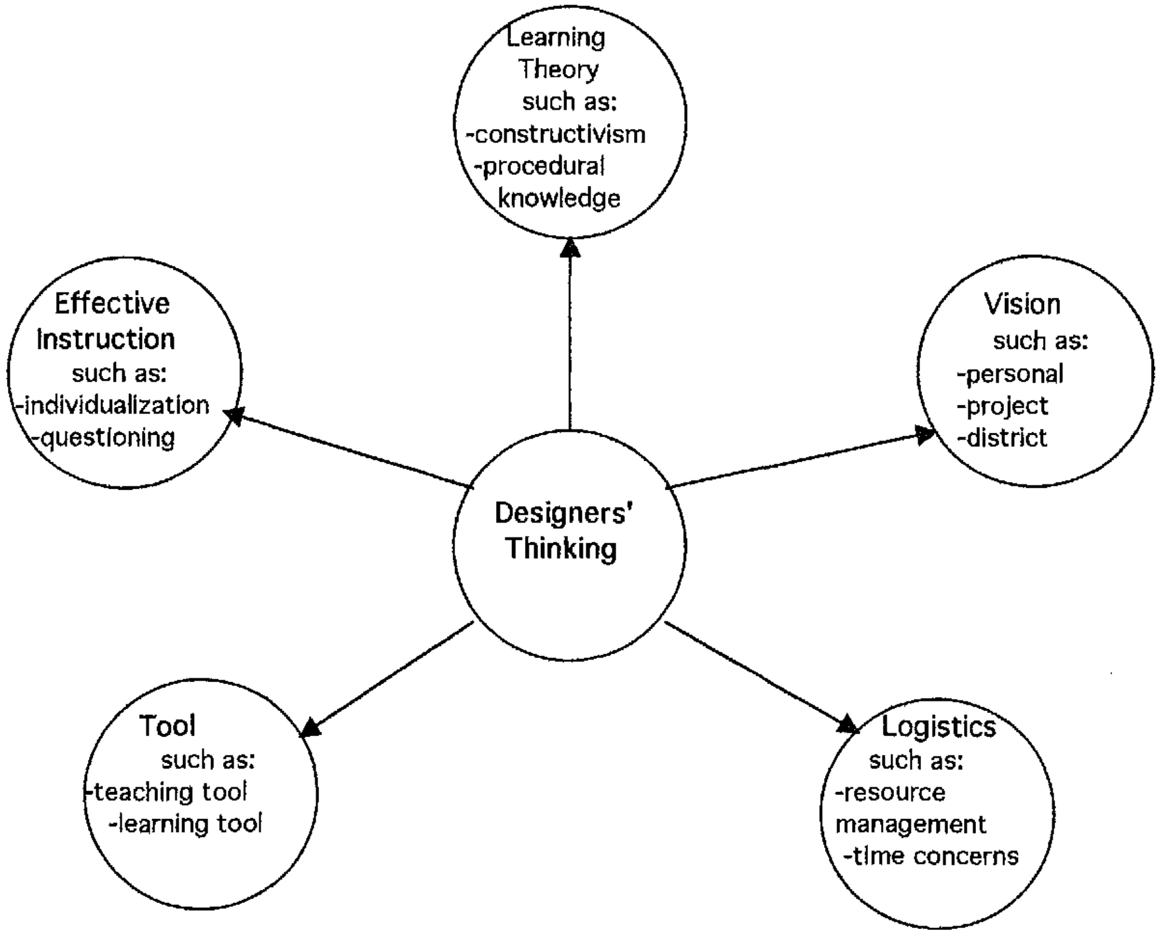

Figure 2. Category development concept map.

The categories derived were reflective of themes found in the literature reviewed and predispositions brought by my HCA experiences to the data at hand. To answer the research questions, all data were analyzed using the above processes. Notes and documents collected were also analyzed in this manner. The categories with supporting phrases and passages are discussed next and can be viewed in Table 2.

Table 2

Categories and Concepts Related to Designers' Thinking

Learning Theory	Effective Instruction	Vision	Tool	Logistics
• constructivism • student achievement • metacognition • working memory • interaction • procedural knowledge acquisition	• individualized instruction • student engagement • teacher efficacy • interaction-questioning • risk-taking • role-change • organization • planning	• individualized instruction • empowering learners • fuller integration of technology • becoming a better educator	• reflection upon teaching • questioning old patterns • speculating about causes of changes teachers were seeing in their students	• appropriation • entry • procurement • maintenance • adoption • time • student frustration

Learning Theory

Based on the initial phase of analysis, it was determined that various concepts of learning theory were evident in the designers' thinking about the HCA project during the design and implementation stages. These concepts included constructivism, student achievement, metacognition, working memory, interaction, and procedural knowledge acquisition. The concepts are discussed in greater detail below (see Table 3).

Constructivism, student achievement, and interaction. Reflected in the interviews were various learning theory principles, particularly the concepts of constructivism and student achievement. One definition of constructivism is the "process whereby new meanings are created

Table 3

Designers' Thinking Related to Learning Theory

Category	Principles and Concepts
Learning Theory	• constructivism • student achievement • interaction • metacognition • working memory • procedural knowledge acquisition

by the learner within the context of her or his current knowledge ... and [the process] is to some degree both personally and culturally relative" (Yakimovicz & Murphy, 1995, p. 203). Leah's comments mirrored this definition in part when relating the teachers' desired result of teaching in the HCA classrooms, "Part of the dream that the teachers came up with is that this [the HCA environment] is the personal pathway to learning."

The designers' comments relating to the HCA project included a belief that an HCA environment would be personal for the students and open pathways to learning. As indicated above, constructivism is to some degree both personally and culturally relative. Jamie reflected a personal goal relative to learning by saying, "My goal ... was to increase my knowledge of how to be a more effective educator." This statement implies a belief that an increase in knowledge would result in a more effective teacher. In addition to reflections upon developing teaching competence, the participants also believed that an HCA environment would be a personal pathway to learning for their students, thereby increasing student achievement.

Dwyer (1994), through the ACOT project, found that student achievement outcomes were dominant in participants' thinking. ACOT students and teachers had constant access to computers and other technology at home and at school. The ACOT researchers and participants assumed that constant access to the computers would raise student test scores. Zach, when reporting on student achievement, echoed this goal, "I think they'll get there faster than other students at their age because they'll have the know-how and the expertise." Zach's thinking about the HCA project included his belief (vision) that the students would achieve beyond their age level because of the technology. In the interview transcripts, Jamie reported that the HCA environment could "bring them up to the same level that some of the more affluent areas have" focusing on increasing student achievement among lower socioeconomic status students in the school district.

Mentioned at the beginning of this section, the data contained numerous overt or inferred references to learning theory, particularly principles of constructivism. Central to the participants' thinking were concepts such as interactive, personal, meaningful, contextual, and collaborative. Leah and Ronnie used "personal" overtly when describing how the HCA program affected students' learning. Leah said, "This personalized learning path means that you really are incredibly deep in any one subject." Ronnie used the same terminology, stating, "This year has allowed me to use more personal connections, using the technology."

Victor similarly referred to personal meaning for his students, "We had all of our kids on FCAT [Florida Comprehensive Assessment Test] Explorer. That was prior to the FCAT testing and they loved it. They were in charge of where they were.... So there's certain things that have more meaning to them as they study." Victor conceived that allowing the students to be in charge of their learning promoted a higher degree of meaning. Victor also discussed the importance of meaningful learning, by saying, "They love those pictures [images the students copied from the Internet]; it's personal when they do things like that and that's what the [HCA] program has kind of done--it's made education so much more personalized."

Likewise, Nancy addressed personal and meaningful connections between her class and one student's father:

> We have one student whose dad is on a Navy ship and he and the grandparents absolutely love it [class web page]. It's been wonderful. So we update it for the dad so that he can log on each week and we have that little message for him.

Nancy went on to acknowledge that the correspondence with the student's father via the class web page provided the students with personal and meaningful opportunities for learning.

In addition to acknowledging meaningful and personal connections to learning by utilizing the HCA environment, participants recounted the collaborative and social aspects of the HCA classroom, in particular Nancy, who said, "They're so eager to work with each other and the problem solving skills.... I have so many experts in here." Or, as Jamie put it:

> I think [HCA allowed for] focusing more on projects of that nature where they're either working by themselves or with a peer or small group even.... You have to let them explore more and so you have to let them talk and so there's the socialization in the classroom; it is much more than it ever has been in my room before. But it's been good because they're helping one another.

Nancy and Jamie noted that their students were eager to work together and help each other as a result of the HCA implementation. Also noted was an increase of social activity among the students in the HCA environment. The children are "eager to work with each other," "you have to let them talk," "they're helping each other" and, "they're either working by themselves or with a peer or small group" were phrases that indicated the collaboration and socialization inherent in a constructivist environment.

Apparent in the previous excerpts were indications of interactive learning within a meaningful context. Leah described a first-grade child discovering the meanings of new words and how a class presentation evolved from the child's efforts. This account furnished an illustration of interaction within a meaningful context.

> She was given a web site to look up Christmas customs around the world and couldn't read all of the words, and she wasn't going to let a little thing [like not knowing the words]get in her way... now, this is strategic learning at its finest for a first grader, for a 6-year-old. She copied all the words, put them into Simple Text, and let Simple Text read it to her over and over again until she could actually read the words. She taught herself to read the words and then made this fantastic Hyper Studio™ stack for Monday morning.

Descriptions of students' socialization were often coupled with the notion of interaction, as noted previously by Nancy and Jamie. In addition, project planning documents clearly indicated that interactive instruction was a goal of the project's designers, as indicated by these excerpts from the documents' notes: "active learner; flexible, fluid groups; simulations, lots of hands-on activities; kids share." These words reflect the HCA project designers' conceptualization of interactivity with the computers and technology in an HCA environment.

Metacognition and working memory. Intricately related to the participants' thinking and evident in the present study's data are two additional principles of learning theory, *metacognition* and *working memory*, that provided a basis for the learning theory category. A component of information processing, metacognition has been defined as "people's abilities to predict their performances on various tasks and to monitor their current levels of mastery and understanding" (Bransford, et al., 1999, p. 12). Phrases from the participants' interview data indicated an awareness of students' metacognition. In particular, Leah reported, "They've become empowered to decide what they need to consume and learn in depth...They are becoming pretty intelligent consumers. The kids are finding resources, and then they're evaluating each other's resources." Ronnie described how students decided to research and present material in different ways, "They may have had the same assignment, but on their own they presented it in such different ways." Taken together, these comments indicated that Leah and Ronnie recognized students' use of metacognition in their knowledge acquisition.

Working memory has been shown to be a vital component in knowledge acquisition and "is enhanced when people are able to *chunk* [italics added] information into familiar patterns" (Bransford, et al., 1999, p. 21; Eggen & Kauchak, 2001). Chunking frees working memory, permitting its more effective use and leads to a level of "automaticity--mental operations that can be performed with little awareness or conscious effort" (Eggen & Kauchak, 2001, p. 262). In thinking about the desirability of working memory, Jamie reported, "I installed a keyboarding program so that they could polish their keyboarding skills." Jamie purposefully provided opportunities for students to enhance their working memory performance. Victor provided an opportunity for students to place information into familiar patterns by taking students on a virtual tour of a site before actually visiting it: "We'll take a virtual tour before we go there. They'll learn a little of the history so that when we go to the fort, they'll say, "Oh, Mr. [Victor], I remember."

In the literature reviewed (e.g. Bransford, et al., 1999; Eggen & Kauchak, 2001), the significance of working memory and metacognition were identified and subsequently validated by the evidence provided by the participants.

Procedural knowledge acquisition. Another outcome from the first phase of data analysis was the importance of procedural knowledge acquisition. Procedural knowledge is knowledge of how to perform tasks and involves three stages: declarative, associative, and automatic (Eggen & Kauchak, 2001). The context in acquiring procedural knowledge is important, because, to become proficient, learners should practice using procedural knowledge in a variety of contexts that involve the embedding of problems and exercises in realistic settings. The HCA project provided a natural, hence ideally realistic, setting.

As reported by the participants, students' and teachers' learning was thought to be accelerated due to the HCA environment. Becoming effective instructors and students in an HCA environment required quickly obtaining expertise in applied hardware, software, and trouble-shooting skills. The participants' numerous references to fast and intense learning to obtain the skills necessary for software and hardware applications demonstrated the learning theory category of procedural knowledge acquisition. Therefore, data analysis resulted in the concept of procedural knowledge acquisition and is summarized here. Vignettes and excerpts that reflect procedural knowledge acquisition are discussed below within the framework of the three stages of development of procedural knowledge.

Learners functioning in the *declarative stage* acquired knowledge about a procedure or process, as evidenced in the following comments:

> We went through all the things on the outside, the ports, the handle, where you plug it in, everything about that. Then for 2 days we went through all the keys that they needed to know how to do, the screens, the names of all the different things. It was a week of training before the machine was ever even turned on which made the [implementation] go much faster. (Zach)

> Setting up the AirPorts™ was an incredible amount of work .... At the beginning of the year I would get done around 11:30 at night and be at it at 4:00 in the morning and that was pretty much straight through.... It's a new program and you're being a pioneer and it takes a lot of work and none of us really know how to get them up and running. And then a lot of the trouble-shooting, I've had to learn myself. (Nancy)

Zach discussed acquiring knowledge about the iBooks' operation and parts as well as sharing of the knowledge with his students. Nancy told of the many hours it took for her to learn about and configure the AirPorts™. Together, the above comments indicated that Nancy and Zach, along with their students, were learning about the processes and procedures required for teaching and learning in an HCA environment and were functioning within the declarative stage of procedural knowledge acquisition.

In procedural knowledge acquisition's second stage, *associative*, learners can perform a procedure or process but must consciously think about what they are doing. Such indications of this stage were reported by Zach. He overtly stated that "it's harder to *think* ... [italics added]" indicating that he was consciously aware of what he was doing.

> Once you get better at it, it gets easier. It's harder to think of the different skills during the beginning, but then once you've done some more, it just gets easier as it goes. The kids were new to the computers. They would do things inadvertently that would cause a problem and then you have to figure out what they were. We spent hours and hours just trying to make sure that everyone's machine was up and functional. (Zach)

Jamie also indicated that Zach progressed through the associative stage by writing step-by-step instructions as he was learning how to configure the AirPorts™:

> He [Zach] was determined to configure the AirPort™. He sat down and got one of his working and gave us all step-by-step plans. I sat down and did mine the way he told us to do it and the three little lights on the front of the AirPort™ all started blinking like red and orange, and it looked like the little AirPort™ was going to take off. We configured them at the beginning of the year, and I haven't had a problem with them since then.

Nancy described Victor's comments in regard to his learning experience during the associative stage.

> And he's looking at it like, okay, give it to me for another year now that I've gotten all of this [experience] under my belt and can troubleshoot ... and I think next year, having all of that training under my belt, I'll be able to really even take this that much further. I'm anxious to see because this is a real learning year for me and I've accomplished so much, and I just can't wait to see what I'd do with another class.

Consciously thinking about the process of configuring AirPorts™ and taking inordinate amounts of time and effort to acquire new trouble-shooting skills are represented in the previous comments and reflect the associative stage of procedural knowledge acquisition.

The final stage of procedural knowledge acquisition, *automatic*, where learners can perform the process with little conscious thought or effort, was evidently achieved by several participants and students. For example, "They're using [keyboarding software] so their keyboarding skills are right there. None of that hunt and peck." According to Jamie, "Things were just really clipping along. I wasn't having the maintenance problems nearly as bad [sic]. I think it's because the children were becoming more adept and better at figuring out, well, this might be the problem, why it's doing this. They would try things on their own."

> I'll hit the floor running because the problems and things that I encountered in the beginning of the year, like networking and stuff like that, I won't have those; we can move a lot faster and we can get a lot more done .... But there's still a lot that I would like them to learn. They can trouble-shoot a lot on their own just because of what happens in here. (Zach)

Effective Instruction

In addition to participants' references to principles and concepts supporting the learning theory category, other comments supported notions of effective instruction. Therefore, the category of Effective Instruction was developed. This category included several concepts and principles of effective instruction: individualized instruction, student engagement, teacher efficacy, interaction and questioning, risk-taking, role-change, organization, and planning (see Table 4).

Individualized instruction. Individualized instruction, a principle of effective instruction, was an HCA goal. The interview data reported here referred to the concept of individualized instruction.

Table 4

Designers' Thinking Related to Effective Instruction

Category	Principles and Concepts
Effective Instruction	• individualized instruction • student engagement • teacher efficacy • interaction & questioning • risk-taking • role-change • organization • planning

The overarching goal of the HCA project was to individualize instruction. This was partially accomplished by providing an Internet capable wireless device for all participating students in the project. Interviewees and program documents regularly reported the importance of individualized instruction goals: "so much easier than you could do it in a whole class setting" (Jamie); "to individualize the program of study" and "to have some sort of individual device" (Leah); and "move [away] from whole class" (project planning documents). These comments reflected the participants' thinking about a move to a more individualized teaching environment as a result of the HCA project's implementation.

Student engagement. A principle of effective instruction, student engagement, has been difficult to define operationally. Sandholtz, et al. (1994) have noted that student engagement included time-on-task, initiative, self-motivation, independent experimentation, spontaneous collaboration and peer coaching, enthusiasm or frustration, and time spent on projects both in and out of the classroom. An example was given in a comment made by an ACOT teacher (Sandholtz, et al., 1994) regarding her students' engagement with the computers – "when given free time, the students chose computer activities over other activities. They came in before and after school and during recess and lunch periods to work with the technology" (p. 3). The participants in this study reported similar experiences with the students in their classes, as illustrated here by Victor's comment, "If they have certain free time or if I just have them researching something, once again, they're not all in the same book at the same time looking at the same thing."

Additionally, Sandholtz, et al. (1994) noted that students' on-task behaviors increased. One ACOT teacher reported, "This was probably the first time I've ever seen a whole group of students with actually every student on task and excited about their [sic] learning" (p. 9). The ACOT teachers indicated student initiative increased as a result of the project.

Specifically, basic assignments were extended by the students without teacher urging. For example, students in a first-grade classroom "independently decided to compile their stories into an illustrated book"

(p. 10). Secondly, students "explored new applications and developed skills ... independently" (p. 11). As a result of this extended learning, some teachers encouraged these students to formally instruct their classmates and other teachers. With their newfound expertise, the students became more willing to take risks and experiment with the technology. Through this experimentation and risk-taking, the ACOT students learned to work independently, make their own discoveries, and share their knowledge with others.

Participants in the HCA project described similar incidents: "one of the stories they had to read independently was about some coins, so they went and researched about coins all over the world, and then they pulled that in" (Ronnie); and, "I never thought I'd see first graders looking for multi-sources on things, or third graders or fifth graders. They've really kind of leaped into this" (Leah). Ronnie and Leah shared that students learned to work independently and made discoveries individually. Zach and Nancy explained how students shared their knowledge with others. Zach said, "They're teaching me some shortcuts. They picked up on how to find shortcuts and how to use them. How it's progressing is the students drive the curriculum." Nancy agreed, stating, "And there's things like they'll definitely get into something and I say we have to stop now and you hear like, 'No!'... It's just such excitement."

Teacher efficacy, interaction, and questioning. Eggen and Kauchak (2001) reported that effective instruction is a combination of teaching behaviors that promote student learning and contribute to productive learning environments. Research-based effective instruction indicators included teacher efficacy, interaction, and questioning. Thinking about and modifying teaching behaviors as a result of the HCA program were evident in the participants' remarks and assisted in answering the present study's fourth question, "How does the HCA program as implemented reflect the thinking of the program designers?"

Teacher efficacy has been defined as a perceived degree of effectiveness of instruction on learning; or more specifically, it is an individual teacher's belief in her or his effectiveness to increase both motivation and achievement among students (Eggen & Kauchak, 2001; Weasmer & Woods, 1998). Several participants' comments documented their conscious efforts to improve their instructional effectiveness with perceived results. Zach reported changing his instructional goals to a more academic focus as opposed to a focus on teaching the technology. "Once you get better at it [teaching with the technology], it gets easier.... But I think my technical goals have lowered and my academic goals have shifted" (Zach). Noting students being overwhelmed with information, Victor made a conscious effort to provide an easier method for the students to search and find information on the Internet. "I said I really want to get them on the Internet but they're just flooded with information so I started playing with [Internet browser software]." Ronnie related how the process of implementing an HCA classroom environment changed previous views about being an effective instructor; by becoming more open-minded, flexible, and providing students the opportunity to stretch their learning.

> But I think it's made me even more open-minded than I ever was. Two things: go with the flow and that whatever happens, happens.... You cannot put a limit on the expectations of the children or limit where they could go. (Ronnie)

Nancy noticed that although she taught in much the same way, her students were motivated to learn even more by using the technology.

> I come in with a general thing [plan] and I say okay, this is where we're going this week, but again, once those children finish those basics, the core things that you have to do, then they just take off. And that's where the real learning comes in.... I teach a lot in the same way actually. I think, again, I could just take it [learning] even further than I could before. (Nancy)

Teacher efficacy, a perceived degree of effectiveness of instruction on learning and an individual teacher's belief in her or his effectiveness to increase student motivation and achievement, is evident in the above comments. The comments conveyed here substantiate the participants' conscious efforts to improve instruction and therefore supported my decision for the effective instruction category. Additional support for the effective instruction category can be found in comments regarding interaction and questioning. For example, when discussing a student, Victor said, "I asked one of my students, 'Well, the next time we're doing something on the Internet, why don't you see if you can find Crater Lake in Oregon?'" The student found a picture of Crater Lake and Victor extended the interaction and questioning by asking for a summary to accompany the picture. The discourse between Victor and his student provided a fine example of interaction and questioning. Solomon, et al. (1964) defined interaction within a learning environment as discourse among teachers and students that can include questioning, explanations, clarification of concepts, and rephrasing. But, in an HCA environment the discourse need not be face - to - face.

In describing the *pub* (the electronic public area on a server), Nancy discussed how she interacted with her students electronically.

> If I find a lesson is going in a direction, I sit down at my break time or at lunch time and type in a quick question, three or four questions, five questions. I can do it when the kids are right here ... and it's relevant to exactly what's going on.

Nancy's students had wireless access to the pub and were aware that information, quizzes, worksheets, and other instructional materials would be posted throughout the day. Nancy used the pub to make lessons interactive.

Self-efficacy and interaction and questioning furnished the basis for utilizing effective instruction as a category. The concepts of organization and planning also served as support for the effective instruction category.

Organization and planning. Because the coded data segments indicated numerous references to effective instruction principles, most notably the principles of organization and planning, I decided to use these effective instruction principles as categories. Provided in chapter 2 was a summary of McCutcheon's (1980) three effective teaching principles that address organization and planning:

- If teachers attend to content, instructional materials, activities, learner needs, and goals in their instructional planning, then the resulting preparedness [can] increase the probability of effective classroom performance.
- If teachers plan, then they [can] experience more confidence, direction, and security in their performance in the classroom.
- If teachers attend to elements such as arrangement of the physical setting, selection of basic texts and materials, and familiarity with social and academic development of their students early in the year, then a framework for future planning is established for the year. (p. 18)

The above referenced organization and planning principles were noted by study participants. For instance, Zach attended to instructional materials (laptops) and established a framework for students working in an HCA classroom, as indicated by the following:

> The first thing we [did] with the students is they were not allowed to open the laptops for about 2 days. We went through all the dynamics of the outside; we talked about treating them, we talked about the role that they need to take in the school and the community, the safety concerns with the laptops, not acting all special because they have laptops, how other people are going to look at them, and the type of attitude they need to have because they are part of this class.
>
> We went through all the things on the outside, the ports, the handle, where you plug it in, everything about that. Then for 2 days we went through all the keys that they needed to know how to do, the screens, the names of all the different things. It was a week of training before the machine was ever even turned on which made the [implementation] go much faster.

Zach noted that providing a framework for students early in the year helped ensure that he would experience more confidence, direction, and security in his teaching. By making these comments, Zach displayed an attention to learner needs, materials, and instructional goals.

Nancy also attends to these elements. Material selection and academic development were important to Nancy early in the year. She reported that, "We start them right off with that [keyboard software] so they wouldn't develop the bad habits." Material selection, instructional planning, and providing a framework for future planning performed vital roles in the design of the HCA project.

Observation notes and program documents obtained during the HCA project's planning phase provided numerous references to hardware, software, and physical environments required for an HCA classroom or school. Examples of hardware, software, and environmental issues referenced by participants as they planned for the HCA project implementation included: AirPorts™, ethernet for LANs, radio wave based connectivity, antennae in lid of each iBook, printers, scanners, mice, headsets, passed carrying case, projection devices, digital video cameras, G3s for teachers, hubs, palm pilots, disks, microphones, USB software, LightSpan™, Norton, future software to track skill data on each student--ILS™, CCC™, Compass™..., IP #, web page development software, WWW resource software, iMovie™, servers, electronic portfolios, HyperStudio™, Inspiration® listserve (project planning documents). As noted, the participants attended to and planned for content, instructional materials, activities, and learner needs in an HCA environment.

Vision

Vision can be generally defined as a "mental image" (Guralnik, 1984, p. 668). This commonly held definition of vision was instrumental in providing a screening concept during data analysis as an indication of the participants' mental image of the goals and assumptions accorded to the HCA project. To clarify, goal is defined as "an end that one strives to attain" (p. 260), and assume is defined "to take for granted or suppose" (p. 27). Together these terms imply that vision, or a mental image, was utilized by the participants as a means of thinking about the future of the project and what outcomes could be predicted or assumed. Participants' thinking about vision included several concepts: (a) individualized instruction, (b) empowering learners, (c) fuller integration of technology, and (d) becoming a better educator (see Table 5).

Table 5

Designers' Thinking Related to Vision

Category	Principles and Concepts
Vision	• individualized instruction • empowering learners • fuller integration of technology • becoming a better educator

Leah reflected that the HCA project's "objective was to individualize the program of study." Her use of the term objective, in an educational context, implies an *end to attain*. Zach's responses also reflected goals and assumptions: "I think the goals of the project were set by the [district], and then I think that each teacher set their [sic] own classroom goals." Zach referred to a differentiation between the teachers' goals and the district's goals for the HCA project. Jamie was more explicit in discussing a personal goal, "We understood this [individualized instruction using technology] was the vision for where the [district] was going. My goal for this was to increase my knowledge of how to be a more effective educator." Chris explained a shared vision for the project: "The need for a fuller integration of instructional technology in the [district] was a vision held by many people."

Tool

The HCA designers' numerous references to the use of technology as a teaching and learning tool provided the basis for *tool* as a category. Three concepts were instrumental in supporting the tool category, including: (a) reflection upon teaching, (b) questioning old patterns, and (c) speculating about causes of changes teachers were seeing in their students (see Table 6). Appropriation, a stage of evolution to a technology enhanced classroom, was the point at which an individual comes to understand technology and use it effortlessly as a *tool* to accomplish real work. The most important aspects of the appropriation stage were an increasing tendency of the participating teacher to reflect on teaching, to question old patterns, and to speculate about the causes

Table 6

Designers' Thinking Related to Tool

Category	Principles and Concepts
Tool	• reflection upon teaching • questioning old patterns • speculating about causes of changes teachers were seeing in their students

behind changes they were seeing in their students. The appropriation stage as defined paralleled data from the interview transcripts.

The definition of tool includes anything that serves as a means. In this study, the computer and its capabilities were the tool. Information provided by the reviewed literature supported the notion of computer as tool and extended the definition to include an effortless means to accomplish real work, reflect on teaching, question old patterns, and speculate about causes behind changes teachers were seeing in their students.

In reference to using the technology effortlessly as a tool to accomplish real work, Zach reported that students in the HCA classroom "know the shortcuts now.... They picked up on how to find shortcuts and how to use them." Other participants referred to the "effortlessness" of the tool, with comments such as: "easily attainable" (Victor); "a huge tool ... to [accomplish] more things in a quicker and accessible way" (Ronnie); "I think it's partly because of the ease... . It's just making it [learning] so much easier" (Nancy); and, "they know all the shortcuts" (Jamie).

Additional comments supported the notion of tool as aiding students in "accomplish[ing] real work":

> We're taking a virtual tour ... before we go there [field trip to a fort]. They'll learn a little of the history so that when we go to the fort, they'll say, "Oh, Mr. [Victor], I remember." I'm really glad that we're able to take the field trip because now it will really corroborate. (Victor)

Before taking students on a field trip, Victor recalled providing a virtual tour of the site via the Internet. He believed that the virtual tour would provide a contextual linkage and make the actual trip more meaningful.

The explanation provided previously for technology as a teaching and learning tool included reflection upon teaching, questioning old patterns, and speculating about causes behind changes teachers were seeing in their students. This explanation applied to participants as they discussed these issues.

After planning and using computers as teaching and learning tools, Victor reflected upon his teaching by stating that: "It's not the nucleus of learning but it's just another tool." Victor's comment conveyed an insight that the computer was an instructional tool and was not simply the basis for instruction. Likewise, Jamie noted:

> I want them to move faster; I want to push them. If they're able to do it, I want them to go with it ... it's the method of imparting the knowledge that has changed. Again I think it's the computers that have influenced that.

Based upon their reflections, both Victor and Jamie reported that the technology was a means of acquiring knowledge, not knowledge itself.

Several participants questioned old patterns in light of using computers as teaching and learning tools. For example, Zach noted, "When we get to something, they instantaneously look it up... . Last year I'm running to the library, grabbing outdated information." Inferred in the comment was an acknowledgement of an old pattern that has been modified by the technology. Similarly, Victor commented, "It has just been such a very useful tool as we've done just certain subjects that I could never do before," indicating that the technology permitted a greater array of subject matter to be covered, breaking a pattern of the past.

Speculation about the causes behind changes seen in students was evident among the following participant's comments: "A lot of them may have had the same assignment, but on their own they presented it in such different ways" (Ronnie); "There is this burning need and the knowledge and skills to get this information. They are not satisfied with print in [a] book" (Leah); and "My class is much more independent at this point" (Jamie). Leah and Jamie speculated that students changed and adapted by becoming independent decision-makers, not satisfied with previous ways of learning available. Further, according to Chris, students were more willing to learn due to the novelty of the tool: "And their willingness to grasp new information because they were using a fun tool to help them do it." Together, the HCA designers' numerous accounts of technology as a teaching and learning tool provided the basis for *tool* as a category.

<u>Logistics</u>

> Along with that comes all the technical know-how that you need ... setting up AirPorts™ [wireless network connection components], or setting up a small network in your room. You're basically running a small network and maintaining it. So there's the maintenance time, the time setting up the network which didn't run the first week that I was trying to get it set up, installing it. (Zach)

Zach's comments indicated an overwhelming concern of his – procuring, maintaining, and learning about the hardware and software involved in an HCA environment. Numerous concerns comparable to Zach's were noticed and coded during data analysis, with 47 segments sorted through Ethnograph v5.0™ QDA software (see Appendix D). Therefore, the participants' remarks provided the foundation for the logistics category.

Assisting in the formulation of the logistics category were results from technology infusion research studies. Concepts from the research results applicable to the study included: (a) appropriation, (b) entry, (c) procurement, (d) maintenance, (e) adoption, (f) time, and (g) student frustration (see Table 7).

Table 7

Designers' Thinking Related to Logistics

Category	Principles and Concepts
Logistics	• appropriation • entry • procurement • maintenance • adoption • time • student frustration

Alert to the logistical difficulties that can arise in an HCA environment gleaned from practical experience, my connoisseurship and critical eye confirmed the logistics category formulation. Data analysis included noticing, labeling, and coding segments with the term logistics. Typically, logistics is known as a military term meaning procurement, maintaining, and transporting supplies. Within the context of the present study, logistics refers to procurement, maintenance, and becoming proficient with computer hardware, software, and HCA environments.

Appropriation. In addition to a reliance upon my own HCA experiences, Dwyer, et al. (1990) research stages of technology evolution (including entry, adoption, adaptation, appropriation, and invention) were applicable to the data analysis and interpretation. The data analysis results closely paralleled three stages of evolution identified in the ACOT study: appropriation, entry, and adoption. The appropriation stage was deemed relevant as an organizing concept for the tool category, and was discussed previously within that context. In the current discussion, the entry and adoption stages are relevant concepts. These stages related to procurement, maintenance, and becoming proficient with computer hardware, software, and HCA environments within the study's operant definition of logistics and served as supporting concepts during data analysis.

Entry. The entry stage was somewhat parallel to procurement within the context of logistics. In the ACOT study, entry was defined as the stage of introducing computers and other technology into a traditional classroom that is text-driven and lecture-recitation-seatwork-based. The physical environment became radically transformed, and instruction in this new environment found experienced teachers faced with 1st-year teacher problems: discipline, resource management, and personal frustration. The participants in this study recounted similar experiences.

Procurement and maintenance. Concern for resource management policies occupied Zach's thoughts and implied an attention to managing hardware and software resources. "We set up acceptable use policies letters to parents...how to deal with the press and distributors of software" (Zach). Jamie indicated a similar concern by noting, "The maintenance issues at the beginning were just huge."

Similar to the 1st-year teacher problems reported by the ACOT research, Victor, Ronnie, and Jamie expressed frustration with the process of implementation and recounted student discipline problems in regard to breakage and lack of responsibility.

> We never got our cables. We just received them.... That made it hard because we were working on screens, going all over the room. I have the same four [students] that always broke them, the same three [students] that always had something wrong. (Victor)

"There were keys popping off and just dealing with a lot of that" (Ronnie). "That's just something you have with machines and you know that from having machines in your classroom and children, you have the two and you sometimes have a problem" (Jamie).

The participants' frustrations were reflective of the entry stage mentioned above. Therefore, entry gained credence as a concept for the logistics category. Another stage of evolution relevant to the present study's results was the adoption stage.

Adoption. During the adoption stage, ACOT teachers accommodated the technology to support traditional text-based practices. Productivity emerged as a major theme, with ACOT students completing district required curriculum in lesser amounts of time than they did before the technology infusion. Also, student engagement and enthusiasm for writing increased. Participants in the present study's HCA project reported similar events, particularly the shift from traditional text-based practices to more constructivist practices, accelerated learning, and increased student interest in writing.

A shift to more constructivist practices was indicated by the following interview transcript excerpts: "You become more of a constructivist, I think, the more you use it [technology] and see how you have to adjust" (Leah). "I really had to change how I was teaching because you can't be the teacher who knows all in this kind of classroom, you have to let them explore more...let them talk" (Jamie). Leah overtly described the shift to more constructivist practices when she said, "You become more of a constructivist" and credited the technology implementation as a cause for instructional adjustments. Jamie inferred this shift, stating, "You can't be the teacher who knows all," indicating that in an HCA environment the teacher's role changes from being in charge to one of facilitator.

Other participants commented upon their perceptions about students' learning at a quicker pace and at higher levels within the HCA environment: "Zach's dilemma was you can't teach what you were going to teach with working at a lower level. Essentially he threw out what he was going to do and bumped it up to meet her needs" (Leah).

Students' accelerated learning was reported by Zach and Nancy: "I think their learning curve is at such an accelerated rate right now" (Zach).

> My scope and sequence that I have, I plan out my year and we're actually a month and a half to 2 months ahead of time.
> All in one morning, whereas in the past to do a graph by hand would take us all day. (Nancy)

Nancy also noted that her students showed an elevated interest in writing, as can be seen by the following comments:

> Their writing: the words are so incredible because it's so easy to do.
> It's carrying over and this [example of student's writing] is one, "Frostbit, icy day in the city of New York. The traffic was like mad bulls thundering around like lightning on a miniature road. I was

> urgently trying to get to my house because I was direly cold." (Nancy)

To illustrate accomplishments by students, Nancy provided a student's writing sample. Student interests and accomplishments in writing, accelerated learning, and a move to more constructivist practices were evident in many of the previous comments. But, other comments reflected negative outcomes that were comparable to the ACOT experiment results.

Time. Two negative outcomes apparent from the ACOT (Dwyer, et al., 1990b) experiment and this study were student frustration and time management difficulties. Certain students in both studies spent an inordinate amount of time choosing fonts or graphics and not enough time on content. Teachers in both studies experienced varying degrees of difficulty with students wanting to go beyond the requirements of assignments, although this was viewed as a positive outcome by some teachers. Comments from data transcripts included similar concerns. Victor said, "It's like, we need to stop and we'll catch up on it the next day. Time has been a big thing." According to Nancy,

> At the beginning of the year I couldn't get them to stop; I couldn't get them to go to resource or recess... they'll definitely get into something and I say we have to stop now and you hear like,

> "No!".... It's just such an excitement and the parents have seen it too.

Time management, as indicated by Victor and Nancy, was a major concern, to the point of students not wanting to go to recess. However, Nancy noted, "It's just such an excitement" indicating that the students' engagement and motivation took precedence over time management.

Student frustration. Victor, Jamie, and Zach noted student frustration when using the technology. The student in Victor's vignette became frustrated because there were too many choices and he did not know how to proceed:

> One boy in particular who was sitting there and he was rubbing his temples because he had too many links, too much information.... I'll never forget his face, because that's certainly something that I thought would never happen.... That was really unique that the Internet had turned some of the students off. (Victor)

The idea of a student being turned off by the technology was a revelation to Victor, one that was not expected. Jamie experienced a similar event with students becoming impatient with the technology.

> That was a big mind thing too because they wanted instant and they would press a command three, four, or five times and then it would freeze.... Well, they don't do that anymore but when we first started, they didn't realize how much time they needed to process. (Jamie)

Jamie's students became frustrated because the software was not responsive instantaneously, but that they eventually learned to be more patient with the software. Similarly, Zach's students did not want to change software applications because font sizes were the students' focus and not the content.

> They have the hardest time getting out of Kids Works™ [word processing software] ... I think because when they printed it, four-five sentences were a page. The text was really big and it looked like a big accomplishment to have. They went over to Apple Works™ or something else and [it] printed it small. That's what I think. (Zach)

The above comments indicate student frustration with the hardware and software was a concern for the participants. These concerns were similar to concerns expressed by the ACOT participants.

The categories discussed above were reflective of the literature reviewed, comments made by the participants, and my HCA experiences. They provided a foundation for the process of theme development and this process is discussed next.

Phase 2 Data Analysis: Theme Development

Themes were developed by discerning relationships between and among the categories discussed in the previous section (see Table 8) and addressing the research questions of the study. The process was similar to the development of the categories, e.g., finding relationships among participants' passages, HCA literature reviewed, learning theory research,

Table 8

Themes and Supporting Categories

Themes	Research Questions	Supporting Categories

Goals and Assumptions	"What was the thinking of those who designed an HCA program?"	• Learning Theory
		  • constructivism
		  • student achievement
		• Effective Instruction
		  • individualized instruction
		• Vision
		  • empowering learners
		  • fuller integration of technology
		  • becoming a better educator

Appropriation	"In what ways did the designers purposefully think about learning theory and effective instruction principles?"	• Learning Theory
		  • metacognition
		  • working memory
		• Effective Instruction
		  • student engagement
		• Tool
		  • reflection upon teaching
		  • questioning old patterns
		  • speculating about student changes

Transformative Teaching	"How does the HCA project design relate to implementation?"	• Learning Theory
		  • constructivism
		• Effective Instruction
		  • teacher efficacy
		  • interaction & questioning
		  • risk-taking
		  • role-change
		  • organization
		  • planning

Learner-Centered Instruction	"In what ways did the designers purposefully think about learning theory principles?"	• Learning Theory
		  • constructivism
		• Effective Instruction
		  • interactive instruction

Logistics	"What was the thinking of those who designed an HCA program?"	• Learning Theory
		  • procedural knowledge acquisition
		• Effective Instruction
		  • planning
		  • organization
		• Logistics
		  • appropriation
		  • entry
		  • adoption
		  • maintenance
		  • procurement
		  • time
		  • student frustration

effective instructional research, and my own personal experiences in HCA environments.

Goals and Assumptions

Several categories were applied, including participants' stated goals and assumptions regarding learning theory and effective teaching strategies, to address the study's overarching research question, "What was the thinking of those who designed an HCA program?" As shown in Table 9, categories derived from the participants' comments were used to determine the theme Goals and Assumptions. These included vision, learning theory principles, and effective instruction principles. Concepts included among the articulations of vision are: empowering learners, fuller integration of technology, and becoming a better educator. These concepts were discussed in-depth with examples of participants' comments in the Phase 1 section of this document.

Learning theory. Reflected in the reported interview excerpts were various learning theory principles, particularly the concepts of constructivism and student achievement. The designers' goals and assumptions relating to the HCA project included a belief that an HCA environment would be personal for the students and open pathways to learning. As indicated in the discussion of learning theory principles,

Table 9

Goals and Assumptions with Supporting Categories

Theme	Research Question	Supporting Categories

Goals and Assumptions	"What was the thinking of those who designed an HCA program?"	• Learning Theory
		  • constructivism
		  • student achievement
		• Effective Instruction
		  • individualized instruction
		• Vision
		  • empowering learners
		  • fuller integration of technology
		  • becoming a better educator

constructivism was defined as being to some degree both personally and culturally relative. Therefore, this category was deemed worthy of supporting the theme. Student achievement as a vision was evident in the thinking of the HCA participants. They predicted that the students would achieve beyond their age level because of the technology.

Effective instruction. Individualized instruction, a principle of effective instruction, was the overarching purpose of the HCA project. Participants reported individualized instruction as a vision to move toward a more child-centered, individualized teaching environment as a result of the HCA project's implementation.

Vision. The use of the vision category assisted in naming the Goals and Assumptions theme, as the operant definition of vision was a mental image. As stated previously, the districts' and participants' mental image of the HCA project included goals and assumptions.

Summary. Categories used to explicate the Goals and Assumptions theme included: learning theory principles, including constructivism and student achievement; effective instruction principles, including individualized instruction; and vision. Derived from the analysis of the interview transcripts and from examination of relevant project documents, these categories reflected the thinking of the HCA program designers and addressed the primary research question, "What was the thinking of those who plan and design an HCA program?" Functioning as interpretative screens, the categories helped to develop the data further (see Appendix D). The assumptions expressed by the designers noted learning theory, including constructivism and student achievement, and individualization, an effective instruction strategy.

The goals and assumptions as stated by the participants point to technology infusion as providing the tool, or means to accomplish an end, in this case individualized instruction and increased student achievement. The participants spoke often about the technology as a tool, and these comments precipitated the development of the next theme, Appropriation.

Appropriation

The study's second and third research questions guided the process for developing the Appropriation theme. The questions asked:

- In what ways did the designers take learning theory principles into account during the design and implementation of the HCA project?
- In what ways did the designers take effective instruction principles into account during the design and implementation of the HCA project?

The participants' comments and reviewed research studies provided the categories of: learning theory principles, including metacognition and working memory; effective instruction principles, including student engagement; and tool (see Table 10). These categories and their conceptual relationships to one another assisted in the development of the Appropriation theme.

Table 10

Appropriation with Supporting Categories

Theme	Research Questions	Supporting Categories

Appropriation	"In what ways did the designers purposefully think about learning theory and effective instruction principles?"	• Learning Theory
		  • metacognition
		  • working memory
		• Effective Instruction
		  • student engagement
		• Tool
		  • reflection upon teaching
		  • questioning old patterns
		  • speculating about student changes

Learning theory. Two principles of learning theory, metacognition and working memory, were evident in the participants' thinking about the HCA project. Metacognition was defined as people's abilities to predict their performances on various tasks and to monitor their current levels of mastery and understanding. Working memory has been shown to be a vital component in knowledge acquisition. Together, these two principles of learning theory helped form the basis for utilizing learning theory as an Appropriation theme category. Another category that assisted in the development of the Appropriation theme was effective instruction, specifically the principle of student engagement.

Effective instruction. A principle of effective instruction, student engagement, includes the concepts of time-on-task, initiative, self-motivation, independent experimentation, spontaneous collaboration and peer coaching, enthusiasm or frustration, and time spent on projects both in and out of the classroom.

The participants provided numerous references to this principle in relationship to thinking about technology as a teaching and learning tool. Therefore, this category was deemed appropriate as a support for the development of the Appropriation theme.

Tool. Appropriation, as defined by Dwyer, et al. (1990) in the "stages of evolution" of the change process, was "the point at which an individual comes to understand technology and use it effortlessly as a *tool* [italics added] to accomplish real work" (p. 6). Becker (1987) reported that this stage of evolution was difficult to find in classroom settings because there were very few classrooms with constant access to technology at that time. The most important aspect of the appropriation stage was an increasing tendency of the participating teacher to reflect on teaching, to question old patterns, and to speculate about the causes behind changes they were seeing in their students. The appropriation stage as defined above was discerned from the present study's interview transcripts and became the tool category. For clarification, an operant definition for tool includes "anything that serves as a means." In conjunction with tool, learning theory and effective instruction principles provided additional categories to support the Appropriations theme.

Summary. The process for discerning the Appropriations theme was guided by the study's second and third research questions: "In what ways did the designers of an HCA program purposefully think about principles of learning?" and "In what ways did the designers of an HCA program purposefully think about principles of effective instruction?" As described in this section, the literature reviewed and comments made by the participants provided the categories of tool; effective instruction principles, including student engagement; and learning theory principles, including metacognition and working memory (see Appendix D).

As indicated, the HCA program's designers did purposefully think about principles of learning theory and effective teaching. As a result of this thinking, instructional modifications became a concern for the participants. The ensuing theme, Transformative Teaching, reflected the participants' thinking about instructional modifications and how these modifications impacted participants' teaching and their students' learning.

Transformative Teaching

Transformative teaching implies that change was occurring in the teaching process. The fourth research question, "How does the HCA project design relate to implementation?" also implies change, or to be more precise, whether change occurred as a result of the design. This question guided analysis and resulted in participants reporting numerous references to change in instruction as a result of the HCA program.

Categories utilized to support the development of the Transformative Teaching theme included: (a) the learning theory principle of constructivism; and (b) effective instruction principles, including teacher efficacy, interaction, and questioning, organization, planning, risk-taking, and role-change (see Table 11).

Learning theory. A move toward a more constructivist approach in the participating teachers' thinking contributed to the decision to utilize this principle of learning theory as a category to support the Transformative Teaching theme development. The data indicated regular attention to a constructivist view of learning, as was evidenced in their comments provided in the Phase 1 section of this document.

Table 11

Transformative Teaching with Supporting Categories

Theme	Research Question	Supporting Categories
Transformative Teaching	"How does the HCA project design relate to implementation?"	• Learning Theory • constructivism • Effective Instruction • teacher efficacy • interaction & questioning • risk-taking • role-change • organization • planning

In addition, several effective instructional strategies related to a change in instruction and were often mentioned by the participants. (See Appendix D).

Effective instruction. As stated previously, issues of effective instruction were applicable to the theme of Transformative Teaching, and include: teacher efficacy, interaction, questioning, risk-taking, role-change, organization, and planning. Each of these issues was discussed previously, and can be revisited in Appendix D.

Summary. As stated at the beginning of this section, transformative teaching implies that change occurred in the teaching process. The fourth research question asked how the thinking of HCA designers' planning reflects the program implementation and leads to the question: "Did change occur as a result of the design?" This question provided a framework for the data analysis process. Taken together, the categories listed above assisted in the Transformative Teaching theme development.

The theme discussed next, Learner-Centered Instruction, rests upon the tenets of constructivism and the effective instruction principle of interactivity as categories. An important issue to many teachers, child-centered instruction, was a major concern of the present study's participants. The theme's name, Learner-Centered Instruction, was based upon the participants' numerous references regarding this issue.

Learner-Centered Instruction

The second research question asked: "In what ways did the designers of an HCA program purposefully think about principles of learning?" Noted in the data reviewed for this section were numerous overt or implied references to learning theory, particularly principles of constructivism. (See Appendix D).

Underlying the theme development was the belief that teachers' attitudes were changed towards a child-centered rather than curriculum-centered instruction; towards collaborative rather than individual tasks; towards active rather than passive learning. The terms *child-centered, collaborative, interactive, personal, meaningful, contextual, social,* and *active* reflect principles of constructivism. One component of constructivism, interaction, encompasses principles of both effective instruction and learning theory. Therefore, interaction served as a category for the Learner-Centered Instruction theme, incorporating learning theory and effective instruction principles (see Table 12).

Table 12

Learner-Centered Instruction with Supporting Categories

Theme	Research Question	Supporting Categories

Learner-Centered Instruction	"In what ways did the designers purposefully think about learning theory principles?"	• Learning Theory
		  • constructivism
		• Effective Instruction
		  • interactive instruction

Learning theory and effective instruction. Mentioned at the beginning of this section, the interview and document data contained numerous overt or inferred references to learning theory, particularly principles of constructivism. Indications of interactive learning within a meaningful context helped support the development of the Learner-Centered Instruction theme (see Appendix D).

Summary. The previous discussion was guided by the present study's second research question that asks, "In what ways did the designers of an HCA program purposefully think about principles of learning?" Participants' comments included the constructivist concepts of interactive, personal, meaningful, contextual, and collaborative-social. These comments echoed my experiences in an HCA environment and previous studies' results involving technology infusion environments, most notably the ACOT project. According to Dwyer, et al. (1990), teachers moved "towards a child-centered rather than curriculum-centered instruction; towards collaborative rather than individual tasks; towards active rather than passive learning" (p. 3).

Technology infusion research studies have reported participant concerns in regard to procurement, maintenance, and learning about technology components, specifically hardware, software, and networks.

Participants in the study indicated preponderant amounts of concern about these issues. This concern guided the development of the Logistics theme.

Logistics

> Along with that comes all the technical know-how that you need ... setting up AirPorts™ [wireless network connection components], or setting up a small network in your room. You're basically running a small network and maintaining it. So there's the maintenance time, the time setting up the network which didn't run the 1st week that I was trying to get it set up, installing it. (Zach)

Procuring, maintaining, and learning about the hardware and software involved in an HCA environment was a major concern expressed by the HCA project's participants and provided the foundation for the theme Logistics. Assisting in the formulation of the Logistics theme were results of technology infusion research studies, a learning theory concept, procedural knowledge acquisition, and the effective instruction principles of organization and planning (see Table 13).

References to logistics within the reported data's content also assisted in answering the study's main research question: "What was the thinking involved in the development and implementation of an HCA program?" The data analysis and interpretation of the present study's HCA program participants' remarks indicated that logistics was a major concern and therefore became a category and subsequently a theme.

Logistics. Of the five stages of evolution in the process of educational technology implementation (entry, adoption, adaptation, appropriation, and invention), three stages (appropriation, entry and

Table 13

Logistics and Supporting Categories

Themes	Research Questions	Supporting Categories

Logistics	"What was the thinking of those who designed an HCA program?"	• Logistics
		  • appropriation
		  • entry
		  • adoption
		  • maintenance
		  • procurement
		  • time
		  • student frustration
		• Effective Instruction
		  • planning
		  • organization
		• Learning Theory
		  • procedural knowledge acquisition

adoption), closely paralleled the thinking of the HCA participants. Previously in this chapter, the appropriation stage was deemed relevant as an organizing concept relating to the logistics category. The entry and adoption stages are concepts relevant to the Logistics theme.

These stages related to procurement, maintenance and becoming proficient with computer hardware, software, and HCA environments within the study's operant definition of logistics and served as organizational concepts during data analysis. In addition, numerous participant references to time spent on the HCA design and implementation, and student frustration with the HCA learning environment, assisted in the development of the Logistics theme (see Appendix D).

Effective instruction. Because the data segments coded as logistics indicated numerous references to effective instruction principles, most notably the principles of organization and planning, a decision to use effective instruction as a supporting category for the theme's development was made. Learning about the software, hardware, and the physical environments inherent in an HCA classroom occupied the thoughts of most participants and led to the utilization of the remaining supporting category, learning theory, specifically the concept of procedural knowledge acquisition.

Learning theory. The learning theory category utilized procedural knowledge acquisition's three stages of development: declarative, associative, and automatic. Many participants' comments contained references to the stages and supported the application of this learning theory principle to the Logistics theme formulation.

Summary. To review, logistics, within the context of this study, referred to procurement, maintenance, and learning about computer hardware, software, and HCA environments. Analysis of the data, results of previous technology infusion research studies, learning theory's procedural knowledge acquisition, and effective instruction principles of organization and planning supported the Logistics theme as categories.

Data analysis, interpretation, and the researcher's connoisseurship and criticism indicated that logistics played an important role in the design and implementation of an HCA program in reference to the present study's research question: "What was the thinking of those who design an HCA program?"

Phase 3: Outcomes, Conclusions, and Results

Chapter 4 presented and organized data to bring order, structure, and meaning to the research findings. By gathering data via interview, observation, and document analysis; applying QDA software, the Ethnograph v5.0™program; applying principles of learning theory and effective instruction; and, applying my connoisseurship and experience in HCA environments to the analysis and interpretation process, five themes were developed which reflected the thinking of those who designed and implemented an HCA program.

Themes generated by the analytic processes discussed in this chapter were: (a) Goals and Assumptions, (b) Appropriation, (c) Transformative Teaching, (d) Learner-Centered Instruction, and (e) Logistics. The themes represent a distillation of the designers' thinking while planning and implementing an HCA program and form a framework for others who may attempt to design and implement similar programs.

The Goals and Assumptions theme represented participants voicing personal goals and organizational goals reflective of the HCA program's vision that each child would have a device to provide Internet access throughout the day and that instruction would become individualized. The participants also reported assumptions regarding increased student achievement due to an HCA environment.

As described in the Appropriations theme's section, participants' reporting of technology as a tool was a predominant thread. Tied to this concept were issues of increased student engagement and increased use of metacognitive strategies. Overt thoughts expressed by participants related to freeing students' working memory to allow for a greater depth of learning while utilizing the HCA environment.

Changes in the teaching process were predominant issues among study participants. Reported incidents of role change between and among HCA teachers and students were numerous and therefore explained the Transformative Teaching theme's name. Participants indicated teacher and student role changes that parallel the results of the ACOT experiment and these role changes were somewhat anticipated in this study.

The Learner-Centered Instruction theme resulted from participants' numerous references to learning theory, particularly principles of constructivism, including the concepts of interaction, personalization, meaningfulness, contextual, and collaboration. Comments made by the participants reflected reviewed studies' results involving technology infusion environments, most notably the ACOT project, and reflected a move toward a child-centered, collaborative, and active learning environment.

The fifth theme, Logistics, was unanticipated. Previous studies have mentioned the procurement, maintenance, and knowledge acquisition inherent in technology infusion environments, but did not report these issues as being of major concern. Reports from the participants indicated a high degree of concern about procurement, maintenance, and knowledge acquisition in the design and implementation of an HCA program. These concerns formed a strong pattern in the data and became the Logistics theme.

Chapter 5 reports the meanings and implications of the findings, conclusions and generalizations, the need for further research, and the limitations of the study's results.

Chapter 5

Summary, Implications, and Conclusions

The idea for this study evolved from my experiences in an HCA environment and the changes that occurred in my teaching and learning as a result of these experiences. Personal experience, as well as the current trends toward technology-based instructional delivery systems, suggested a need to explore the thinking of those who design and implement HCA projects and to illuminate, appraise, and interpret their experiences. The outcomes of the study indicated many of the same thoughts and situations I experienced, in addition to others not anticipated. Outcomes were similar to previous technological enhancement research study results (Dwyer, et al., 1990a, 1990b; Ringstaff, et al., 1991; Web-Based Education Commission, 2000).

This chapter presents a summary of the study, implications for educational practice and educational leadership, and conclusions. The summary reviews the research problem and the four focusing questions, research reviewed, methodology procedures, and findings resulting from data analysis.

Summary

Chapter 1 described the rationale for the present study. Admittedly, considerable literature exists that describing the structure, implementation, and outcomes of a wide variety of technology enhancement programs, but little is known about the explicit thinking of those who design and implement these programs. Further, even less is known about the extent to which there are conscious attempts to base the development and implementation of HCA programs on principles of learning and effective instruction.

Because of the likelihood of an increase in the role of technology within the educational process, educational leaders need data that examine the design and implementation of HCA programs so they can make informed decisions. Therefore, the purpose of the study, to explore the thinking of HCA project designers as related to learning theory and effective instruction principles, led to four research questions:

- What is the thinking of those who design and implement an HCA program?

- In what ways did the designers of an HCA program purposefully think about principles of learning?
- In what ways did the designers of an HCA program purposefully think about principles of effective instruction?
- How does the HCA program, as implemented, reflect the thinking of the program designers?

Chapter 2 presented a review of the literature that examined not only previous technology infusion programs but also principles of learning theory and effective instruction. Concepts garnered from the literature assisted in category development during the process of data analysis.

Chapter 3 described the research methodology, including the design, the type of research, limitations, the HCA program and participants chosen for investigation, data collection methods, and a data analysis plan.

Chapter 4 provided an explanation of the data analysis process, with a focus on bringing order, structure, and meaning to the research findings. Five themes were identified that reflected the thinking of those who designed and implemented an HCA program. Cognitive mapping and QDA software assisted in the analytic process.

Chapter 5 discusses the interpretations and significance of the findings, conclusions and generalizations, the need for further research, and the limitations of the study results.

Interpretation and Significance of Findings

The analysis of data resulted in the identification of five themes: (a) Goals and assumptions, (b) Appropriation, (c) Transformative Teaching, (d) Learner-Centered Instruction, and (e) Logistics. The themes do not fall within any particular hierarchical order, but do serve rather as discrete and equally important components of the thinking of the HCA project designers. The themes identified reflect a conscious attempt by the designers to incorporate principles of learning theory and effective instruction into the HCA environment.

The Goals and Assumptions theme addresses the participants' thinking about the organization's (district's) goals which were assumed to be measurable and definable. In reality, the people who were charged with the design and implementation of the HCA project redefined the goals to make the goals more meaningful to them. Because the HCA project was a work in progress, the definitive goals and assumptions (of the teachers and the district administrators directly involved) evolved during the design and implementation phases. As a result, there was a discontinuity between the district's goals and the designers' reality. This in turn caused uncertainty among all the stakeholders involved in the project. Yet, the individual HCA classroom teachers continued to do what they believed fulfilled the project's stated goals and therefore this discontinuity was inconsequential to the project's implementation.

The second theme identified was the Appropriations theme, as the time and commitment devoted to the implementation of computer as a learning and teaching tool resulted in much more time and effort than was anticipated by all those involved in the project. The participants reported that the technology never quite became *transparent* (i.e., it never became usable as a learning and teaching tool equal to other teaching tools, such as books, videos, overheads). However, it should be noted that comments abounded praising the technology as a tool to take learning above and beyond what could be accomplished without it. The thinking of the participants showed that implementing a computer-based learning environment required more effort than other innovations, but overall the extra effort was considered worthwhile as it resulted in enhanced student learning.

Changes in the teaching process and role-changes among teachers and students were reported many times by HCA teachers and these reports helped develop the Transformative Teaching theme. Several participants reported becoming increasingly facilitative in the classroom and rearranged schedules to accommodate project-based instruction. Also reported were incidences of students teaching other students and teachers. Evident in the participants' remarks was a high degree of self-efficacy, an awareness of their abilities and short - comings, and a willingness to learn from the students who became technological experts.

The Learner-Centered Instruction theme resulted from participants' numerous references to learning theory, particularly principles of constructivism. Comments made by the participants reflected a child-centered, collaborative, and active learning environment. Typically, most teachers would agree that a child-centered environment is appropriate, particularly at the elementary school level. Therefore, this theme reflected what most teachers, whether implementing an HCA project or not, would aspire to attain.

The fifth theme, Logistics, was unanticipated to the degree to which it occurred. Previous studies mentioned the procurement, maintenance, and knowledge acquisition inherent in technology infusion environments, but did not report these issues to be of such a major concern as those involved in the HCA project. The strong pattern apparent in the data suggests this theme was of great portent among the designers.

In fact, many of the comments made by participants indicated that the design and implementation of the HCA project was overwhelming. Mentioned are the many hours initially invested to set up, learn, and trouble-shoot the hardware and software. Frustration was gleaned from references to students not following protocol, breakage of the hardware, computers freezing, lack of connectivity or specific software, and the uncertainty of the project's future.

The findings reported above provided the basis for the implications that follow and helped describe what meanings can be attached. In summary, the trend to implement technology enhanced programs into schools suggests that educational leaders become knowledgeable about this topic.

Implications for Educational Leadership

As indicated previously, the planning phase of the HCA project consisted of a two-week summer training workshop. From the study findings, it appears that a planning structure relating more to the change process may have been just as important as the technology component. The change process was mentioned by one workshop participant, but did not appear to be a central focus of the project's planning phase. In interview transcripts, participants reported that the training on differentiated learning was beneficial, and it was evident that most chose to utilize this form of planning and instruction.

Another area not mentioned by the participants was a recognition or reward structure. The need for many hours of additional work, before and after school was reported by participants. Also, several mentioned having bought software or equipment with their own funds. Nevertheless, there was no mention of reward, either financial or public recognition, for their efforts. The participants were pictured on the web site for the project, so they were recognized by the school district in this manner. Specifically, there was no recognition of the time, commitment, knowledge and skills acquired, or changes in teaching methods adopted by the participants. In addition, there was no recognition of the accomplishments of the students.

The fact that several participants bought materials with their own funds leads one to believe that the organization or administrative staff did not support the project as well as the participants felt necessary. The project was initially designed with assurances of monetary support via grants, but these grants did not materialize. It must be kept in mind that this was a new project for the school district as well as the participants, and learning was occurring for all stake-holders as the project progressed.

These findings have implications for educational leaders who would decide to implement an HCA project into a school or district. Specifically, leaders who develop and implement HCA programs should provide: (a) extensive and ongoing training on the change process for participants, (b) sufficient funding allocations, (c) a recognition and reward infrastructure throughout the planning and implementation process, and (d) training in one or more alternatives to the traditional instructional model (e.g., differentiated instruction).

At this juncture, questions concerning how the findings from this study relate to similar studies arise. How might these findings generalize to future HCA projects? How are the results of the present study typical or atypical vis-a-vis results from other studies of technology enhanced programs? These questions will be discussed next.

The HCA project studied for the present inquiry was similar in many ways to the ACOT (Ringstaff, et al., 1991) study examined extensively in chapter 2. The ACOT study was reviewed primarily because it was a benchmark study in the area of educational technology infusion and because the expressed goals and design incorporated many of the elements attendant in the HCA project. Three major differences between ACOT and this study included the size of the populations, the availability of the Internet, and participants' logistical concerns.

The ACOT study was conducted before the Internet was easily available, and the study encompassed a large population across the United States. The ACOT results did not indicate that the logistics of implementing the ACOT project was a major concern for participants, whereas the participants in this study expressed a high degree of concern. The HCA project included the Internet in the design and was a very small program, encompassing 10 classrooms. Yet, many of the reported results of the studies are quite similar (see Table 14).

As indicated in Table 14, a majority of the results from the two studies are similar. A child-centered focus on learning and a move to more facilitative instructional delivery methods are reflected in the results of both studies. The differences could be accounted for by the increased sophistication of current technology applications. More logistical knowledge is presently required of users; therefore, a higher degree of concern for the logistics involved in planning and implementation is expressed in the results from the HCA study.

Table 14

Comparison of Present HCA Study Results to ACOT Study Results

ACOT Study	HCA Study
Vision & Goals – Increase Student Achievement	Vision & Goals – Individualize Instruction to Increase Student Achievement
HCA (no Internet)	HCA (Internet access)
Change in Instruction - Facilitative	Change in Instruction - Facilitative
Change in Learning – Constructivism	Change in Learning - Constructivism
Change in Student – Teacher Roles	Change in Student - Teacher Roles
Low degree of concern for Logistics	High degree of concern for Logistics

Overall, the HCA study results closely mirrored the ACOT study results, particularly in the areas of learning theory, effective instruction principles, and change in student and teacher roles. Consequently, these parallels lend credence for an expectation of similar results in future HCA studies. However, when discussing generalizability within the context of a qualitative study, limitations of the study must be included.

Limitations

As stated in chapter 1 the limitations of the study were discussed within the venue of a qualitative research design, in particular descriptive case study. Although studies of this type are limited by sample size, lack of comparative groups, or ability for replication, much can be learned from a descriptive case study, particularly one framed within Eisner's

(1998) educational criticism analysis design.

The study set out to discover the thinking involved in the design and implementation of an HCA program. The aim of a case study is to produce a detailed and supported interpretation of the behavior and perspectives of others. Detailed case studies of teaching using a variety of observational and interview procedures have frequently resulted in well-documented and insightful accounts of teachers' thoughts and practices (Calderhead, 1996).

Also, as reported in chapter 1, the role of researcher as tool was determined to be a limitation of the study. The self as instrument role was assumed because of my connoisseurship in HCA environments. Having taught in an HCA environment for more than 5 years during the 1990s, I brought a personal perspective to the self as instrument role. While teaching in an HCA environment, I struggled to learn and implement technology into instruction. This struggle changed how I viewed learning and teaching. My students' attitudes about their learning also changed. These experiences assisted in understanding the HCA designers' thinking while planning and implementing the HCA program. This self as instrument role also brought to the study a depth of knowing and the ability to see situations from several points of view and personal experience. But again, within the typical guidelines of case study research and the adherence to these conventions during the process of the study, this limitation was minimized.

Limitations were also described within chapter 3's discussion of the research methodology, including a description of the roles of the researcher as connoisseur and educational critic. This discussion was provided to acknowledge the limitations and to assure the reader that conventions were being followed. Chapter 4 provided an explanation of the data analysis process, with a focus on bringing order, structure, and meaning to the research findings. QDA software assisted in the analytic process, and the inherent limitations of these types of software were described.

The HCA project reviewed for the present study was in the 1st year of implementation and the study encompassed only that year. Also, only 5 of the 11 teachers and 2 of the 3 administrators assigned to the project agreed to participate. If all had agreed, the results may have been different. Therefore, these facts add to the study limitations. The *what ifs* mentioned here lead to a discussion of the need for further study.

Need for Further Research

The research conducted by the National Research Council and reported by Bransford, et al. (1999) recommended "extensive evaluation research be conducted through both small-scale studies and large-scale evaluations, to determine the goals, assumptions, and the uses of technologies in classrooms and the match or mismatch of these uses with the principles of learning and the transfer of learning" (pp. 239-240). Likewise, the Web-Based Education Commission's report of 2000, recommended additional research and development to establish a pedagogical base for the effective use of Internet learning. Central to both of the above-mentioned reports was a call for additional research into the effects of technology on teaching and learning. The results of the present study indicated a continuation of these calls to conduct additional HCA studies.

In addition, other ideas and concepts involved in the design and implementation of HCA environments need to be addressed. Mentioned previously, the HCA project reviewed for the study was in the 1st year of implementation and encompassed only that year. Longitudinal studies over several years would provide additional data and either extend or diminish the evolutionary trends discovered in the present study. Also, focusing on HCA projects with more participants and of different socioeconomic status or geographical areas would provide results to extend this study.

Another avenue to explore involves the type of technology utilized for the HCA project. Computer and Internet technology changes at a rapid pace, and research studies must follow suit. Apparent in the present study's results was an impact on teaching and learning and how the participants thought about these concepts. According to the 2000 report of the Web-Based Education Commission, technology can support what we now know to be more effective learning environments. New technological tools and applications allow for expanded forms of communication, analysis, and expression by students and teachers. These innovations support new forms of teaching and understanding built on the early findings of learning research. Using these comments and the study results as a base, studies need to be advanced that would focus on the professional development of HCA projects, involving the change process, instructional strategies, and learning theory.

The HCA project in this study was limited to the elementary grades. Future studies involving an HCA environment in middle and high schools would yield additional information, particularly in a longitudinal study starting in Grade 1 or kindergarten.

Educational leaders work within an ever-changing and multi-faceted environment, with technology infusion serving as one of many potential means for enhancing teaching and learning. To provide the best practice for these endeavors, additional HCA research needs to be initiated. Long term studies, using larger and more diverse populations, and both quantitative and qualitative research studies will add to the knowledge base and provide guidance to those who would implement HCA programs into schools.

This study's endeavor was to seek the views, learning, and knowledge of those who experienced an HCA classroom environment. They represent pioneers who embrace change and provide all educators with a glimpse into the future of teaching with technology. To the participants of this study, may you continue your trek toward the future.

Appendix A

Interview Questions

General, Open - Ended Questions:

- What is the HCA project? I would like to know everything that you feel is worth telling.
- Can you provide more detail?
- Can you provide a specific example?
- What else would you like to say about the HCA project?

Clarifying Questions:

- Why do you think you were asked to participate in this project?
- Why and how did the district support this project?
- Why do you think your school was chosen to participate?
- Who initially influenced the development of this project? Why?
- What preparation do you have for your participation in the project?
- What training was provided to the participants?
- How much of your time has gone into HCA?
- How many people were or are involved in the design and implementation of the project?
- Can you describe the chronology of its design?
- How is the design team organized?
- How is the HCA project being implemented?
- How did the design team make decisions about the project?

Appendix B

Informed Consent Form

University of North Florida Doctoral Program in Educational Leadership

Informed Consent Form

DECISION MAKERS' THINKING DURING THE DESIGN AND IMPLEMENTATION OF A K-5 HIGH-COMPUTER-ACCESS (HCA) PROGRAM
Constance D. Gutknecht

Dear Participant:
I am interested in studying those who design and develop K-5 High-Computer-Access programs. My study involves identifying key persons who are responsible or who have been responsible for the design and/or development of a part of your district's High-Computer-Access program and subsequently observing and conducting interviews with the identified persons. The purpose is to discover how High-Computer-Access programs are conceptualized, perceived, designed and implemented in a team-based setting and how the team's and individuals' work translates into practice. I am hoping the results of this study will lead to more information about designing and developing K-5 High-Computer-Access programs.
Your participation will involve:

- permitting me to conduct audio tape-recorded interviews with you.
- agreeing to provide more than one interview, each interview being no more than one hour in length.
- allowing me to observe you and your design team meetings during the duration of the project's development and implementation phase.
- providing me access to any written materials related to the design and development of the High-Computer-Access program, including lesson plans, design plans, research utilized, reports, etc.
- permitting me to further contact you via telephone, email, or in person.

The study is designed to maximize your confidentiality. Risk of discomfort or psychological, physical, or social injury to you is considered to be minimal. Data will be coded to enable analysis and to assist in protecting your identity. Pseudonyms, numerical assignations, and a disguise of participants' identity in relation to their particular job title or position will be utilized in the report.

Your participation is voluntary, and you are free to withdraw your consent and discontinue participation at any time without prejudice. No monetary compensation will be given for participation in the study.

If you have any questions regarding this study, you may contact Connie Gutknecht at 273-4100 or email at bcgut@att.net. Also, you may feel free to contact my dissertation committee chair, Dr. Kenneth Wilburn, kwilburn@unf.edu or 620-2991 for further information or questions.

I have read and understand the procedures described above. I am aware that I am free to ask questions about the procedures being used in this study, and I am free to withdraw my consent and to discontinue my participation in the project at any time without prejudice. I agree to participate in the procedure, and I have received a copy of this description.

Signature ______________________________ Date ______________________________

Appendix C

Control Document - Confidential Data/Information

The person indicated below as "recipient" has received the documents or data described below, which has been obtained during research involving human subjects. The recipient recognizes the principles of protection of human subjects and by signature below commits to ensuring the continued confidentiality of this information/data.

Material transmitted: Audio-tapes of interviews, transcripts of audio-taped interviews on floppy disks, and hard copies of transcribed interviews.

PI or project administrator authorizing the transfer or use of the referenced data/information:

Name: Connie Gutknecht

Signature:____________________

Date: September 17, 2001

Recipient: Name:____________________

Signature:____________________

Date: September 17, 2001

Recipient has returned data or completed work and no longer retains control of confidential information:

Signature of PI or project administrator:____________________

Date: ____________________

8/00 JLC/IRB

Appendix D

Categories, Principles, Concepts, and Participants' Comments

Categories	Principles and Concepts	Participants' Comments
Learning Theory	• constructivism	• Part of the dream that the teachers came up with is that this [the HCA environment] is the personal pathway to learning. (Leah) • My goal for this was to increase my knowledge of how to be a more effective educator. (Jamie) • This personalized learning path means that you really are incredibly deep in any one subject. (Leah) • This year has allowed me to use more personal connections, using the technology. (Ronnie) • We had all of our kids on FCAT [Florida Comprehensive Assessment Test] Explorer. That was prior to the FCAT testing and they loved it. They were in charge of where they were....So there's certain things that have more meaning to them as they study. (Victor) • They love those pictures [images the students copied from the Internet]; it's personal when they do things like that and that's what the [HCA] program has kind of done, it's made education so much more personalized. (Victor) • We have one student whose dad is on a Navy ship and he and the grandparents absolutely love it [class web page]. It's been wonderful. So we update it for the dad so that he can log on each week and we have that little message for him. (Nancy) • They're so eager to work with each other and the problem solving skills...I have so many experts in here. (Nancy) • I think focusing more on projects of that nature where they're either working by themselves or with a peer or small group even. (Jamie) • You have to let them explore more and so you have to let them talk and so

Categories	Principles and Concepts	Participants' Comments
		there's the socialization in the classroom; it is much more than it ever has been in my room before. But it's been good because they're helping one another. (Jamie) • She was given a web site to look up Christmas customs around the world and couldn't read all of the words, and she wasn't going to let a little thing...now, this is strategic learning at its finest for a first grader, for a six-year-old. She copied all the words, put them into Simple Text, and let Simple Text read it to her over and over again until she could actually read the words. She taught herself to read the words and then made this fantastic Hyper Studio™ stack for Monday morning. (Leah) • active learner; flexible, fluid groups; simulations, lots of hands-on activities; kids share (Documents notes)
	• student achievement	• I think they'll get there faster than other students at their age because they'll have the know-how and the expertise. (Zach) • [to] try to help bring them up to the same level that some of the more affluent areas have (Jamie)
	• metacognition	• They've become empowered to decide what they need to consume and learn in depth...They are becoming pretty intelligent consumers. The kids are finding resources and then they're evaluating each other's resources. (Leah) • They may have had the same assignment, but on their own they presented it in such different ways. (Ronnie)
	• working memory	• I installed a keyboarding program so that they could polish their keyboarding skills. (Jamie) • We'll take a virtual tour before we go there. They'll learn a little of the history so that when we go to the fort, they'll say, "Oh, Mr. [Victor], I remember." (Victor)

Categories	Principles and Concepts	Participants' Comments
	• procedural knowledge acquisition	• We went through all the things on the outside, the ports, the handle, where you plug it in, everything about that. Then for two days we went through all the keys that they needed to know how to do, the screens, the names of all the different things. It was a week of training before the machine was ever even turned on which made the [implementation] go much faster. (Zach) • Setting up the AirPorts™ was an incredible amount of work...at the beginning of the year I would get done around 11:30 at night and be at it at 4:00 in the morning and that was pretty much straight through....it's a new program and you're being a pioneer and it takes a lot of work and none of us really know how to get them up and running. And then a lot of the trouble-shooting, I've had to learn myself. (Nancy) • Once you get better at it, it gets easier. It's harder to think of the different skills during the beginning, but then once you've done some more, it just gets easier as it goes. (Zach) • The kids were new to the computers. They would do things inadvertently that would cause a problem and then you have to figure out what they were. We spent hours and hours just trying to make sure that everyone's machine was up and functional. (Zach) • He [Zach] was determined to configure the AirPort™. He sat down and got one of his working and gave us all step-by-step plans. I sat down and did mine the way he told us to do it and the three little lights on the front of the AirPort™ all started blinking like red and orange and it looked like the little AirPort™ was going to take off. We configured them at the beginning of the year and I haven't had a problem with them since then. (Jamie) • And he's looking at it like, okay, give it to me for another year now that I've gotten all of this [experience] under my belt and can troubleshoot...and I think next year, having all of that training under my belt, I'll be able to really even take this that much further. I'm anxious to see because this is a real learning year for me and I've accomplished so much and I just can't wait to see what I'd do with another class. (Nancy) • They're using [keyboarding software] so their keyboarding skills are right there. None of that hunt and peck. (Nancy) • Things were just really clipping along. I wasn't having the maintenance problems

Categories	Principles and Concepts	Participants' Comments
		nearly as bad. I think it's because the children were becoming more adept and better at figuring out, well, this might be the problem, why it's doing this. They would try things on their own. (Jamie) • I'll hit the floor running because the problems and things that I encountered in the beginning of the year, like networking and stuff like that, I won't have those; we can move a lot faster and we can get a lot more done. • But there's still a lot that I would like them to learn. They can trouble-shoot a lot on their own just because of what happens in here. (Zach)
Effective Instruction	• student engagement	• If they have certain free time or if I just have them researching something, once again, they're not all in the same book at the same time looking at the same thing. (Victor) • Like one of the stories they had to read independently was about some coins so they went and researched about coins all over the world and then they pulled that in. (Ronnie) • I never thought I'd see first graders looking for multi-sources on things or third graders or fifth graders. They've really kind of leaped into this. (Leah) • They're teaching me some shortcuts. They picked up on how to find shortcuts and how to use them. How it's progressing is the students drive the curriculum. (Zach) • And there's things like they'll definitely get into something and I say we have to stop now and you hear like, "No"... It's just such excitement. (Nancy)
	• teacher efficacy	• Once you get better at it [teaching with the technology], it gets easier...But I think my technical goals have lowered and my academic goals have shifted. (Zach) • I said I really want to get them on the Internet but they're just flooded with information so I started playing with [Internet browser software]. (Victor) • But I think it's made me even more open-minded than I ever was. Two things: go with the flow and that whatever happens, happens. ...you cannot put a limit on the expectations of the children or limit where they could go. (Ronnie) • I come in with a general thing [plan] and I say okay, this is where we're going this week but again, once those children finish those basics, the core things that you

Categories	Principles and Concepts	Participants' Comments
		have to do, then they just take off. And that's where the real learning comes in...I teach a lot in the same way actually. I think again I could just take it [learning] even further than I could before. (Nancy)
	• interaction & questioning	• I asked one of my students, "Well, the next time we're doing something on the Internet, why don't you see if you can find Crater Lake in Oregon?" (Victor) • If I find a lesson is going in a direction, I sit down at my break time or at lunch time and type in a quick question, three or four questions, five questions. I can do it when the kids are right here...and it's relevant to exactly what's going on. (Nancy)
	• organization and planning	• The first thing we [did] with the students is they were not allowed to open the laptops for about two days. We went through all the dynamics of the outside; we talked about treating them; we talked about the role that they need to take in the school and the community; the safety concerns with the laptops; not acting all special because they have laptops; how other people are going to look at them; and the type of attitude they need to have because they are part of this class. (Zach) • We went through all the things on the outside, the ports, the handle, where you plug it in, everything about that. Then for two days we went through all the keys that they needed to know how to do, the screens, the names of all the different things. It was a week of training before the machine was ever even turned on which made the [implementation] go much faster. (Zach) • We start them right off with that [keyboard software] so they wouldn't develop the bad habits. (Nancy) • AirPorts™, ethernet for LANs, radio wave based connectivity, antennae in lid of each iBook, printers, scanners, mice, headsets, passed carrying case, projection devices, digital video cameras, G3s for teachers, hubs, palm pilots, disks, microphones, USB software, LightSpan™, Norton, future software to track skill data on each student—ILS™, CCC™, Compass™..., IP #, web page development software, WWW resource software, iMovie™, servers, electronic portfolios, HyperStudio™, Inspiration™, listserve (Documents notes)

Categories	Principles and Concepts	Participants' Comments
	• risk-taking	• Like one of the stories they had to read independently was about some coins so they went and researched about coins all over the world and then they pulled that in. (Ronnie) • I never thought I'd see first graders looking for multi-sources on things or third graders or fifth graders. They've really kind of leaped into this. (Leah) • I'm always telling my children, I want you to take risks. Just go out there if you have ideas, go for it. And one of my students came in one day and she said, "I found this at night." And she said, "Ms. [Nancy], you really have to start taking more risks at home." She had the whole idea for the lesson. Okay, put away the lesson plan and just go with what you're learning. (Nancy) • Yes, I was petrified to be honest with you. (Nancy) • Even now things change daily and so it's just kind of a not knowing what's out there. (Nancy) • Because it's a new program and you're being a pioneer. (Nancy) • We're pioneers. We're trail blazers. That's what my principal calls me; it's someone that's [sic] willing to step out there and take the risk. (Nancy) • There were some of us who aren't very big risk-takers and it [implementing an HCA program] was a big risk...We are discovering things. It's like being Christopher Columbus or Ponce de Leon. It's a voyage of discovery. It's a lot of risk-taking because things aren't laid out. We're just kind of feeling our way through this dark tunnel and hope there's some light at the end there. (Leah) • I try and be open about new things and I said, "Certainly." Well, you know, really, you have to think outside the box if you're going to try something new. (Jamie) • It was a brave new world for everyone. (Chris)
	• role-change	• They're teaching me some shortcuts. They picked up on how to find shortcuts and how to use them. How it's progressing is the students drive the curriculum. (Zach) • I really had to change how I was teaching because you can't be the teacher who knows all in this kind of classroom...I'm no longer standing up in front of the room being the person that [sic] is in charge, the expert. It's more I'm a resource. (Jamie) • What we were able to change is who is doing the learning and how is it done, and

Categories	Principles and Concepts	Participants' Comments
		what is driving the learning. In this case, adults and children having to learn together was a really important piece of information, certainly one of the largest challenges that teachers would ever have. What do I have to give up, how do I not be the expert and still be in charge? (Chris)
Vision	• individualized instruction	• so much easier than you could do it in a whole class setting (Jamie) • to individualize the program of study and to have some sort of individual device (Leah) • move from whole class (Documents notes)
	• empowering learners	• [The] vision for the future of every child [was] every student having a device that points to the internet. (Zach) • Objective was to individualize the program of study. • [Administrator's] vision and our district's vision that technology can empower learners. [To] look at teaching and to look at learning. • Part of the dream that the teachers came up with is that this is the personal pathway to learning. (Leah) • We understood this was the vision for where the [district] was going.
	• fuller integration of technology	• The need for a fuller integration of instructional technology in the [district] was a vision held by many people. (Chris)
	• becoming a better educator	• My goal for this was to increase my knowledge of how to be a more effective educator. (Jamie)
Tool	• reflection upon teaching	• It's not the nucleus of learning but it's just another tool. (Victor) • I want them to move faster; I want to push them. If they're able to do it, I want them to go with it...it's the method of imparting the knowledge that has changed. Again I think it's the computers that have influenced that. (Jamie)

Categories	Principles and Concepts	Participants' Comments
	• questioning old patterns	• When we get to something, they instantaneously look it up... Last year I'm running to the library grabbing outdated information. (Zach) • It has just been such a very useful tool as we've done just certain subjects that I could never do before. (Victor)
	• speculating about causes of changes teachers were seeing in their students	• A lot of them may have had the same assignment, but on their own they presented it in such different ways. (Ronnie) • There is this burning need and the knowledge and skills to get this information. They are not satisfied with print in [a] book. (Leah) • My class is much more independent at this point. (Jamie) • And their willingness to grasp new information because they were using a fun tool to help them do it. (Chris)
Logistics	• appropriation	• Along with that comes all the technical know-how that you need...setting up AirPorts™ [wireless network connection components], or setting up a small network in your room. You're basically running a small network and maintaining it. So there's the maintenance time, the time setting up the network which didn't run the first week that I was trying to get it set up, installing it. (Zach)
	• entry	• We set up acceptable use policies letters to parents...how to deal with the press and distributors of software. (Zach)
	• adoption	• You become more of a constructivist, I think, the more you use it [technology] and see how you have to adjust. (Leah) • I really had to change how I was teaching because you can't be the teacher who knows all in this kind of classroom, you have to let them explore more...let them talk. (Jamie)
	• maintenance	• The maintenance issues at the beginning were just huge. (Jamie) • I have the same four [students] that always broke them, the same three [students] that always had something wrong. (Victor) • There were keys popping off and just dealing with a lot of that. (Ronnie) • That's just something you have with machines and you know that from having

Categories	Principles and Concepts	Participants' Comments
		machines in your classroom and children, you have the two and you sometimes have a problem. (Jamie)
	• procurement	• We never got our cables. We just received them...that made it hard because we were working on screens, going all over the room.
	• time	• I think their learning curve is at such an accelerated rate right now. (Zach) • My scope and sequence that I have, I plan out my year and we're actually a month and a half to two months ahead of time. • All in one morning, whereas in the past to do a graph by hand would take us all day. (Nancy) • It's like, we need to stop and we'll catch up on it the next day. Time has been a big thing. (Victor) • At the beginning of the year I couldn't get them to stop; I couldn't get them to go to resource or recess... they'll definitely get into something and I say we have to stop now and you hear like, "No!"...It's just such an excitement and the parents have seen it too. (Nancy)
	• student frustration	• One boy in particular who was sitting there and he was rubbing his temples because he had too many links, too much information...I'll never forget his face, because that's certainly something that I thought would never happen...That was really unique that the Internet had turned some of the students off. (Victor) • That was a big mind thing too because they wanted instant and they would press a command three, four, or five times and then it would freeze...Well, they don't do that anymore but when we first started, they didn't realize how much time they needed to process. (Jamie) • They have the hardest time getting out of Kids Works™ [word processing software]...I think because when they printed it, four-five sentences were a page. The text was really big and it looked like a big accomplishment to have. They went over to Apple Works™ or something else and [it] printed it small. That's what I think. (Zach)

Appendix E

Transcript Excerpt from Ethnograph™ v5.08

(see following page)

#1 of 47 Zach

SEARCH CODE: LOGISTICS

#-LOGISTICS

```
     Zach:  Our part in that is showing them      24  -#
       the                                        25   #
       processes of incorporating technology      26   #
       that's available today and how that's      27   #
       going to impact when the school wide       28   #
       or county wide plan is in effect,          29   #
       giving us the training so that we may      30   #
       be facilitators of training later, or      31   #
       showing them what works and what           32   #
       doesn't work in this process, and what     33   #
       things are needed in that device.          34  -#
```

#2 of 47 Zach

E: *-TOOL
E: $-CHANGEINST
E: #-LEARNINGTH

SEARCH CODE: LOGISTICS

@-LOGISTICS

```
       I-book to do that.  Along with that        48  -# -$    -* -@
       comes all the technical know-how that      49               @
       you need to do, setting up airports,       50               @
       or setting up a small network in your      51               @
       room.  You're basically running a          52               @
       small network and maintaining it.  So      53               @
       there's the maintenance time, the time     54               @
       setting up the network which didn't        55               @
       run the first week that I was trying       56               @
       to get it set up, installing it, and       57               @
       parent education.                          58              -@
```

#3 of 47 Zach

SEARCH CODE: LOGISTICS

#-INSTRUCTN #-LOGISTICS

```
     Zach:  I had to have an inservice for        60  -#
       the                                        61   #
       parents to teach them.  The parents        62   #
       put hardware into the laptops,             63   #
       installing all the software, teaching      64   #
       all the students how to use the            65   #
       different pieces of software, and          66   #
       appropriate uses of the internet.  One     67   #
       way that I solved that is any site         68   #
       that I want them to go to I built my       69   #
       own web page and that any site that        70   #
```

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Vita

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Education

Doctor of Education - 2002
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Master of Education in Educational Leadership - 1996
University of North Florida

Bachelor of Arts in Elementary Education - 1991
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Recent Professional Experiences

University of North Florida - 2000 to present
Visiting Instructor

Duval County School District - 1992-2000
Assistant Principal and Teacher

Publications

Gutknecht, B., & Gutknecht, C. (2001, Fall). Connecting at-risk children & teacher prep students virtually: Applications of synchronous distance education technologies, Journal of Reading Improvement, 38 (3), 99-105.

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Memberships

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International Reading Association
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Professional Interests

Early Childhood and Elementary Literacy
Educational Leadership
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