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A Mixed Methods Study on CBAM and the Adoption of Thin Client Computers by Adolescents

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A MIXED METHODS STUDY ON CBAM AND THE ADOPTION OF THIN CLIENT COMPUTERS BY ADOLESCENTS

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by

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DEDICATION

This dissertation is dedicated to my ever-supportive husband, Hoppy Chandler, to my twins, Leah Rochelle (Rachel) Chandler and Elijah Hillel Chandler, to my father and mother, father James Sistek (and spouse, Beverly) and mother, Jan Hop (and spouse, Gary) who instilled in me a drive to succeed no matter what the obstacle. Without their support, encouragement, and understanding, this dissertation would not have been possible.

ABSTRACT OF THE DISSERTATION

A Mixed Methods Study on CBAM and the Adoption of Thin Client Computers by Middle School Adolescents
By
Cynthia Sistek-Chandler
Doctorate of Education
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Although stages of change and adoption of innovation dynamics have been examined for adult populations, comparable research for adolescents is limited. Applying a change instrument grounded in Concerns-Based Adoption Model (CBAM) to an adolescent population, this study investigates perceptions of 45 middle school students who used thin client portable computers in a one-to-one program at home and at school for 3 years.

A mixed methodology design identified which of the 7 stages of concern students passed through and why some students adopted the innovation more readily than others. The Change Facilitator Stages of Concern Questionnaire, a modified version of CBAM, was used to collect quantitative data from students at the beginning and at the end of 6th grade. Qualitative interviews from 8 purposively selected students, their parents, and their teachers supplemented the survey data in the final year of the program.

To guide this study, three questions were investigated: (1) What stages of concern were evident? (2) To what extent can variation in these stages of concern be explained by select demographic measures? (3) Based on the qualitative interviews, how do select students describe their adoption?

Three distinct adoption pathways emerged in both the population and the sample. In Pathway 1, progressions occurred from lower to higher stages; in Pathway 2, no change between Pre- and Posttests; and in Pathway 3, backwards movement occurred through the stages. Unexpectedly, only 5 of the 7 stages of change were high stage scores.

Regression analysis also revealed two significant findings: first, in the posttest analysis, the dependent variable (free lunch) suggested that poverty levels may influence a slower progression through CBAM stages; and second, there was a significant difference in pre- and posttest second high stage scores for the dependent variable (gender), suggesting that adolescent males gained nearly two more stages of change than did females.

This study appears to be the first adaptation of the Change Facilitator Stages of Concern for adolescents. Both quantitative and qualitative evidence explained that adolescent pathways differ fundamentally from those of adults.

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I would first like to acknowledge my dissertation committee, my chair Fred Galloway, and committee members Bob Donmoyer, Bobbi Hansen, and Cheryl Mason for their time and effort in guiding me in this journey.

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CHAPTER 1

INTRODUCTION

The use of technology has become ubiquitous for adolescent members of the educational community. Computer use at home and at school has been increasing steadily in the United States. In 1996, 79% of 4th-graders, 91% of 8th-graders, and 96% of 11th-graders reported using a computer at home or at school to write stories or papers, a substantial increase from 1984 (National Center for Educational Statistics, 1998). The Digest of Education Statistics (2000) reports the percent of students using computers at school more than doubled between 1984 and 1997. However, despite widespread efforts to provide computers to students in schools and to increase the computer-to-student ratio, not every student in the U.S. has been provided with school access to a computer. As reported by *Education Week* (2003), the ratio of students to computers in the United States was 4.3:1, a small decrease from 5.6:1 in 2002. This change in the accessibility of computers signifies a dramatic increase in the number of computers used in schools today.

Portable laptops and wireless computing are becoming the norm; classrooms around the world have begun to implement laptop programs for school and for home use. More than 19 states have implemented laptop initiatives to place computers into the hands of students, for school and for home use, 24 hours a day, and seven days a week (Barios, T. et al, 2002, 2004). School laptop initiatives are not a new phenomenon. Beginning in early 1990s, successful laptop programs have spanned the globe. One of the earliest adoptions, the laptop program at the Methodist Ladies College in Melbourne, Australia (1990) has spread throughout the continent of Australia; the Teacher Leadership Project and Microsoft's Anytime Anywhere Learning Laptop Project followed (1997-2003); and Maine's Learning with Laptops Initiative (2002) provided laptops to every seventh grader in the state. In spite of these successes, technology reform efforts and adoption of innovation continues to be slow and sporadic.

Why has this movement for all students to use computers in the classroom become pervasive in school reform? Simply stated, it is because the use of technology has the

potential for transforming education to meet the educational demands of the 21st century. "Technology has changed or altered how people access, gather, analyze, present, transmit, and assimilate information. Today's technologies provide the tools, applications, and processes that empower individuals of our information society" (See, 1994, p.30). Like portable laptops, thin-client and tablet computers (computers that are wireless with limited hard drive capacity connected to mainframes and a central file server) may fulfill the promise of the "one-kid-to-one computer" paradigm (Johnstone, 2003). "Parents already understand that acquiring fluency in the use of computers is crucial to their children's future prospects. They must demand that schools prepare their kids for tomorrow's world, not yesterday's" (p. 7).

Computers continue to impact teaching and learning. In a national study of the use and impact of laptops in the classroom, the *Year 3 Laptop Report* states that attitudes and beliefs towards the use of computers for school activities and learning were more positive for students who were involved in the laptop program than for those who were not (Walker, Rockman, & Chessler, 2001). In addition to benefits in student attitude are "increased collaboration, movement towards independent learning, greater enthusiasm for schooling, and more engagement in problem solving" (p.*v*).

The need for learners to engage in interactive technologies such as wireless laptop computers, personal digital assistants (PDAs), cellular phones, and global positioning devices in an educational setting is increasing. Along with identifying the need for young people to obtain access to a personal computer, leading researchers, education policy analysts, and educational futurists tell us that the adolescent population is changing in ways we may not have anticipated (Negropante, 1995; Prensky, 2000; Tappscott, 1998). In order to meet the needs of adolescent learners, it is more critical than ever to provide them with up-to-date tools for the digital revolution of the 21st century. Whether this new generation of learners is described as the "Net Generation" (Tapscott, 1998), "Gen Y" (Harper, 1999), or as "Digital Natives and Digital Immigrants" (Brown, 2000 & Prenksy, 2003), adolescents are growing up in an era of fast-paced, technological change. To this generation, change seems to be second nature.

Why is it important to study change in this particular population? Up to now, no one has investigated whether the lessons of classical change apply to adolescents (Fullan, 1993,

1999; Hall & Hord, 1987; Hall, George, & Rutherford, 1987). What the longstanding research on the adoption of innovation with adults reveals is that change does not occur rapidly, but rather in stages that involve varying levels of concern towards the attainment, application, and embracement of the innovation (Loucks-Horsley, 1983). Gene Hall, a noted researcher in the field of teacher education and in change theory, tells us that concern toward change can be qualitatively as well as quantitatively different among individuals and that the levels of concern can be correlated to these individuals' closeness to and involvement with a particular innovation (1991). However, what is true for adults may not be necessarily true for adolescents. Training, in-service, and ongoing integration strategies for adolescents are not prevalent in middle schools.

In this study, adolescents in 2 sixth-grade urban classrooms were provided the opportunity to adopt a specific innovation: a thin-client, tablet-style, wireless computer for both school and home use, 24 hours a day and seven days a week for a period of one year. [1] This study describes how the students have adapted to the tablet (innovation) and how they have integrated it into their daily lives at school and at home. A research instrument that notes adoption stages was used to document this adaptation as well as the perceptions about the adoption.

BACKGROUND

For over a decade, a small urban school district in Southern California has been implementing and integrating technology into the curriculum. In the fall of 2003, 2 sixth-grade classes, a total of 52 students, received thin-client computers. Since each student in the program received a computer, a 1:1 correspondence of computer-to-student, the district called the program "One-to-One @Home and @ School." Students, along with their teachers and their parents, received training in the use of the same thin-client, wireless, and tablet style computer. All of the 52 students' homes were outfitted with wireless cable modems to provide 24-hour-a-day access both to the Internet and to the district's Intranet, a communication system that provides the students with a limited access to web-based content

[1] A thin client, sometimes called a lean client, is a tablet style computer with a stylus and a touch screen to navigate through files. It is devoid of components such as a CD ROM, a hard drive, disk drive, and expansion slot.

and is directly connected to the Internet by means of a secure connection through the district office's website. At the end of the first year of the program, students were given the choice to enroll for a second year and to continue with the thin-client tablet program in seventh grade. The original cohort of 52 sixth-grade students was reconfigured in the second year, 2004-2005.

To understand how the thin-client tablet computer (the innovation) was adopted by middle school students, the Concerns Based Adoption Model (CBAM) developed by Francis Fuller was used. CBAM defines seven distinct phases (Stages 0 through 6) that occur in the adoption of an innovation while participants are learning to use that innovation. According to the CBAM model presented by Hall and Hord (1987), early concerns begin with Stage 0. As the innovation begins to take hold and becomes implemented, the self-concerns of Stages 0, 1, and 2, progress to the Management Concerns of Stage 3. Subsequently, in Stages 4, 5, and 6, the Stages of Concern move into Impact Concerns, in which the participant gravitates towards being more focused on the impact the innovation has on others rather than on his or her own ability to use the innovation.

Like that of dozens of other studies that have used the CBAM stages to describe and categorize how innovation is adopted and how adult innovators move through the stages, this study's hypothesis was that all CBAM stages would be evident during all phases of the thin client's adoption. The CBAM tool has helped provide an understanding of the change process from the viewpoint of the participant. The CBAM theory "launched a set of exploratory and descriptive studies to further elaborate the concept of concerns and to develop procedures for assessing concerns" (Hall, Newlove, George, Rutherford, & Hord, 1991, p. 5).

Based on the CBAM, the Change Facilitator Stages of Concern Questionnaire (CFSoCQ) is a research and assessment instrument developed by Gene Hall and his associates (1991). This questionnaire was designed to measure participants' concerns about an educational innovation. Together, CBAM and the CFSoCQ attempt to explain how the adopter of an innovation moves from a state of nonuse to a state of use for the innovation.

The CFSoCQ instrument, which was specifically used in this study, identified 7 stages beginning with Stage 0 and ending with Stage 6. Progressing through these stages or levels, the user moves from Stage 0 (Awareness) to Stage 6 (Refocusing). As shown in

Table 1, in the first stage, Stage 0, the user shows little or no interest in the innovation. With the early levels of exposure comes the desire to know more about the innovation, its uses, and effects. Next, users move towards managing the innovation themselves in Stage 3. Finally, by Stage 6, they manifest a desire to collaborate with others and to consider the innovation's effect upon the larger society.

Table 1. Definitions: Change Facilitator Stages of Concern

Stage 0 Awareness	Change facilitation in relation to the innovation is not an area of intense concern. The student's attention is focused elsewhere.
Stage 1 Informational	Student manifests interest in learning more about the innovation. The concern is neither self-oriented nor necessarily change-facilitation oriented.
Stage 2 Personal	Uncertainty about ability and role in facilitating use of innovation is indicated. Lack of self-confidence or in the support to be received from superiors, nonusers, and users are part of this stage.
Stage 3 Management	The time, logistics, available resources, and energy involved in facilitating others in use of the innovation are the focus.
Stage 4 Consequences	Attention is on improving student's own style of change facilitation and on increasing positive innovation effects.
Stage 5 Collaboration	Coordinating with other change facilitators (or students) to increase student's capacity in facilitating use of the innovation is the focus.
Stage 6 Refocusing	Ideas about alternatives to the innovation are a focus.

Note. From Hall et al., p. 17. Descriptions have been adapted for interpretation and for use with sixth-grade students.

According to Hall et al. (1996), nonusers of an innovation have been shown to have a low rate of adoption, as noted in Stages 0, 1, and 2 (see Table 1). In these beginning stages of

the adoption of the innovation (Stages 0-2), participants are affected by high-intensity concerns, while during in the last few stages they are affected by low-intensity concerns. As the use of the innovation begins, Stage 3 Management Concerns increase in intensity while at the same time Self Concerns (Stages 0, 1, and 2) decrease in intensity (a higher rating, with zero being no effect and a six rating a high intensity). As the adopter gains more experience with the innovation, the Impact Concerns (Stages 4, 5, and 6) gradually begin to increase in intensity. With experience, increased comfort, and sophistication in use, Impact Concerns (Stages 4, 5, and 6) become increasingly intense, while Self Concerns continue to decrease in intensity.

STATEMENT OF THE PROBLEM

Our youth are important stakeholders in the adoption of innovation; in particular, for this study, it was critically important to address how adolescents adapted to changes imposed by implementing technology. While thousands of educators have contributed to the concerns-based, adoption literature, what was notably absent previously was empirical and analytical data that reflects how adolescents have adopted and adapted to these innovations.

RESEARCH PURPOSE

The purpose of this study was to determine the adoption levels (levels of concern and stages) of an adolescent population as it embarked upon an adoption of an innovation: a thin-client, portable laptop-style, tablet computer. A multiple-method approach was used to examine change behavior for 52 sixth-grade students. The main hypothesis of the study was that the adolescent students would move through all seven stages and their respective levels of concern. In addition to documentation by the CFSoCQ instrument, students, along with one or both of their parents and a tablet teacher from each year of the program were also asked to reveal individual stories that described their adoption of innovation process.

The following research questions were investigated:

1. During the first year of the adoption, what stages of concern were evident among the students at the beginning of the year as well as at the end of the year?
2. To what extent can variation in these stages of concern, as well as the progression throughout the year, be explained by select demographic measures (gender, race/ethnicity, and prior experience with computers)?

3. Based on the qualitative interviews, how do select students describe their adoption of this innovation in Years 1, 2, and midway through year 3?

Theoretical Framework for the Study

The research was guided by two theoretical constructs. The first construct addressed the levels and Stages of Concern. Application of this CBAM instrument to adolescents was designed to be a new but contextualized experience for this population. In regards to the adoption of the innovation, learning how to use a thin-client computer in this case may not be a direct linear process, (Stage O to Stage 1, on to Stage 2, and so on); rather, students may deviate from the normal stage progression cited in the literature. Sixth graders may move through the recognized Stages of Concern in different ways, possibly beginning in Stage 6 and then ending in a lower stage. It is important to note, that even when the levels of concern are individualized and are greater in intensity for some learners than for others (Hall, 1976), concerns-based researchers have indicated that all levels of concern are present as a natural function of the learning process. For example, Loucks-Horsely (1983) hypothesizes that the adoption of an innovation, such as integrating computers into teaching and into learning, does not occur rapidly, but rather in stages that involve levels of concern toward the attainment, application, and embracement of the innovation.

The second guiding theoretical construct was based on the notion that students are adapting rapidly to innovation; adolescents tend to adopt the behaviors of technological change without intervention or intense training in the innovation. Is this adaptation due to the student's background and level of proficiency, to demographic differences, or is it due to this generation's ability to adopt change behavior more readily than their adult counterparts? This study has attempted to correlate differences in background, demographics, and other selected criteria to address issues surrounding the adoption of change to an adolescent population.

Significance of the Study

This study has documented both quantitatively and qualitatively the effects of the adoption of innovation in an adolescent population. The CBAM levels of use and the CFSoCQ have not been applied to an adolescent population in any other empirical study. CBAM instruments, including the CFSoCQ, have historically been administered to educators, usually in-service and preservice teachers. Designed to provide a medium for the voice of an adolescent population, this study has provided its participants with an opportunity

to share their reflections. In essence, this study has shared with the reader a deeper understanding of the effects of innovation on young people in our modern society. Questionnaires, surveys, and interviews have helped to frame the adoption process by offering an abundance of rich description of the adoption journey for 8 students.

LIMITATIONS OF THE STUDY

While the focus on adolescents' attitudes and beliefs about thin-client computers are critical criteria in the evaluation of an innovation, the CBAM and CFSoCQ instruments may not be able to reflect accurately attitudes and beliefs concerning how readily innovation has been diffused (Rogers, 1993). According to Roger's theory of diffusion of innovation, there are adopters and nonadopters of innovation and a myriad of determiners beyond what is espoused in change theory that explain why someone does or does not adopt an innovation.

Many studies have linked the effectiveness of classroom laptop computers in raising test scores, increasing achievement, and in decreasing absenteeism (Wenglinsky, 1998). Although this study does not purport to be an evaluation study, anecdotal data contained in interviews does offer perceptions that link the overall academic success of the student to the use of the thin-client computer.

CHAPTER 2

REVIEW OF THE LITERATURE

Currently, there is little research in the literature concerning adolescent adaptation to, and adoption of, technological innovations at school and at home. As we begin to build our communities of learning that extend outside the four walls of educational institutions, all of us need to look beyond the hardware infrastructure and gain insight into the behavior of young people in this age group as they embrace and apply new technologies in their lives.

To address this issue, there are five main areas of literature that will be reviewed. This chapter will: (a) provide an overview and history of concerns theory and the Concerns-Based Adoption Model (CBAM), (b) highlight studies involving change stages and CBAM for adults, (c) describe a context for change for teachers who use innovations, (d) examine the diffusion of innovation (DOI) theory (Rogers, 1985) to describe why some individuals adopt innovations more readily than others, and (e) explore the social behavior of adolescents, and how it relates to technology age appropriate skills acquisition set forth by the National Educational Technology Standards (NETS[2], 2000).

Since there is an absence of literature that describes how adolescents use and adapt to a technological innovation as this adaptation relates to CBAM, case studies involving adults and CBAM will be included to help provide insight into influences that determine the adoption or nonadoption of an innovation.

Overview of Concerns Theory and CBAM Research

Stemming from exploratory and descriptive studies by Francis Fuller conducted in the 1960s; concerns theory is the foundation for the Concerns-Based Adoption Model or CBAM (Hall & Hord, 1987). As a result of this research, a set of procedures for assessing concerns was developed (Hall et al., 1991). It is the underlying premise of the CBAM that when an innovation is introduced, individuals will move progressively through a series of stages or

[2] Designed by the International Society for Technology in Education (ISTE, 2000)

concerns. As the adopter — the person who is exposed to the educational innovation — becomes more familiar with that innovation, distinct categories of his or her concerns will be noted. Adopter concerns or stages can be described as changes in the developmental process during the progression through stages of change. Along with these concerns, adopters' perceptions involve a metacognitive or gestalt-like state in which adopters think about their own perceptions and about their individual abilities to adapt to change. Hall, Wallace, and Dossett originally proposed the CBAM in 1973 to help frame adoption behaviors of adults and to help us understand how adopters perceive change.

The Concerns-Based Adoption Model examines the element of concern. What is concern, and why is it an important measure for the adoption of innovation? Hall et al. (1991) describe concern as follows:

> To be in a mentally aroused state about something....the intensity of the arousal will depend on the person's past experiences and associations with the subject of arousal as well as how close to the person and how immediate the stimulus is perceived. Close personal involvement is likely to mean more intense concern, which will be reflected in greatly increased mental activity, focus of thought, worry, analysis, and anticipation. Through all of this, it is the person's perceptions that stimulate concerns, not necessarily the reality of the situation. It is this gestalt of psychological activity that is being tapped in the Change Facilitator Stages of Concern Questionnaire [CFSoCQ] (p. 5).

Hall, George, and Rutherford (1979) hypothesized that concern is a mental state of activity that is present when an innovation is introduced to an adult population. With this hypothesis, can we then make the intellectual leap that the state of concern is also present for adolescents who are adopters of innovation? The literature on stages of change, change behavior, and on the beliefs and practices by educators who use technology in their classrooms indicates that there are distinct phases in the adoption of an innovation and in the use of technology. According to the CBAM model presented by Hall and Hord (1987), early concerns begin with Stage 0, a level of Nonuse with a focus on Self-Concerns, while the next two Stages, 1 and 2, also focus on Self-Concerns. As the innovation begins to take hold and become implemented, the Self-Concerns of Stages 0, 1, and 2, progress to the Management Concerns of Stage 3. Subsequently, in Stages 4, 5, and 6, these move into Impact Concerns. These move the adopter from a focus of concern about the self towards the logistics of how to manage the innovation, time, available resources, and how to direct the energy of the use.

Management Concerns also involve connecting the use of the innovation to interaction facilitation with others who are using the innovation.

As the adopter moves from a focus on Self-Concerns (Stages 0, 1, and 2) into Management and Impact Concerns (Stages 3 through 6), the CFSoCQ frames this transformation in the context of facilitation; how the use of the innovation is impacted by the facilitation of the innovation. Section II of the CFSoCQ manual describes change facilitators as those individuals who are responsible for facilitating "front line" use of an innovation.

Concerns theory provides the foundation for several CBAM and Stages of Concern instruments: the Stages of Concern Questionnaire (SoCQ), Computer Concerns Questionnaire (Martin, 1999), Levels of Use of an innovation (LoU), and the instrument used in this study, the Change Facilitator Stages of Concern (CFSoCQ). It is important to note that this last instrument, the CFSoCQ, which is used to measure stages of change for change facilitators, contains the same hierarchy as CBAM (Levels 0 through 6).

Change Stages and CBAM for Adults

There is legitimacy to the study of change and to the collection of information about change behavior in adults. Three widely known perceptions about change are the following: (a) Change is a process, not an event; (b) change is a highly personal experience involving developmental growth in feelings (the Stages of Concern) and skills (Levels of Use); and (c) personal concerns about change are legitimate (Horsley & Loucks-Horsley, 1998). Like change, the stages of concern in the CBAM are described as highly individualized. Gray (2001), in his multiple-method case study, investigated teachers' perceptions of innovation and adoption of technology in a graduate-level course for in-service and for preservice teachers. A critical finding of this study was that "In order for teachers to adopt innovations, the learning process must be individualized" (p.30). While Hall and Hord (1987) and Loucks (1997) agreed that the adoption of innovation process focuses primarily on the individual, they add that it also affords change facilitators (the program and change-assessment agents) the opportunity to address needs by providing feedback to the adopters.

Teachers and Change: Influencers and Implementers

Is the adaptation of an innovation dependent upon the instructional use of the innovation by the teacher? Students do not adopt innovations in isolation; in fact, it is

strongly suggested that a teacher's practice and own use of technology also influences the student's practice. In a pivotal study outlining the beliefs, practices, and computer use by teachers, Riel and Becker (2000) noted that teacher-leaders are "better educated, continuous learners, computer users, and promote constructive problem-based learning over direct instruction" (p. 1). Riel and Becker also reported that a teacher's position in the community mirrors the student's position in his or her classroom. While this study focused primarily on the teacher-leader's attributes, including the attribute of the strong use of computers, other studies have focused on the student's level of computer use and of software integration. Interestingly, although the educators studied were computer literate, the study indicated that only 10% of the teachers were found to be "Highly Active Computer Users" (p. 13). [3]

Because they themselves are inextricably connected to the process of change in the educational learning environment, teachers may affect how their students experience the change stages. Although student behavior regarding the use of the thin-client computers may reflect change stages over time, Guskey (1987) in his research on computer-based instruction suggested, "Significant change in teachers' beliefs and attitudes is likely to take place only after changes in the student learning outcomes are evidenced" (p. 7). Guskey also reported that the change in the teacher's classroom practice by modeling, integrating, and using technology should be followed by changes in his or her attitudes and beliefs. These findings may still hold true today as a critical factor in how adolescents adapt to an innovation.

Windschitl and Sahl (2002), in a multicase, ethnographic study, traced teachers' use of technology in a laptop-computer school and found a distinct interplay between teacher beliefs, the social dynamics of the innovation, and the effects of the institutional culture. In the 2-year study, the data were analyzed to see how the participants' practice with technology changed. Windschitl and Sahl found that the personal histories and beliefs about their students influenced the teacher's thinking about technology use in the classroom. In this study, teacher beliefs and institutional expectations also influenced the instructional choices regarding how the laptops would be integrated.

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[3] A "Highly Active User" is one that reflects .25 standard deviations above the mean on Student Tool Uses, .25 standard deviations above the mean on Teacher Use and Expertise, and not lower than .25 standard deviations below the mean on Frequent Simple Uses (p. 13).

Carol Peters (in Windschitl & Sahl), a social studies teacher with 10 years of experience, reconsidered her pedagogy, including her beliefs about technology integration, because of the "connections" she found between the affordances of the technology and the needs of her students as developing adolescents. Peters recognized that individual laptops allowed her students to access primary-source documents on the Internet for research and enabled them to use digital tools to develop professional-looking documents for the classroom. In the same study, Peters' colleague, Stephan Gonzales, changed his teaching practices as he shifted toward constructivist instruction and directed his students toward a web-based, relevant curriculum. Not surprisingly, during the course of the study, the students who also used laptops underwent change by becoming more collaborative and by contributing a positive social dynamic in the classroom.

In addition to changing the paradigm of teaching and learning at this middle school, the laptop program was observed to be more "pervasive than the traditional desktop learning" (Windschitl & Sahl, p. 201). In summary, Peters, Gonzales, and others found there were powerful influences at work that helped, over time, to shape the teachers' practices with technology. The laptop program brought several observable changes in students' lives, in the lives of teachers, and in the school environment.

Technology Integration

Technology integration brings about changes that impact the entire school environment. For one year, Zhao, Pugh, Sheldon, and Byers (2002) studied the effects of innovation as teachers attempted to integrate technology into their classrooms. The study found 11 salient factors that significantly impacted the degree and success of classroom technology innovations and further categorized them into three interactive domains: "the innovator, the project (or innovation), and the context" (pp. 482-483). Zhao et al. suggested several factors associated with the teacher that effect success: (a) the level of technology proficiency of the individual, (b) the pedagogical compatibility by the individual, and (c) the social awareness of the environment of innovation. Although these factors are reliant upon the degree to which the individual teacher has adapted to the technology, there are other social and environmental effects that may need to be taken into consideration.

Adolescents and Social Behavior

Many noted sociologists and psychologists have helped to characterize the unique social behavior and development of adolescents. For example, Csikszentmihalyi & Larson (1984) framed the behavior of adolescents by their experiences in the environment which are categorized by 3 distinct locations: school, home, and public locations; however known fact youth are also highly influenced by the people in their daily lives: family, friends, classmates, teachers, and also by personal time spent alone.

We are also learning that much of this behavior in the 21st century has been heavily influenced by modern technologies for academics and for leisure activities, predominantly the desktop computer and cellular mobile phone. For over 21 million adolescents in the United States, using the Internet is normal daily activity (Pew Internet & American Life Project, 2002). In fact, more than 87% of children between the ages of 12 and 17 go online almost daily to use email and for instant messaging, to play games, to make purchases, to get news, seek health information and also to work on homework (American Institute for Research, 2005).

Students and Change: When Students Use Computers

Wenglinsky (1998), in a report for the National Assessment of Educational Progress (1996) presented findings on the relationship between different uses of educational technology and various educational outcomes. Data, including information on the effects of educational technology, were drawn from samples of 6,227 fourth-graders and 7,146 eighth-graders. Four areas were addressed, two noting student use and two noting teacher use. As in many of the technology use and laptop studies, the Wenglinsky report indicated that technology-using students who have laptops use computers more frequently than do students who do not have their own personal computers. Along with how often the students used computers (frequency levels), the lack of access to computers at school and at home was found to relate negatively to academic achievement and to the social environment of the school (1998).

Over a period of 3 years, Gulek and Demirtas (2005) examined the impact of another laptop study, the Harvest Park Laptop Immersion Program in Pleasanton, California. Examination of student learning was made for three middle-school cohorts (259 students)

that compared achievement data of laptop students to comparable data for nonlaptop students. Statistical analysis of grade point averages (GPAs), end-of-course grades, District Writing Assessment results, results of Standardized Testing and Reporting (STAR), Norm-Referenced Tests (NRT-CAT/6), and the California Standards Tests in English language-arts and mathematics showed a significantly higher achievement in nearly all measures after students had spent one year in the program.

Diffusion of Innovation Theory (DOI): Description and Application

Why some individuals (including adolescents) embrace technological change and adopt innovations more readily than do others may be explained by the application of diffusion of innovations (DOI) theory (Rogers, 1985). Diffusion of innovation is defined as "the process by which an innovation is adopted and gains acceptance by members of a certain community" (Surry, 1997, p.1). DOI may also explain why certain variables, such as personality, intelligence, education, the individual's skill level, the social context of innovation, and characteristics inherent in the innovation itself, can influence the adoption of innovations (Hornick, 2004).

According to Rogers, the effects of change are highly influenced by communication among the members of the social system and between the change agents and their clients (or the adopters) in that system (1995). He further concludes that the diffusion of innovation is a type of social change highly dependent upon the individuals who are involved in the adoption of the innovation. In the CBAM, the adoption of innovation is focused on the individual; however, Rogers paints adoption as an interconnected process among all members of the society, not just between the adopter and the innovation.

Case Studies of One-to-One Laptop Use

State and national laptop initiatives (Jeroski, 2003; Kerr, Pane, & Barney, 2003; Stevenson, 1998) show that laptops have a positive effect on students, on teachers, and on the educational community. In an attempt to highlight lessons learned from these successful laptop initiatives, task force members provided reports on several dozen schools in Florida and others from throughout North America. The schools in these reports have adopted and implemented laptop technology for a variety of reasons and with a mixture of approaches.

THE WIRELESS WRITING PROJECT

Jeroski (2003, 2005), the lead researcher for a school in British Columbia, reported on the *Wireless Writing Program* (WWP), a systemic, action-research project encompassing five classrooms for grades six and seven. Teachers who were asked to describe the impact of the project on student technology skills gave the program the highest rating, 5 out of 5. All parents in this program reported that their children's technology skills had improved "extensively" or "substantially" (Barrios, et al., p.39). In addition, in the follow-up report Jeroski (2005) suggests that student writing was also more substantive.

PROJECT CONNECT

Another large laptop implementation project, *Project Connect* at Key Largo School in Florida, connected all students, grades 6-12 with wireless laptops. As was the case in the *One-to-One Project @ School and @Home* cited earlier, *Project Connect*, also included wireless access in the students' home, for the 2004-2005 school years.

MICROSOFT ANYTIME, ANYWHERE LEARNING

In a pivotal 3-year study, *Microsoft Anytime, Anywhere Learning* (1997) reported an increase in the levels of attitude and motivation and an increase in positive student behavior. In fact, laptop students consistently showed deeper and more flexible uses of technology than did the nonlaptop groups with whom they were matched. Changes in these students were observed within a very short time after the program's implementation. This study continues to be a landmark case and impetus for the National Laptop Initiative and for the One-to-One laptop per child movement. One Laptop per Child (OLPC) is a non-profit association dedicated to research to develop a $100 laptop. This initiative was launched by faculty members at the MIT Media Lab and by co-founder Nicholas Negroponte (Retrieved: December, 2006 http://laptop.org/).

NEWHOUSE STUDY

In another laptop study by Newhouse, 70% of students in an Australian middle school indicated they could not do without computers (2001). These middle-school students also cited an increase of a perceived need to use computers at home for word-processing

assignments. What is interesting to note about this middle-school population is that 40% of the total group studied had used portable laptops in elementary school. This is an important consideration that establishes the need to obtain background computer-use information from the adolescent population.

Selwyn and the Computer Attitude Scale

Selwyn (1997) designed a computer-attitude scale for students ages 16 through19, which emphasized a strong need for both educators and researchers to be aware of students' attitudes toward using and interacting with computers. Findings from the study identified themes regarding attitude that could be cross-correlated with students in other classes and in other populations. Students who were highly active users of computers reported a more positive attitude to using that computer. [4]

Technology Standards

By the year 2006, every eighth-grade student in the U.S. needed to be proficient in the technology literacy skills as set forth in the No Child Left Behind legislation (2002). The International Society for Technology in Education (ISTE) created 10 technology standards for grades 3-8, which ranged from troubleshooting, identifying, and solving routine hardware and software problems to personal productivity and group collaboration (ISTE, 1998). One of the main goals of these standards commonly referred to as the NETS (National Education Technology Standards) is to enable stakeholders in Pre-K-12 education to develop and apply national standards for educational uses of technology (Retrieved: October, 2003 http://cnets.iste.org/nets_overview.html). These standards (Appendix I) describe what students should know about technology and what they should be able to do with technology in the 21st century.

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[4] A "Highly Active User" is one that reflects .25 standard deviations above the mean on Student Tool Uses, .25 standard deviations above the mean on Teacher Use and Expertise, and not lower than .25 standard deviations below the mean on Frequent Simple Uses (p. 13).

Summary

The One-to-One @School and @Home Project, the case for this study, has attempted to identify factors that describe conditions for innovation and for the adoption of thin-client computers by adolescents. Studies to support the adoption or diffusion of innovation by adolescents are currently not present in the literature; however, theories such as CBAM and DOI may have helped explain why some individuals adopt or diffuse innovation more readily than others. In conclusion, the research surveyed in this chapter, by citing increased motivation and attendance, helps to build a case for students' use of personal, portable, laptop computers. Not only does the use of the technology increase student motivation and attendance, but more importantly, by using technology, students will meet federal requirements for technology literacy.

CHAPTER 3

METHODOLOGY

Adult educators are the most widely studied population in the areas of the adoption of innovations, diffusion of innovations, and organizational change; however, the ability to adapt and adopt an innovation does not belong exclusively to adults. Researchers, including Hall, Hord, Loucks-Horsely, et al., have hypothesized that change stages can be identified for groups when those individuals are exposed to an innovation.

To support this hypothesis, the methodology in this chapter has focused on data collection and analysis activities that help to describe how a group of middle-school-aged students have adapted to and adopted an innovation. In the quantitative section of this analysis, pre- and post survey details from the Change Facilitator Stages of Concern Questionnaire (CFSoCQ) have been provided to show the effects of the use of thin-client computers for two technologically enriched, 6th-grade classrooms.[5] In addition to documenting the extent of use of the innovation, this study has also collected qualitative data that helps to frame the students as agents of change; students in this study are benefactors and stakeholders affected by change resulting from using an innovation. The case study further describes how a group of 9 students and a subgroup of 4 of the 9 adopted the thin-client computers in Years 1, 2, and 3 of the One-to-One program.

During the first year, each of 52 sixth-grade students received a laptop-style, thin-client, and portable computer for personal use at school and at home. Thin-client, portable computers have been reported to be a cost effective and affordable solution for business, industry, and for some school districts in the United States. At the end of the first year, the students were asked by the school district to reapply for the program, which was continued in seventh grade, for the 2004-2005 school years, and in eighth grade, for the 2005-2006 school years. In Year 2 and Year 3, some students reapplied, while others did not. While following the original Year 1 cohort, a qualitative, case-based study, a subset of 8 students who

[5] The CFSOCQ results from the pre-and post test exists as previously collected data from 2003-2004 data.

remained in the program through Year 3 was interviewed midway during the final year of implementation.

The purpose of this study was to determine the adoption levels (levels of concern and stages) of an adolescent population as it embarked upon an adoption of an innovation: a thin-client, portable, laptop-style, tablet computer. A multiple-method approach was used to examine change behavior for 52 sixth-grade students. The main hypothesis of the study was that the adolescent students would move through all seven stages and their respective levels of concern. In addition to documentation by the CFSoCQ instrument, students, along with one or both of their parents were also asked to reveal individual stories that described their adoption of innovation process.

The following research questions were investigated:

1. During the first year of the adoption, what stages of concern were evident among the students at the beginning of the year as well as at the end of the year?
2. To what extent can variation in these stages of concern, as well as the progression throughout the year, be explained by select demographic measures (gender, race/ethnicity, and prior experience with computers)?
3. Based on the qualitative interviews, how do select students describe their adoption of this innovation in Years 1, 2, and midway through Year 3?

Sample Selection

This study was conducted at a small urban school district in Southern California, which for over a decade has embraced innovative technology-based, educational practices. By the turn of the 21st century, this district had already started to reduce its computer-to-student ratio, had built an Intranet for school and for home use, and had begun to use thin-client, desktop computers to reduce hardware costs.[6] The catalyst for this study involved the school district's implementation of a thin-client, tablet computer program called "One–to-One @ School and Home" in September 2003.

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[6] Case studies from industry indicate that "thin client computers require fewer staff to manage more machines, significantly reducing the Total Cost of Ownership (TCO) of technology (Thin-Client Solutions for K-12 Schools, White Paper, 2000, p.1)."

Setting

In September 2003, 60 sixth-grade students received a thin-client tablet computer from their school district for school and for home use. Prior to the start of school, the district randomly divided the population into two groups of 30 students, which later declined to 52. Each group was placed either in a morning or an afternoon section of language arts and social studies taught by the same teacher. After parents signed a letter of consent to participate in the program, the students were loaned, at no cost, a wireless cable modem from the local cable company for use in their homes. For one year, students used the computers and then were asked to reapply for the second year as seventh graders, and again for the third year as eighth graders.

Participants for Quantitative Study

The total population for the quantitative section of this study originally included 60 6th-grade students, 30 from the morning section of a language arts/social studies class and 30 from an identical afternoon section with identical content and each with the same teacher. By the end of Year 1, pre and posttest data from a total 58 students were included in the quantitative portion of the study. Initially, the plan was to survey all 60 students who were enrolled in the first year of the program at the beginning and at the end of the year. Due to some attrition, which will be discussed later, and due to the entry of new students once the innovation was underway, a total of 58 students were surveyed (this was a combination of pre and posttest totals). In the end however, a total of 45 students had participated in the both the pre and posttest, with an additional 8 students completing the pretest only, and 5 students completing the posttest only (see Table 2).

As shown in Table 2, the Change Facilitator Stages of Concern Questionnaire (CFSoCQ) data in Year 1 were collected in the fall and in the spring; 45 participated in both the pre- and posttests, 53 respondents took the pretest only and 50 respondents took the posttest only.

Table 2. Frequency Distribution of the Population: Year 1

Population	Male	Female	Total	Both Pre & Post
Pretest, Fall	21	32	53	45
Posttest, Spring	18	32	50	45

(Note: the dropouts from Year 1 of the program equal 13, *N*=58)

Participants for Qualitative Study

A small sample, consisting of 8 students who remained in the program through 7th grade, was drawn from the CFSoCQ posttest population of 52 from Year 1 to develop the eight case studies. These studies were purposive since the objective was to obtain a sample that represented a variety of characteristics and criteria (Patton, 2002). A data-selection criterion grid was used to document interest and data from the potential subjects (see Appendix D). In addition to the demographic criteria, subjects were then selected according to their scores on the CFSoCQ and rated according to their individual adoption stages of the innovation.

There were two main goals for obtaining the student sample: The first was to obtain a sample of eighth-grade students that were gender and ethnically balanced — ideally two females and two males and including one Latino, one African-American, one Caucasian, and, one student of Asian or Pacific Island descent; the second goal was to find at least 4 of the 8th-grade subjects who met these criteria, and who remained in the program as Year 1 and Year 2 adopters. Another criterion was to obtain a range of participants whose pretest and posttest scores from the CFSoCQ exhibited a wide range of levels.

In addition to the students, several parents of the final group of students were also interviewed. The purpose of the interviews was to obtain rich data that framed the connection between the innovation and the student's home. This has helped to describe the adoption process from the parents' perspective. Lastly, along with the interview from the parents, data was collected from a teacher from each year of the program to assist with triangulation for the case studies. In sum, to complete a series of case studies and to help triangulate the data from all parties, students, parents, and the language arts/social studies or science teachers from all three years were all interviewed.

Data Collection Procedures

Data was collected in two phases for this mixed-methods study. During the first phase, using the CFSoCQ, quantitative data was collected as a pretest in September 2003 and as a posttest in June 2004. In phase two, qualitative data was gathered from 8 purposively selected students who participated in Year 1 and Year 2 and in eighth grade completing Year 3 of the program.

Quantitative Data Collection

INSTRUMENTATION

To ensure confidentiality, students identified themselves on the CFSoCQ only by their student number; those surveys were matched with selected demographics for gender, race, ethnicity, GPA, and Free and Reduced Lunch.

As previously mentioned, the quantitative instrument used for this study was the Change Facilitator Stages of Concern Questionnaire (CFSoCQ). The CFSoCQ was based on Hall's Stages of Concern Questionnaire (SoCQ) and then modified in 1989 to meet the needs of change facilitators. Neither of these versions had adolescents specifically in mind. The CFSoCQ, however, was selected for this study because of its ability to document stages of concern for change facilitators, namely, for adults who had been involved with several stages of change and in several adoption processes. The adolescent population who received the thin-client laptops had been involved in innovational programs using computer technology from early elementary grades.

The CFSoCQ is a three-part questionnaire, which includes an introduction, a set of questions using an 8-point Likert Scale,[7] and a demographic section. This survey was "normed" on a population of 589 adults and, as reported by Hall, has an overall test and retest reliability that ranges from 0.65 to 0.86 and an interval consistency (alpha coefficients) that ranges from 0.83 to 0.94. However, since the norming took place with adults, it was difficult to predict what the applicability or reliability would be when the instrument was used with adolescents.

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[7] Note: responses begin with 0 and end with 7 making it an 8-point scale if we count zero as a number. This may also be referred to as an ordinal scale.

The CFSoCQ questionnaire consists of 35 statements, each expressing a certain concern about an innovation. By marking a number next to each statement on an 8-point ordinal scale (ranging from 0 through 7), all respondents indicated the degree to which each concern applies to them. High numbers indicated a greater concern level, and low numbers indicated a lower level of concern. As reported in the Manual for Use of CFSoCQ, the questions in this instrument were carefully selected by the developers to represent the seven fundamental areas of concern. "Each scale consists of items that are representative of concerns which are prominent at the specific Stages of Concern" (Hall et al., p. 25).

Within each of the seven stages of concern, there are 5 statements or questions, for a total of 35 items to which the participant responds. The seven fundamental areas of concern include the following: Stage 0, Awareness; Stage 1, Informational; Stage 2, Personal; Stage 3, Management; Stage 4, Consequence; Stage 5, Collaboration; and Stage 6, Refocusing. (See Appendix B for Definitions: Change Facilitator Stages of Concern).

Table 3 shows the item (question number) and its corresponding Stage of Concern, with 5 of the 35 questions being associated with each level or Stage of Concern. (See Appendix C for entire instrument and corresponding questions).

Table 3. Facilitating the Use of the Innovation: 35 Item Numbers (Questions) and Associated Stages of Concern

CFSoCQ Level	Item Number
0	2, 5, 10, 22, 25
1	1, 7, 16, 30
2	8, 11, 17, 24, 29
3	4, 14, 23, 28, 34
4	6, 18, 21, 27, 31
5	3, 9, 15, 20, 33
6	13, 19, 26, 32, 35

Hall et al., p. 25.

Hall, George, and Rutherford, the originators of the instrument (1979) have hypothesized that whenever an innovation is introduced, as represented by the CFSoCQ,

three major categories of concern will always exist: Self, Task, and Impact Concerns. Self includes Stages 0-2; Task, Stages 3-4; and Impact, Stages 5-6.

PILOT STUDY FOR THE ADAPTATION OF THE QUANTITATIVE INSTRUMENT

In the spring of 2003, the CBAM/CFSoCQ questions were distributed to three subject-matter experts who taught middle school or who worked with middle-school students. Based on the feedback from the subject matter and grade-level experts, a revised CFSoCQ was adapted and rewritten for a middle-school population. The revised instrument was then administered to 4 fifth-graders and 4 sixth-graders at a parochial school in Southern California. To test for readability and for comprehension, students were asked to indicate any questions they felt were unclear and to comment on the meaning of key words used in the questionnaire. Based on their comments, further changes were made to make the questions more comprehensible to adolescents. In addition to the readability changes, the instrument was again rewritten to substitute the word *computer* for the more general term *innovation* (see Appendix C). The revised CFSoCQ was administered by the district in the fall of 2003 and then again in the spring of 2004.

Qualitative Data Procedures

In phase two, qualitative data was gathered from 8 of the 58 students; all 8 students participated in Year 1, Year 2, and who were in eighth grade at the time of the final data collection. Data from these Year-3 students, their parents, and their then current science teacher were also collected, analyzed, and triangulated. Results will be reported in Chapter 4 by narrative description.

INSTRUMENTATION

In order to provide different perspectives on the adoption of innovations and to help document stages of change from a variety of viewpoints and perspectives, three groups of stakeholders from the community were interviewed. Each survey instrument contained a series of open-ended questions that were formulated to complement the 35- question CFSoCQ (See Appendix C).

As mentioned earlier, the student sample was intended to be a purposive sample since it represented a variety of characteristics and criteria (Patton, 2002). A data selection-criterion grid was used to document potential subjects (see Appendix D). The final sample of eight students was selected based on features or characteristics that enabled detailed exploration of the innovation and the adoption of the innovation process. Conditions for selection also included student interest and availability, parent interest and availability, and participation in the Year-1 and Year-2 implementation. In addition, the sample was gender balanced and represented several ethnicities.

Student Instrument

The student questionnaire, which was used for all 8 students, contained 11 open-ended questions that allowed the students to discuss and describe how they were using the thin-client computers at school and at home, providing qualitative data on their perceptions of use. In addition to the usability questions, students were also able to describe their journey in adopting and adapting to the changes that have occurred by using the innovation as well as by the effects that this innovation had already had on their lives (See Appendix E).

Parent Instrument

After parents gave consent to interview their children, the interviews began by asking each parent to provide some general demographic information regarding ethnicity and computer use in the home prior to 2003. Meetings with the parents were scheduled according to the availability of one or both parents of each student.

The parent-interview questionnaire consisted of eight open-ended questions that allowed the parents to discuss and describe how their children were using the thin-client computer at home and also how they perceived their children to be using the innovation at school. In addition to questions that pertained to computer use, the parents were asked to describe the project journey from the beginning of the implementation to the current stage of the project. They were also asked to comment on how their children had adopted and adapted to the changes resulting from the use of the innovation and how the innovation had impacted their lives. Finally, they were asked to speculate on the impact the use of the innovation might have on their children's lives in the immediate and long-term future.

Analysis of Quantitative Data

Two sets of data were collected—the pretest data from September 2003 and the posttest data from June 2004. A complete description of the scoring of the quantitative data follows.

SCORING

Upon receipt of the completed CFSoCQ questionnaires, the data were sorted and coded by student number for analysis. Each survey was then hand-scored using the CFSoCQ Quick Scoring Device (Hall, Newlove, George, Rutherford, & Hord, 1979). The scoring device includes six sections, A through F (see Appendix I). In Section B of the scoring device, each stage contains five questions, five questions for each of the 7 stages (0-6). As previously stated in this chapter, the pretest and posttest data were scored according to the Stages of Concern scale (Hall et al., 1976) and to the CF Stages of Concern Raw Score-Percentile Conversion (1989).

This process began by calculating the raw score for each scale as the sum of the responses to the five statements for that scale. The raw score for each stage was then calculated by finding the sum of the responses to the five statements for that stage. Raw score totals were then converted to percentile scores, using percentile ratings previously developed by Concerns Based Systems International (Hall, et al., 1989). Data were entered into SPSS, computed, and analyzed. Separate multiple regression analyses were undertaken to determine whether demographic variables could be associated with stages of concern for the pretest scores, posttest scores, and for the difference between the pre- and posttest scores.

If any items were left blank, the average was computed for the items marked in that section, and that average was then used for the missing responses. If a respondent did not circle any number for an answer but left the section blank, the survey was counted, but without the one missing response.

After the issue of missing data was addressed, the means and standard deviations of the raw scale scores were calculated and presented. The raw scale scores were then converted to percentile scores.

Analysis of Research Data

The following narrative displays the analytical approach that was taken for the quantitative data. Alpha level for this study were set at $p = .05$. However, due to the exploratory nature of this study, findings significant at the $p = .10$ level were noted in the hope of suggesting possible trends for future research.

Research Questions One and Two (student stages at beginning and at the end of adoption period) were primarily descriptive in nature. The data was analyzed using standard summary statistics (means, standard deviations, frequencies, and percentages). Student stages based on demographics were also examined through the use of multiple regressions analysis that used demographic measures to try and explain why the students' stage scores vary. The demographic variables used in the analysis included gender, ethnicity, GPA, and whether the student was receiving free/reduced lunch. (Selected demographic measures have helped explain why some students progressed through the change stages more rapidly than others). The data were examined in a similar fashion. The demographic variables were used to compare the participants' pretest to their posttest.

Analysis of Qualitative Data

The qualitative analysis in this section was informed by the results of the quantitative data analysis of the CFSoCQ collected for the nine case studies. All qualitative data was collected, analyzed, and coded to represent all participants. These included (a) 9 of the 52 sixth-grade students who participated in the implementation Years 1, 2, and 3; (b) one or both of the parents or guardians of the nine students; and (c) one of their tablet program teachers from each year. Multiple sources of data were compared and triangulated among all of the students, among the parents, and among the various reports about the students from the teacher. Using a multimodal, case-study approach to coding data from interviews has helped to ensure a multidimensional report of perceptions.

A cross-case analysis was also used to look for themes between the groups. Possible themes might include computer use, reasons for computer use, adaptation of technology, and reasons for adoption or nonadoption. Data was compared within the group of the 8 students and as a cross-case comparison and within the subgroup. As reported in chapter 4, the interviews and cross-case comparisons have attempted to provide a list of themes and factors

that identify reasons why one adolescent showed in the past a propensity to adopt an innovation more quickly than others in their group.

Since it was presumed that each of the eight students would have a unique Year-1 pathway of adoption and a unique score from the CFSoCQ, statements from the instrument were also to be used to help describe how each participant fitted the profile and pathway of adoption.

Limitations of the Quantitative Instrument

The CFSoCQ questionnaire was designed exclusively for diagnostic purposes with adult personnel involved in the facilitation, the adoption, or the implementation of an innovation (Hall, et al., 1991). According to the manual, the CFSoCQ should not be used for screening or for evaluation. The manual also stated that any attempt to modify one or more of the questionnaire items could result in the invalidation of scoring and could influence the norming of the standards. This, in effect, could lead to the misrepresentation of results and, as noted, the interpretation of the data.

Although the above limitations may suggest the instrument may not be used with any other population, ideally, the study will ideally help pave the way for future measurement of change in student populations. The instrument used for this study was selected because of its ability to categorize stages of concern and behavior associated with individuals who are confronted with adapting to and adopting an innovation. Typical technology and computer usability instruments indicate levels of use but do not adequately address or track how individuals adapt to change when presented with a new innovation. Thus, in addition to applying the analysis and interpretation of the change categories from the CFSoCQ, qualitative data would help describe how students adapted to change and articulate their level of concern in the adoption process.

Ethical Considerations

While this research was undertaken, the established procedures of the Committee on the Protection of Human Subjects for both the University of San Diego and San Diego State University were followed. Since the participation in this study is entirely voluntary, there was no risk to the participants. Teachers and parents are not considered an "at-risk" population.

For the qualitative portion of the study, the school district sent a letter to the parents to ask for volunteers from the original 60 students who participated in Year 1. After the signed letter of intent to agree to an interview was returned to the school and the documents for informed consent were clearly understood, the students were interviewed. In addition to the students, one or both parents of all these students were also interviewed. All participants were assured that the information obtained would remain confidential and that every effort would be made to report the findings in a way that did not jeopardize a subject's confidentiality.

CHAPTER 4

RESULTS

This study investigated the perceptions of 45 middle school students who used thin client, tablet style portable computers at home and at school for more than one year as part of a one-to-one program. Specifically, this study used a mixed methodology design to investigate (a) whether the seven stages of concern that research indicates adults pass through as they adopt innovations can be applied to students, and (b) the extent to which select demographic measures may explain why some students adopted innovations more readily than others.

The study began in the fall of 2003 and was extended to include qualitative interviews during Year 2 and Year 3 of the innovation. Data were collected longitudinally from Cohort 1 in Year 1 (sixth grade); in Year 2 (seventh grade); and in Year 3 (eighth grade), with the final data collection ending in December 2005. During Years 2 and 3, a purposively selected group of students who remained in the program all three years and their parents were interviewed.

RESEARCH QUESTIONS OVERVIEW

This study utilized three research questions about the perceptions of adolescents who participated in a one-to-one, thin client, tablet computer program. The first question focused on the Stages of Concern that were evident among the students at both the beginning of the year and at the end of the year (during Year 1 of the program). This question was answered with quantitative data generated by a modified version of the Change Facilitator Stages of Concern Questionnaire (CFSoCQ) instrument, which has been used to assess responses to innovations over time among adults (Hall et al., 1979).

Question 2 asked to what extent variation in stages of concern among students—as well as stage changes during the first year of the innovation—can be explained by select demographic measures such as gender, race/ethnicity, GPA, and free/reduced lunch. Multiple regression analysis was used to address this second question.

Question 3 focused on how select students described their adoption of this innovation in Year 1, Year 2, and midway through Year 3 of the one-to-one program. Qualitative interviewing with purposively selected students (and their parents) was the methodology used to answer the third question.

QUANTITATIVE PROCEDURES

Data were collected in two phases for this mixed methods study. During the first phase, Pretest data were collected from 53 subjects in September of Year 1 (2003), and Posttest data were collected from 50 subjects in June, (2004). Phase two began in the fall of 2004 and ended in December, (2005). By the end of the first year, to reconcile the difference in numbers, it was discovered that only 45 students took both the Pre and Posttests. Based on the data analysis from phase one, a small sample of 8 students from the 45 was purposively selected to answer the third research question. The sample selection procedures and the qualitative interviewing strategies employed during Phase 2 will be described later in this chapter. Here, it is sufficient to note that, in addition to the qualitative procedures that will be summarized later to answer Question 3, the second phase of the study also employed quantitative data analysis. Specifically, the scores from the Change Facilitators Stages of Concern Questionnaire (CFSoCQ) were used to construct Stage of Concern profiles and pathways for each of the 8 selected students.

Data Representation from CFSoCQ

This section describes the data representation and coding schema employed for the first two research questions. Data are first represented as group Pretest scores. These scores are the participant's highest score from 1 of the 7 Stages of Concern (determined by results from the modified CFSoCQ). The 7 Stages of Concern (0 through 6) begin in Stage 0 (Awareness) and end in Stage 6 (Refocusing). (See Appendix B for CFSoCQ stages and descriptions.) The data is then represented as Posttest (high stage scores) and again as Pre- and Posttest comparisons. In addition to Pretest, Posttest, and to Pre- and Posttest-differential analysis of the high stage scores, Hall, George, and Rutherford (1979) also suggest analysis of the second high Stage of Concern scores to determine possible patterns. Examining both the high stage (first highest stage reported) and second high stage (second highest stage reported) in the Pretest and in the Posttest, made a detailed interpretation of the Year 1 data

possible. The notable high and second high stage combinations and their frequencies are plotted, analyzed, and are shown in Tables 8 and 9 which represent a detailed reporting of the double peak (highest and second highest scores).

The coding of the Pretest and Posttest high and second high pairs is as follows: (a) Pre1High, (b) Pre2High, (c) Posttest1High, and (d) Posttest2 High.

Self-Use, Task, and Impact Dimensions

Throughout the Concerns Based Adoption Model (CBAM) literature, three distinct dimensions— Self-Use, Task, and Impact— are clustered around a specific phase of adoption; these dimensions are used to further categorize the Stages of Concern. As each name implies, the first dimension, Self-Use (Stages 0 through 2), is focused on the personal use of the innovation; the second dimension, Task (Stages 3 through 4), is focused on the task of the innovation (time, logistics, and management); and the third dimension, Impact (Stages 5 and 6), is focused on the impact of the innovation. (See Appendix B for more detailed explanations of each of the seven stages).

RESEARCH QUESTION 1: STAGES OF CONCERN

The first research question was stated as follows: During the first year of the adoption, what stages of concern were evident among the students at the beginning of the year as well as at the end of the year? This section will clearly identify Stages of Concern for the population and include Pre- and Posttest High Stage scores. (See Appendix N for CFSoCQ scoring sheet example). In addition to reporting the first highest stage score, the Pre- and Posttest High Stage scores, and the difference between Pre- and Posttests, the Second High Stage scores will also be presented.

Pretest Findings

In this section, discussion of the Pretest data will address all seven Stages of Concern, Stages 0 through 6. Table 4 below shows the Pretest frequencies and the percentage of the population whose high stage scores were associated with each Stage of Concern. Data are reported and analyzed according to the following group names: Self-Use (Stages 0-2), Task (Stages 3 & 4), and Impact (Stages 5 & 6).

Table 4. Pretest Frequencies for Stages of Concern

Stages of Concern	Frequency	Percent
Stage 0 Awareness	15	28.3
Stage 1 Informational	6	11.3
Stage 2 Personal	18	34.0
Stage 3 Management	0	0.0
Stage 4 Consequence	0	0.0
Stage 5 Collaboration	3	5.7
Stage 6 Refocusing	11	20.8
Total	53	100.0

SELF-USE DIMENSION: STAGES 0, 1, AND 2

At the outset of the innovation, Pretest findings suggest that 15 students were in Stage 0, the so-called Awareness Stage. According to the developers of the instrument, this means that 15 members of the population (28%) held "little concern about or involvement with the innovation" (Hall & Hord, 1987, p. 60). According to the description from the CFSoCQ, which was developed by the authors from the analysis of adult data (see Appendix B); the participants' attention at the beginning of the year was focused elsewhere, not on the innovation.

For Stage 1, the Informational Stage, 6 respondents (11%) expressed a "general awareness of the innovation and interest in learning more detail about it is indicated" (Hall & Hord, 1987, p. 60). Although according to the CFSoCQ and to the definition of this stage, the respondents held a concern that is not necessarily "self-oriented" or "change-facilitation oriented" (Hall & Hord, 1987, p. 60).

For Stage 2, the Personal Stage, 18 respondents fell into this stage; approximately one-third (34%) of the population. According to the developers of the instrument, this means that 18 members of the population may have been "lacking in confidence in themselves or in support from others" (Hall et al., p.17). In Stage 2, rather than holding a high stage of awareness about the innovation or about how the innovation works (as defined in the Stage 1, the Informational stage, by the CFSOCQ guidelines and descriptions), the participant's focus

tended to be on him or herself (Hall et al., p.17). The following is a more detailed definition of Stage 2, Personal Concern: The individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision-making, and consideration of potential conflicts with existing structure or personal commitment (Hall & Hord, 1987, p. 60).

For all three stages combined (Stages 0 through 2), Pretest scores indicated 39 out of 53 participants or approximately three-fourths (74%) scored high in one of these three stages.

TASK DIMENSION: STAGES 3 AND 4

Stage 3, the Management Stage, and Stage 4, the Consequences Stage, both focus on the dimension of "Task." According to the developers of the instrument, this dimension of change focuses on "the manual functioning or mechanical tasks about the innovation" (Hall et al., p.17).

Interestingly, there was an absence of respondents whose highest scores in Stage 3 were not reported. According to the authors, this may have signaled a lack of high stage concern with "time, logistics, available resources or the energy involved in facilitating others in the use of the innovation" (Hall et al., p.17). In making sense of this anomaly, we may say that students, at the time of the Pretest, were not concerned with these factors.

In the Pretest, there were also zero respondents who exhibited high concern as noted by Stage 4, the Consequences Stage. In the Consequence Stage, "Attention is on improving one's own style of change facilitation and increasing positive innovation effects" (Hall et al., p.17). The fact that zero respondents exhibited high stage scores in Stages 3 and 4 indicates an "absence of concern about expanding their facility and style for facilitating change (Hall et, al, p. 17)."

IMPACT DIMENSION: STAGE 5 AND 6

In Stage 5, the Collaboration Stage, only 3 respondents expressed "interest in coordinating facilitation of the innovation" (Hall et, al., p. 17). As stated by the authors, the focus in Stage 5 is on "coordination and cooperation with others regarding the use of the innovation" (Hall & Hord, 1987, p. 60).

Of the total population, 20.8% fell into Stage 6; when both stages 5 and 6 were combined, 26.5% were in this Impact Dimension. In the beginning phases of adoption of innovation, it is common that few, if any, adults or adolescents would be in this stage of concern (Hall, et al., 1991).

Posttest Frequencies

In this section, discussion of the Posttest data includes all 7 Stages of Concern, 0 through 6. Table 5 shows the Posttest frequencies and the percent of the population whose high stage scores are associated with each Stage of Concern.

Table 5. Posttest Frequencies

Stages of Concern	Frequency	Percent
Stage 0 Awareness	15	30.0
Stage 1 Informational	4	8.0
Stage 2 Personal	8	16.0
Stage 3 Management	0	0.0
Stage 4 Consequence	0	0.0
Stage 5 Collaboration	2	4.0
Stage 6 Refocusing	21	42.0
Total	50	100.0

Stages of Concern evident at the End of Year 1

SELF-USE DIMENSION, STAGES 0 THROUGH 2

Posttest results indicated that 15 respondents (30%) had their highest scores at the bottom of the Stages of Concern scale (Stage 0). Four respondents (8%) expressed an interest in learning more about the innovation (Stage 1, Informational Stage). In Stage 2, the Personal Stage, 8 of the respondents (16%) may have been focused on self concerns.

TASK DIMENSION, STAGES 3 AND 4

In Stage 3, the Management Stage, again, zero respondents exhibited high scores in this stage. According to the Posttest data, not one student indicated a high stage concern with time, logistics, available resources, or the energy involved in facilitating others in the use of

the innovation. For Stage 4, the Consequences Stage, again, zero respondents exhibited high stage scores, indicating they were not concerned about improving their style of change. The absence of Stage 3 and 4 scores will be addressed later in Chapter 5.

IMPACT DIMENSION, STAGES 5 AND 6

Surprisingly, for Stage 5, the Collaboration Stage, high stage scores for only 2 respondents (4%) were reported. According to the CFSoCQ definition, this means that only two students "expressed any interest in coordinating facilitation of the innovation" (Hall et, al., p. 17). Facilitation or use of the innovation in this stage is focused toward "collaborating with others to potentially increase the individual's own capacity in learning how to use and apply the use of the innovation" (Hall et al., p. 17).

Stage 6, the Refocusing Stage, experienced the greatest number of students; 21 students ended in Stage 6, their highest Stage of Concern in the Posttest. The Refocus Stage implies just that: The students' "attention is refocused on having ideas about alternatives to the innovation" (Hall et al., p.17). Forty-two percent of the population finished Year 1 in Stage 6.

Posttest Analysis

In the posttest analysis, the total number (15) of Stage 0 respondents for both the Pre- and Posttest high scores remained the same. Typically, when the CFSoCQ has been conducted with adults, there has been a decrease reported in Stages 0, 1, and 2 and an increase in Stages 3 through 6 (Atkins & Vasu, 2000; Dell, 2004; Rakes & Casey, 2002; Vaughn, 2002; Wesley & Franks, 1996). Past studies with adults attribute the decrease of Stage 0 concerns to the phenomenon that, over the course of time, many participants became more secure with the innovation and had a higher stage of concern with other factors pertaining to the adoption of the innovation. Hall et al. (1979) offer an additional point of clarification: "A high Stage 0 score indicates that the facilitator [user of the innovation] currently has intense concerns about a number of other things besides the innovation" (p.31). Since there was no change between Pre- and Post concern in Level 0, there was a tendency for some students to stay in then their current awareness level (Stage 0) or to go back to the awareness level from a higher level. The number of students in this stage may be explained by the students' high level of comfort in the Awareness Stage. To help explain potential

reasons for these changes, further analysis for 8 individuals will be reported in this study in Question 3.

Pre- Posttest Comparisons

Table 6 shows the number of respondents and the associated Stages of Concern, which were evident for the Pre- and Posttests.

Table 6. Pre- Posttest Stages of Concern

Stages of Concern	0	1	2	3	4	5	6
Pretest	15	6	18	0	0	3	11
Posttest	15	4	8	0	0	2	21

SLIGHT DECREASE IN STAGES 0 AND 1

While the number of Posttest, high stage scores in Stage 0 remained the same (15), the total number of respondents in Stages 1 and 2 decreased. Stage 1 scores decreased by 2 and Stage 2 decreased by 10.

ABSENCE OF STAGE 3 AND STAGE 4 PHENOMENON

Data analysis of the Pretest and of the Posttest confirms an absence of any high stage scores reported for Stages 3 and 4. An absence of these two stages was an unusual finding. Previous studies found in the literature that were conducted with adults typically show representation of concern in Stages 3 and 4 (Atkins & Vasu, 2000; Dell, 2004; Rakes & Casey, 2002; Vaughn, 2002; Wesley & Franks, 1996).This absence may be explained by two factors: (a) the question of the instrument and its appropriate use with adolescents or (b) distinct differences in the roles and responsibilities of teachers and of students who are using innovations.

INCREASE IN STAGES 5 AND 6

The most dramatic increase occurred in the Stage 6 Posttest figures, which almost doubled, starting at 11 in the Pretest and ending at 21 in the Posttest. In other words, 10 more

students moved from the lower stages of concern to higher stages. As the innovation became more familiar, students apparently became more comfortable with the beginning Stages 0 through 2 (Awareness, Informational, Personal) and became less concerned with the "Impact" of the innovation on the "Self." Posttest data confirmed a greater number of high stage concerns, which shifted the total population closer to the Refocusing Stage of the innovation.

Pre- and Posttest Differences: Analysis of Stages Changed

The next section presents data related to Pretest and Posttest differences and indicates the number of stages changed by the 45 respondents who took both the Pre- and the Post-tests. Table 7 displays the difference between the Pretest high stage scores and the Posttest high stage scores. The most frequently occurring value is zero; 20 respondents made no change between Pre- and Posttests. Over half of the population (31 out of 45) or 69% started in Stages 0, 1, or 2 and ended in the same three stages, 0, 1, or 2 (Self-Use Dimension). Ten participants in this study started in Stages 5 and 6 and ended in the same stage (Impact Dimension). Four participants changed four, five, or six stages, either beginning at a high stage and ending up as a low stage or beginning as a low stage and ending up as a high stage. These large jumps in stages as indicated by (-6, -5, and -4) represented a rather wide variance. These data about Pre- and Posttests differences will again be interpreted in Chapter 5.

At the beginning of the year, 39 students were in the Self-Use Dimension; but by the end of the first year, only 27 remained in this dimension. In Year 1, at the time of the Posttest, 12 more students had moved up through the Stages of Concern. Although this was significant as an upward movement through the stages, still, 54% of the total population remained in one of these three stages (Stages, 0, 1, or 2).

Analysis of High and Second High Stage Peak and Paired Scores

Hall et al. (1979) recommend: "In order to develop [an] additional insight into the dynamics of concerns, the second high stage scores along with the peak stage [first high] scores may be analyzed" (p. 32). In Table 8, the Pretest pairs of the first high and second

high scores and their frequencies are presented. Along with this data representation, the percent of the population and corresponding dimension is also presented.

Table 7. Pre- Posttest Differences

Stages Changed	Frequency	Percent
-6	1	2.2
-5	2	4.4
-4	1	2.2
-3	0	0
-2	7	15.6
-1	1	2.2
0	20	44.4
1	1	2.2
2	2	4.4
3	0	0
4	3	6.7
5	4	8.9
6	3	6.7
Total = 45		

DISCUSSION

Pretest scores are shown using data from 45 students who participated in both the Pre- and the Posttests; other participants who took the Pretest only were not included in Table 8. Analyses of the data were made for the Pretest, high peak, Stages of Concern and for the second high peak Stages of Concern. Paired frequencies revealed a pattern that placed participants in only two of the three dimensions: Self-Use (Stages 0-2) and Impact (Stages 5 and 6), with an absence of the Task Dimension (Stages 3 and 4). Pairs reflected 19 participants or 42% of the population falling into the Impact Concern category while 26 participants (58%) were in the Self-Use Concern category. Again, notably absent were Stage 3 and Stage 4 Task Concerns.

Of the paired frequencies, 6, 0 was the most frequent high stage pair; and 0, 2 was the most frequent low stage pair. In analyzing the high peak stages, the majority of the group, a little over a half (58%) were in the Self-Use dimension (Stages 0, 1, or 2).

Table 8. Pretest Pairs by Category

Stage 0-6 Pairs		Frequency of Pairs	Percent of Population
Impact Dimension			
6	0	7	29%
6	2	3	
5	2	2	
5	6	1	
Task Dimension			
4	0	0	0%
3	0	0	
Self-Use Dimension			
2	0	3	71%
2	1	7	
2	2	0	
2	3	2	
2	6	2	
2	5	1	
1	2	4	
1	3	1	
1	0	1	
0	1	1	
0	2	7	
0	3	0	
0	4	0	
0	5	1	
0	6	2	
N=45			

PRE- POSTTEST ANALYSIS OF FIRST HIGH STAGE AND SECOND HIGH STAGE SCORES

As previously stated, interpretation of the double peak (highest and second highest scores as shown below in Table 9) can provide additional insight into the dynamics of concerns.

Table 9. Posttest Pairs

Stage 0-6 Pairs		Frequency of Pairs	Percent
Impact Dimension			
6	0	7	42%
6	2	5	
6	3	2	
5	5	2	
6	6	1	
5	2	2	
Task Dimension			
4	0	0	0%
3	0	0	
Self-Use Dimension			
2	0	4	58%
2	1	1	
2	5	1	
2	6	2	
1	0	2	
1	2	1	
1	6	1	
0	1	2	
0	2	5	
0	3	3	
0	4	1	
0	6	3	

ANALYSIS OF PRE-, POSTTEST HIGH-PEAK AND SECOND HIGH PEAK SCORES

In addition to the Pre-, Post first high peak scores, the second high peak scores were also analyzed for this study. According to Hall, and his associates, "Assuming the developmental nature of concerns, the second highest stage of concern will often be adjacent to the highest stage of concern (Hall, Newlove, George, Rutherford, & Hord, 1979, p.29)." When applying this analysis to the group data and to the paired frequencies for first and second high peak scores, it was evident that this group did not conform to the standard patterns established by prior research with adults. While this was an unusual finding, i.e., one that was inconsistent with prior studies by Hall et al., other patterns did exist in this study that warranted additional analysis.

Upon further examination of the Posttest High Peak Scores, it can be seen that 58% of the participants were in the Self-Use Dimension and 42% of the participants were in the Impact Dimension. Again, the absence of any high stage scores in the Task Dimension (Levels 3 and 4) is worth noting.

For the participants who were categorized in the Self-Use Dimension (Levels 0 through 2), the number of students with high stage scores in these levels decreased 13 percentage points— from, 71 % to 58%— in the interim between the Pre- and Posttests. In the analysis of the Impact category, pairs of Pre- and Posttest scores increased by 19 percentage points from 29% to 48%. What was most surprising again, in analysis of the peak and second peak high scores, is a gaping absence of any scores from the Management (Stage 3) and Consequence (Stage 4) Stages of Concern, the Task dimension. As noted in the CFSoCQ manual "a difference of ten (10) or more percentile points (for findings in group data) is usually significant" (p. 32). Chapter 5 will try to make sense of this apparent anomaly.

RESEARCH QUESTION 2: EFFECT OF DEMOGRAPHIC VARIABLES

Research Question 2 was stated as follows: To what extent did select demographic measures explain why some students adopted innovations more readily than others? This section will begin by providing a brief description of the procedures and then report three significant findings.

Regression Analysis Procedures

To address this question, regression analysis procedures were used to determine whether the demographic information collected explained variation in Pretest scores, Posttest scores, and in the difference between those scores. Six dependent variables were used in the analysis:

1. Pretest High Stage Analysis
2. Posttest High Stage Analysis
3. Difference between Pre- and Posttest High Stage Scores
4. Pretest Second High Scores
5. Posttest Second High Scores
6. Difference between Pre- and Posttest Second High Peak Scores.

In addition to these dependent variables, 11 demographic variables were used in this analysis: GPA 2004, Full Pay Lunch, Reduced Lunch, Free Lunch, Race and Ethnicity (White, Hispanic, African American, Vietnamese, and Native American), and Gender.

PRETEST HIGH STAGE ANALYSIS

To determine whether any of the demographic information collected was helpful in explaining variation in the dependent variables, a stepwise regression analysis was conducted. Further examination of both the *F*-statistic and the various *t*-statistics revealed that in the pretest, none of the demographic variables was a significant predictor. Because of this, the complete regression results are not presented here.

POSTTEST HIGH STAGE ANALYSIS

A linear regression that used a stepwise analysis was performed using Posttest Peak Stage Scores as shown in Table 10.

Table 10. Posttest High Stage Analysis

Variable	Estimated Coefficient	*t*-statistic
Free Lunch	-2.5	-2.97**

** $p \leq .05$, ** $p \leq .01$

As shown in Table 10, the significant variable for the Posttest High Stage analysis was "free lunch," which was reported at (–2.97 *t*-statistic) with a significance of (.001). It is important to note that none of the other variables, including gender or GPA, was significant. For the next three regressions, (a) Pretest Peak and Posttest Peak Difference, (b) Pretest Peak Second High Scores, and (c) Posttest Peak Second High Scores, again, there was no significant difference reported for the variables. However, the regression results for the difference between the Pretest and Posttest second high peak scores did yield some interesting findings.

DIFFERENCE BETWEEN PRETEST AND POSTTEST SECOND HIGH PEAK SCORES

Hall et al. (1991) have suggested that an analysis of the second high peak scores may add a new dimension to the final data due to the intense review of each of the seven stages. "By examining the percentile scores for all seven stages and interpreting the meaning of the different highs and lows and their interrelationships, a very rich clinical picture can be developed" (p.29). As shown in Table 11, the difference between the Pre- and Posttest second high scores showed significance at level (.05) with a *t*-statistic of 2.03. In analyzing the difference or change reported in the number of stages for the second high stage scores (*B*= 1.75), we see that boys gained close to 2 stages more than girls by the end of the first year of the tablet program.

Table 11. Difference Second High Peak Pre- and Posttest Scores

Variable	Estimated Coefficient	t statistic
Gender	1.75	**2.03

$p \leq .05$, ** $p \leq .01$

Analysis and Summary for Question 2

Two significant findings appeared for this question, one significant variable, the dependent variable for Posttest analysis (free lunch) and one significant variable for the difference in Pretest and Posttest Second Stage High Scores, (gender). At the time of the pretest, the beginning baseline of the population all started out with similar skill sets and experiences. What happened between the Pre- and Posttests may explain how poverty level

(in addition to influences from home and environment) may be a factor in how students adapted and adopted the innovation as well as how they progressed through the change stages.

Analysis of Pre- and Posttest Differences of the Second, High Peak scores provided an unexpected result. Why did the difference between the population's Second, High Peak scores show a gain of nearly 2 full stages for adolescent males whereas adolescent females showed no significant change? In this study, Pretest High Peak (first stage scores) and the difference between Pretest and Posttest High Peak Scores were not found to have a correlation with any of the other variables— gender, poverty level, or with race and ethnicity.

RESEARCH QUESTION 3: QUANTITATIVE AND QUALITATIVE ANALYSIS OF CASE STUDY DATA

Research Question 3 states: How did specific students describe their adoption of the thin client, tablet computer (the innovation) in Year 1, Year 2, and midway through Year 3? This section will begin by giving an overview of statistical data and demographics and then present narrative accounts from eight students who participated in the case study.

STATISTICAL DATA FOR CASE STUDY

This first section will provide a brief overview of the procedures and the statistical data for 8 of the 45 students who answered both the Pre- and Posttests from the modified Change Facilitator Stages of Concern Questionnaire (CFSoCQ). Qualitative data is represented by interviews and observations. It is important to note that the qualitative investigation reported here for Question 3 did not take place until after the CFSoCQ data were collected and analyzed during Year 2. Midway through Year 3, interviews with all of the 8 students and their parents were finalized.

In order to answer Question 3, it was first necessary to analyze the Pre- and Posttest results obtained from the CFSoCQ for the entire population ($n = 45$). Based on the interesting results of the Year 1 quantitative data, the sample for the qualitative research was changed to reflect a larger sample than what was originally anticipated. As such, the original plan to interview two adopters and two nonadopters (a total of 4 students) was changed to reflect a more representative sample of the total population. Eight of the 45 students who participated in Year 1 of the program comprise the case.

Table 12 shows the case study demographics (n=9), the distribution of females and males, and their Posttest high stages of concern at the end of the first year. Consequently, because no pretest had been taken by the third male (Frank), he was not included in the case. Using the 7 Stages of Change (Stages 0-6) of the Concerns Based Adoption Model (CBAM), Table 13 shows that only five of the seven stages (0, 1, 2, 5, and 6) were represented in the case study sample, with Stages 3 and 4 notably absent. In addition to Stage 3 and Stage 4 high stage scores being absent, only two of the CBAM dimensions were reported: the Self-Use dimension (Stages 0-2), and the Impact dimension (Stages 5-6). Much like results from the larger population of 45, zero students reported high stage scores in the Task Dimension (Stages 3 and 4).

Table 12. Final Distribution Posttest Stages

Stage	0	1	2	3	4	5	6
Female	1	1	1	0	0	1	2
Male	0	0	1	0	0	0	2*
Total	1	1	2	0	0	1	4

Note. *1 male Posttest only.

PRE- AND POSTTEST RESULTS FOR SAMPLE

We are reminded that the 8 students in this sample were purposively selected from the total group of 45 students who participated in both the Pre- and Posttests. Of the 16 respondents, 8 students were purposively selected to represent a sample that was balanced for gender, ethnicity, and a side representation of scores.

Table 13 presents information about each participant's stages of change—or a lack of change evident at the beginning and at the end of Year 1. A 9th interviewee, Frank, did not take the Pretest because he was absent the day of the test (he originally stated he took the Pretest); consequently, the degree of difference for that student could not be calculated. The coding for Table 13 is as follows: (a) the high stage score on the Pretest instrument is PreH1; (b) the Pretest second high stage score is PreH2; (c) the Posttest high stage score is PostH1; (d) the Posttest second high score is PostH2; (e) the stage of concern is identified as "stage" and the representative number, 0 through 6; (f) the difference between the Pre- and Posttest

high stage score is "Dif"; (g) the paired frequencies of the Pre- and Posttest high stages are "Pairs."

Table 13. Pre- and Posttest

	PreH1	Stage	PreH2	Stage	PostH1	Stage	PostH2	Stage	Dif	Pairs
Michelle	99	0	97	6	87	2	87	1	2	0, 2
Teresa	99	2	97	5	55	6	48	0	4	2, 6
Wendy	91	0	89	2	67	5	62	2	5	0, 5
Ariel	99	6	56	2	96	6	81	2	0	6, 6
Justin	99	6	81	0	99	6	97	0	0	6, 6
Michael	59	2	55	0	87	2	81	0	0	2, 2
Shelly	56	2	47	6	61	0	13	4	-2	2, 0
Mariah	99	6	87	2	98	1	97	2	-5	6, 1
Frank*					99	6	98	0	-	-, 6

Final sample size n= 8.The degree of difference could not be calculated for Frank.

Bounded Case Study: Eight Students

The following section further describes the eight case studies, statistically compares the sample of eight to the entire population of students, and includes qualitative descriptions of how each of the eight students has adopted his or her thin client tablet computer.

The data are organized by 3 representative pathways of change: Path One (P1)— a group of 3 students who made consistent, upward gains as they progressed through the stages; Path Two (P2)—a group of 3 students who made no change; and Path Three (P3)—2 students who reversed their direction in how they moved through the stages, ending in a lower stage than when they began.

Table 14 provides the description of change, with the three associated pathways, the number of students, and the individual students in each group.

COMPARING PATHS

Next, Table 15 shows the distribution of the three pathways in both the population and the case study sample. All three pathways were represented in both the population and in the sample. Overall, the population exhibited a higher percentage of P2's, as measured by the

results of the CFSoCQ; the majority of the students (44%) experienced no change between their Pre- and Posttests. By comparison, Pathway 2 and the degree of difference between the population and the sample was not exceptionally large (difference of 6.5 percentage points).

Table 14. Three Pathways through Stages of Change

Pathway	Description of Change	Names of Students
P1	Growth upward through the stages. 2, 4, & 5 stage progressions between Pre- and Posttests	Michelle, Teresa, & Wendy
P2	No Change between Pre- and Posttests.	Ariel, Justin, & Michael
P3	Reverse pathway through Stages of Change. High-low, 2 & 5 stages lower than when they began.	Shelly & Mariah

Table 15. Case Study Sample Compared to the Entire Population

	P1	%	P2	%	P3	%
Population	12	29%	19	44%	14	27%
Sample	3	37.5%	3	37.5%	2	25%

Pathways are determined by reporting the number of change stages between the Pre- and Posttests and are represented by (P1) Gain of 1 or more stages, (P2) No Change, or (P3) Reverse by 1 or more stages

PATHWAY COMPARISON BY GENDER

Pathway analysis by gender revealed some particularly interesting results. While an equal number of males and females were represented in Pathway 1, Pathways 2 and 3 present a rather different picture emerges for the other two pathways. As shown in Table 16 when looking at relationship between the paths from the population to the paths from the case sample, looking at P2, three more females than males experienced "no change" in their Pre-Posttests scores. In the analysis of gender for Pathway 3, which is the tendency to show a reverse movement through the stages, a greater disparity exists between males (3) and females (11). In the population, eight more females than males exhibited P3's, and in the case study, two females and zero males exhibited a reverse pathway.

Table 16. Pathway Analysis by Gender

	P 1			P 2			P 3		
Gender	**Total**	**M**	**F**	**Total**	**M**	**F**	**Total**	**M**	**F**
Population $N = 45$	12	6	6	19	8	11	14	3	11
	26.7%	13%	13.3%	42.2%	17.8%	24%	31%	6.7%	24%
Case Study $n = 8$	3	1	2	3	1	2	2	0	2
	37.5%	12.5%	25%	37.5%	12.5%	25%	25%	0%	25%

Three Paths and Eight Journeys: A Qualitative Review

How did specific students describe their adoption of the thin client tablet computer (the innovation) in Year 1, Year 2, and halfway through Year 3? To answer this question, I describe 3 pathways and 8 stories of how students adapted to using the tablet. The stories were from students who were purposively selected to be interviewed. As was pointed out in Chapter 3, the interview sample was selected because it represented a range of the CBAM stages, was demographically balanced, and helped to shape the emergence of the 3 pathways. What follows is a description of the pathway and the students who fell into the pathway description.

PATHWAY 1: TYPICAL PROGRESSIVES

According to the data from the CFSoCQ, three females, Michelle, Teresa, and Wendy, all reported notable forward progressions through the CBAM Stages of Concern. Michelle began in Stage 0 and moved forward two stages ending, in Stage 2. Teresa began in Stage 2 and moved forward 4 stages, ending in Stage 6, while Wendy began in Stage 0 and ended in Stage 5, progressing 5 stages. All three students showed substantial gains in their CFSoCQ scores. In numerous studies conducted by researchers who have used the CFSoCQ with adults, growth patterns have typically been exhibited by movement through the stages, which begin in Stage 0, with an upward progression or an increase of two or more stages (Atkins & Vasu, 2000; Rakes & Casey, 2002; Vaughn, 2002;). Compared to the entire population of this study, 29% of the students also shared this progressive pathway.

Michelle's Journey

As shown in Figure 1, in the first year of the program, Michelle, an African American female, began in Stage 0 and ended in Stage 2, experiencing two stages of growth. Michelle's two-stage progression on the CFSoCQ was discussed during an interview, which was conducted midway through the third year. Michelle, in retrospect, expressed the following feelings and perceptions about the one-to-one program and about the tablet:

> I can remember back when I got it [the tablet] in 6th grade. I always had problems typing on the keyboard. I didn't know what the letters stood for. You could only use the keyboard in school [the keyboard was not built into the tablet; rather it was an external plug-in keyboard]. I needed to ask special permission to bring it home and bring it back the next day [she did take the keyboard home on a regular basis].

As Michelle familiarized herself with the keyboard and trained herself how to type, her skills in using the tablet grew. Michelle shared, "I learned how to use the keyboard to push tabs and shift, R1 and F, whatever [shortcut keys]." She also frequently explored the Internet and learned how to build a web page using a simple word processor (Microsoft Word). She regularly used the online tools provided by the district portal at school and at home. In addition, her teachers consistently provided assignments at their websites, complete with descriptions on how to work on homework assignments. Michelle also shared information about a tool she used quite regularly over the course of the program. She explained, "You have access to the Internet and to United Streaming[8], you would go on the tablet at home to see what you have to do in the classroom and then turn it in the next day."

In reporting her feelings about using the computer in 8th-grade, Michelle stated simply, "It's easier than opening up a book all the time." She offered comparisons between using the computer and not using the computer (compared to taking books out of her backpack) and shared scenarios of what it would be like without the tablet computer when she continued on to high school the following school year.

> When I don't have the tablet, I will not have access to the Internet to finish my assignments for school. I won't be able to type my assignments. It will be harder because you won't have the tablet right in front of you.

[8] United Streaming is a service that provides video clips and images of proprietary, filtered content.

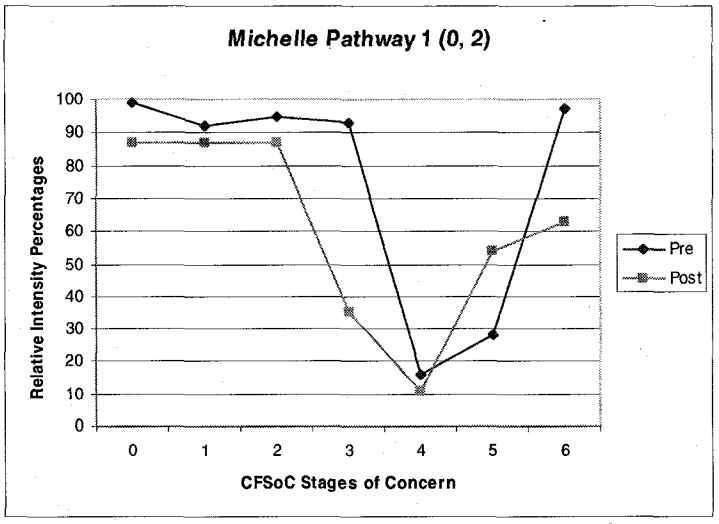

Figure 1. Michelle's Pre-Posttest Profile.

Teresa's Journey

As shown in Figure 2 in the first year of the program, Teresa, a Hispanic female, began in Stage 2, and by the end of that first year, had experienced four stages of growth, ending in Stage 6. She recounted some of her earliest experiences:

> I think the first few days, we learned like, how to use little things, like how to use school email and I could log on to PowerSchool[9] and check to see if my learning portal wasn't working. We learned how to create our own website in 6th grade. We didn't really use it [the website] in 7th or 8th but we used it a lot in 6th grade for social studies and history.

Teresa exuded great confidence in using the tablet and articulated how skillful she was compared to the earlier days.

> [Using] the tablet was easy. In 6th grade, I have always used 2 fingers for typing; now I can use all my fingers without looking. I type faster now. Just by doing the work and paying attention to where the keys are. With the computer you have everything you need. You have the teacher's email. You can go on to PowerSchool every day and check grades instead of waiting. I think it's easier [using the tablet] than always writing. It's faster.

[9] PowerSchool is a browser-based, cross-platform school management system where students and parents access grades online. This product is a registered trademark of Pearson Learning.

Teresa also gave a detailed report of an online writing tool, Criterion[10], she was using in 8th-grade. She enjoyed the ability for her teachers to grade her work instantly and to provide her with immediate feedback.

> Criterion is where you have a login and write or type whatever, like an essay. You can tell it [the program] what it is about, and you can save it or keep writing and use the spell check. It says, 'this is spelled wrong', then you submit it, the teacher reads it and puts comments on it, we save it or keep writing and finish later, or spell check, then you submit and you turn it into the teacher.

By the third year of the program, Teresa had many ideas about how her homework processes could be streamlined by using the tablet. The instrument's authors (Hall et al., 1979) describe Stage 6 (Teresa's ending stage), as the Refocusing Stage; that is, where the participant has ideas about alternatives to the innovation. With a Posttest high stage score ending in Stage 6, it was evident that Teresa's growth pattern and application of skills had progressed. She applied her refocusing attributes to a scenario at home that described when she used her Internet connected computer that she would almost always multitask, often working on two different homework assignments while listening to music or while watching television.

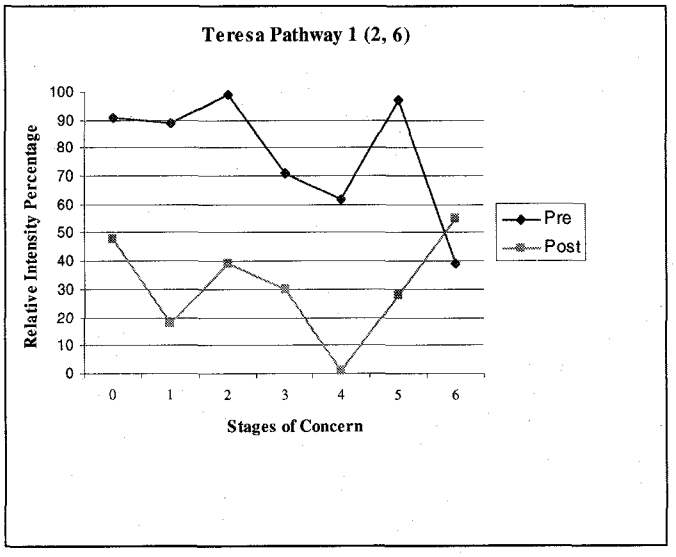

Figure 2. Teresa's Pre-Posttest Profile.

[10] Online writing evaluation service that is web based provides scoring and diagnostic feedback for teachers and students.

Wendy's Journey

By the end of the first year, Wendy, a white female, had scored 5 stages higher on the CFSoCQ Posttest than on her Pretest. As shown in Figure 3, Wendy exhibited a typical and predictable pattern of moving through the Stages of Concern; starting off with high concerns in Stage 0 and finishing the first year with Posttest scores of Stage 5; reflecting a gain of 5 stages in one year (Figure 3). Ending in Stage 5, the Collaborative Stage, authors of the instrument describe "collaborators" as changers who often want to increase their capacity for facilitating the use of the innovation (Hall et al., 1979). Wendy, true to the definition of a collaborator, expressed a strong inclination toward helping others in using their tablet computers. In contrast, at the beginning of the program, she began in Stage 0 (the Awareness Stage) where her awareness level was focused more on herself than on others. Wendy described how she felt that first year:

> When we first received them, everyone was like, really excited, we were *really* excited and we never stopped using it [the tablet]. It was really exciting and fun. It was advanced and a really wonderful technology and we felt really honored...we were given the opportunity to use them. We were first, the first grade to use them.
>
> Throughout the interview, Wendy, a caring young woman, frequently used the word "we" in her responses.

When asked the question, "What kinds of things are you doing with your computer now?" her response echoed not only what she was doing but also what others were doing:

> [In the third year] we feel kind of the same now, but it is not as exciting as the first year, we know how to use it and do everything. They are teaching us the same things over and over again. We did get new tablets [at the beginning of the 3rd year] and those were exciting...we are still kind of excited, but not as much as we were back then. In 6th-grade, I wasn't good with the keyboard...now I am a little better at it [typing on the computer] because I used a link on the computer called Microtype[11].

By the end of the first year and by midway through the 3rd year, Wendy appeared to be a confident computer user who was eager to learn new things about the tablet. Several times during the interview she expressed a need to help others who were struggling with their computer skills. "I like to be able to help kids who are failing," she told me at one point.

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[11] MicroType is typing tutorial, which is accessed online through the students' district portal. The product is owned by Thomson South-Western Educational Publishing.

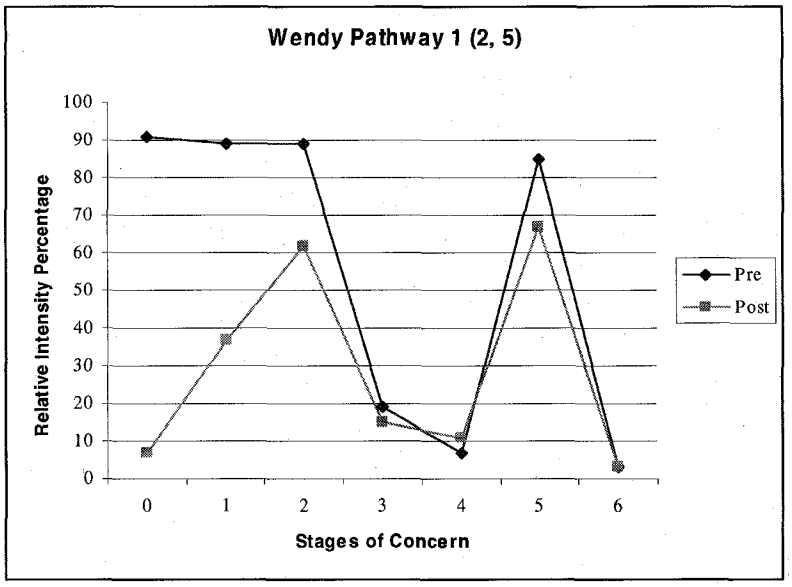

Figure 3. Wendy's Pre- Posttest Profile.

PATHWAY 2: NO CHANGE

Three of the 8 students in Year 1, Ariel, Justin, and Michael, shared a path that reflected "no change" as reported between the Pretest and Posttest scores. Compared to adults who have been administered this instrument, the "no change path" is somewhat inconsistent.

Ariel's high stage score from the Pretest was 6 and from the Posttest, also 6. Justin, like Ariel also began in Stage 6 and ended with a Stage 6 high stage score. Ariel and Justin were 2 of 7 students from the total population (N=45) who scored a 6 on the Pretest and a 6 on the Posttest. By using the instrument as a gauge to note change or progress, these 7 students in the first year, technically did not have anywhere to progress or move to; the CFSoCQ instrument does not have additional categories after the Refocusing Stage (Stage 6).

Michael, on the other hand, as a "No Changer in P2", began in Stage 2, the Personal Stage, and ended in the same stage. Since 4 other students also scored a (2, 2) he was not alone in his distinction.

Ariel's Journey

Ariel, a Hispanic female, was an introspective and technologically "savvy" eighth-grader. She was quite forthcoming with many of her opinions about the tablet and about the program. By the end of the first year, as shown in Figure 4, Ariel remained in the same stage

where she began, Stage 6. She described her first exposure to the tablet in 6th-grade:

> The first few days we learned how to use school email, to log on to the learning portal, but it wasn't working. We learned how to use our website. It took us about two months to figure it out. We would have to call the tech office. For use at home, it was like, hard, because she, my mom, is not from here [parent could not assist because of a language difference].

Ariel boasted about her most recent accomplishments and proficiencies with using the tablet:

> I got an A+ in that class [in eighth grade Science using motion and animation to show people running]. I used Excel. You just graph it and it does it automatically. I can check PowerSchool online. It is like a progress report. I login for her [my mom] and she sees my grade. I feel like I know everything now. I can do PowerPoint, make comics, and use Kid Inspiration. I can type faster now because there is an online type helper.

Conversations with Ariel revealed that she was a young woman who was confident and comfortable with using the thin client tablet. Her statements regarding the tablet were highly critical of the administration when it came to allowing access to outside email and blocking websites that she felt were critical to her success. Several times during the interview she said, "When I am done with my homework, I would like to connect with my friends...not all of my friends are in the program and it's hard to connect with them." She expressed a great desire to be engaged in the activity of "instant messaging," and to be able to connect with her friends on "My Space" that enabled her to email and chat at the same time.

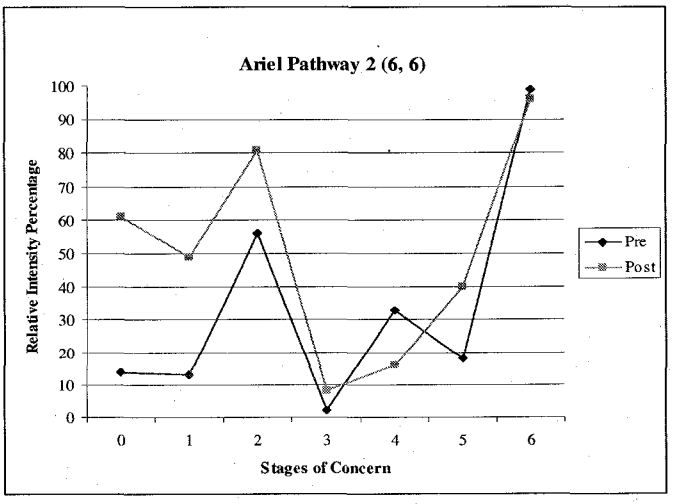

Figure 4. Ariel's Pre-Posttest Profile.

Justin's Journey

Justin, a male of mixed descent (Caucasian, European, and Native American Indian), began the first year of the tablet program in Stage 6 and ended in Stage 6 (Figure 2). From the beginning of the program, he exuded a confident attitude about himself and about his knowledge about the tablet. During the final interview, he continued to demonstrate a high level of confidence and security with the tablet. When asked to describe his first impressions with regard to using the tablet, he started to talk about complexities and intricacies of the unit as though he were a systems engineer for a computer company:

> I have been in it [the program] two, almost three years now. The teachers [8th-grade teachers] don't know as much about the tablet as I do. I learned a lot. That's how I feel. I learned how to get around things. I know how to make things happen. You can figure out different things [he was referring to getting around the issues of blocked websites and other firewall issues].

Several questions on the CFSoCQ pertained to the issue of change (Stage 6 questions), specifically, changing the innovation. During the interview, when Justin was asked how he would change the computer, he answered with comments that may be consistent with Stage 6 thinking. Often Stage 6 thinking focuses on how the innovation could be improved. Justin offered his own ideas for redesigning the unit:

> Something with shoulder straps, unzip it, and it folds out, zip it up like this [he demonstrates during the interview]. [Remarking about the tablet's style] it was not cool to carry it around. You looked 'dorky' or you looked like a 'geek' at this age, like you are 'too cool' for school. They tried hard to redesign the case so that they were a little better looking. It is supposed to be a big backpack, but kids still say they look like they carry a lunch box; they set it down and leave it.

Justin revealed innovative suggestions and expressed the desire to change the tablet's design, making comments on how music and games would enhance his experience with the tablet. He expressly wanted to play games, but knew he wasn't allowed to play them in school. He also shared one other thing he would like to be able to do: "You could [should] be able to play GAIA animated characters—kind of like Neopet—all online."

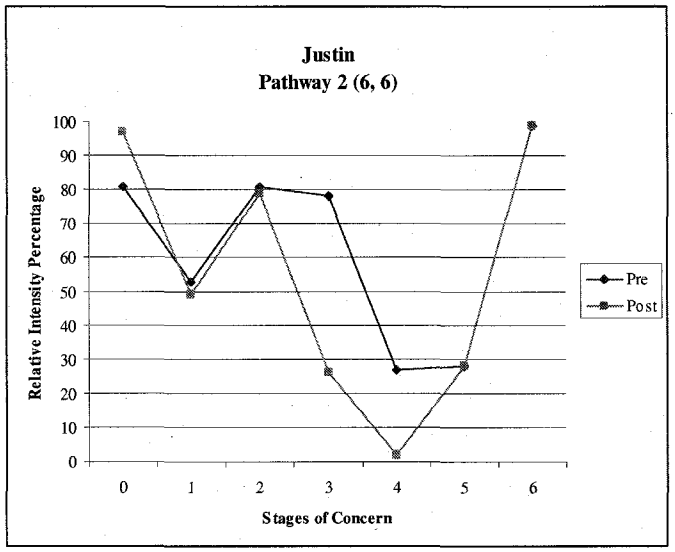

Figure 5. Justin's Pre-Posttest Profile.

Discussion: Ariel and Justin

While ending in Stage 6 was not an anomaly when comparing these two students to the rest of the population (N = 45); at the end of the first year, 21 out of 45 participants or 42% of the total population also ended in Stage 6. Notably unusual was that both Ariel and Justin began and ended in Stage 6, beginning in Stage 6 and ending in Stage 6, something that only 5 other students shared, only (15%) of the total population began and ended in Stage 6.

Michael's Journey

Michael, a white male, was unique in his "no change" pathway since he began in Stage 2 and ended in Stage 2 (Self-Use Dimension), a stage much lower than the his P2 counterparts (see Figure 6). Like the majority of the students in the one-to-one tablet program, Michael began using computers in third grade. He was quite comfortable with his tablet and shared his great pride in the successes he had in mastering many of the computer applications and in the products he had created with the tablet. He commented:

> We know a lot more now that we did in 6th grade…we learned to navigate a lot of websites, do a lot of PowerPoint, and Excel. [Last year in 7th grade] Ms. K taught us how to make a brochure. We didn't use it very much in math.

Michael's comments focused on usability issues; cords, cables, the unit shutting off and on, access to the websites, and general attributes of the tablet. Although over a year and a half had elapsed since Michael took the CFSoCQ, his responses still tended to focus on

Stage 2 or on Self-Use thinking. There were several instances when Michael expressed on the desire for the tablet to be able to play music, like his iPod. He definitely wanted to be able to listen to music at school while he was working on the tablet (something his teachers did not allow).

Michael showed signs that he had learned how to use the tablet and appeared quite competent in its use. He felt as though he began the program as a 2 (on a scale of 1 to 10), and ended the program as an 8. He genuinely expressed great concern regarding the end of the program in 8th grade and commented:

> I want to use it [the tablet] in high school... It is an old school and they don't have any computers. I don't have very good handwriting. It would be easier for me to type everything. They [our teachers] are going to want you to do a 3 or 5-paragraph essay. I will ask if I can type it up.

He continued to offer evaluative comments about the program and summed up the experience as, liking it a lot. He commented, "Sometimes it works, sometimes it doesn't, [especially when] people [don't] mess around with it."

At the end of year 1, with regard to Michael's rating, he was not alone. Four other students (11%) also exhibited the (2, 2) "No Change" pathway.

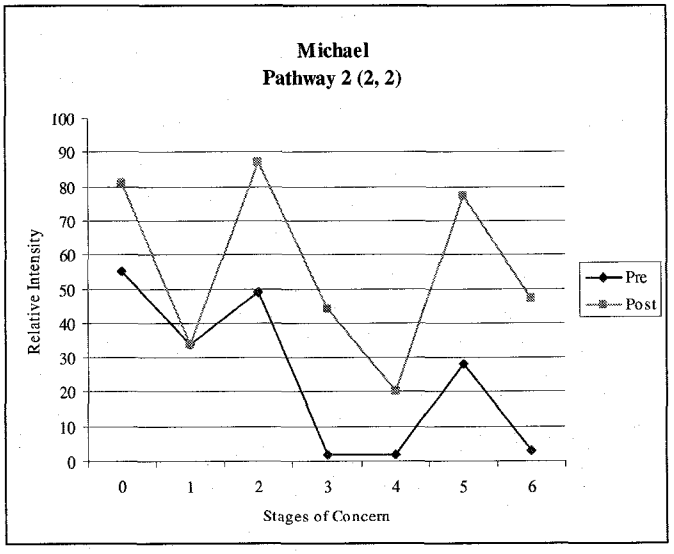

Figure 6. Michael's Pre-Posttest Profile.

PATHWAY 3: BACKWARDS MOVEMENT

Two of the 8 students interviewed, exhibited a backwards movement through the

Stages of Concern. Compared to the rest of the population, 20 students, 44%, almost half, also scored lower in their posttest stage than the stage in which they began.

Shelly and Mariah, as evidenced by lower stage Posttest scores than those of their contemporaries, did not progress through the stages, but rather went backwards. Shelly began Year 1 in Stage 2 and ended in Stage 0 (as shown in Figure 7), while Mariah's scores reflected more pronounced regression (see Figure 8). Beginning in Stage 6 and ending in Stage 1, Mariah experienced a backwards movement of 5 stages. These two pathways through the Stages of Concern are inconsistent with patterns reported in widely published studies with adults. This backwards movement phenomenon will be discussed later in Chapter 5.

Shelly's Journey

Shelly, an African American adolescent female, imminently shared her thoughts and experiences about the tablet program. Shelly described some of her early recollections of how she learned to adapt to the tablet technology:

> I couldn't figure out how to turn it off, so it stayed on the whole time and it kept on turning off in class ...then I learned how to [turn it off] just by pressing a button. I thought it was heavy but eventually I got used to it. It was different than in elementary school [in grades 4 and 5 Shelly had access to classroom computers, 'Winterms']. I was kinda late to the program and everyone helped me. I just played with it [the tablet] at home, just going on the menus. Mr. Adams [her sixth grade Social Studies and Language Arts teacher] helped us all...some of the first assignments were writing short essays on ancient civilizations on like, Word and on our website.

As an experienced computer user since 4th grade, Shelly frequently played games at home on her computer. Moreover, she much preferred to use the home computer, a Windows terminal that was also provided by her school district. Shelly preferred using the "WinTerm" to using the tablet; her connection at home with her tablet, she reported, "didn't always work."

Although Shelly's Year 1 ending score reflected a high Stage of 0, by midway through Year 3 she appeared to be quite competent and comfortable with the tablet. An adult profile for a participant whose high stage ending score is in Stage 0 may be described as, "the participant's attention may have been focused elsewhere...change facilitation [or in the student's case, the desire to help others] in relation to the innovation is not an area of intense

concern" (Hall et al., 1979, p. 17). When Shelly was asked what improvements she has made in her computer skills she responded: "On PowerPoint, I have learned how to do more animations and custom animations for only the words...more stuff on Word definitely. I know how to put up more stuff on my own website."

Shelly seemed quite excited about two new programs the one-to-one program had implemented in Year 3, and was particularly detailed in her description of Criterion, an online essay construction tool.

> We have a new program this year, a math program. I am not sure what it is called? [It was Microsoft Excel]. We have been figuring out the shortcuts. We are using another one, with Criterion, where you submit your essays online. You don't have to print everything out. Your teachers can grade it and Criterion will tell you everything you got wrong...Criterion shows you everything. It can usually fix it. You know how to correct it when you do your essay the next time. Criterion will grade it for you, mechanics and grammar. [You can see your] profile for the whole year, like every single essay, automatically it saves.

Shelly's first year, Posttest Stage 0 score appeared to be somewhat of an anomaly. It was evident by her detailed descriptions about the tablet that she showed tremendous insight and "refocusing," which was not common behavior for a Stage 0 responder. Shelly reveled in how she had not only grown in her skills but also made changes and adaptations in her life as a student as a result of using the innovation. She admitted, "I have improved over the years...we learned a lot more on the computers than when we wrote everything hand written. [We] learned some new stuff about writing... [We] learned a lot when we used the tablets."

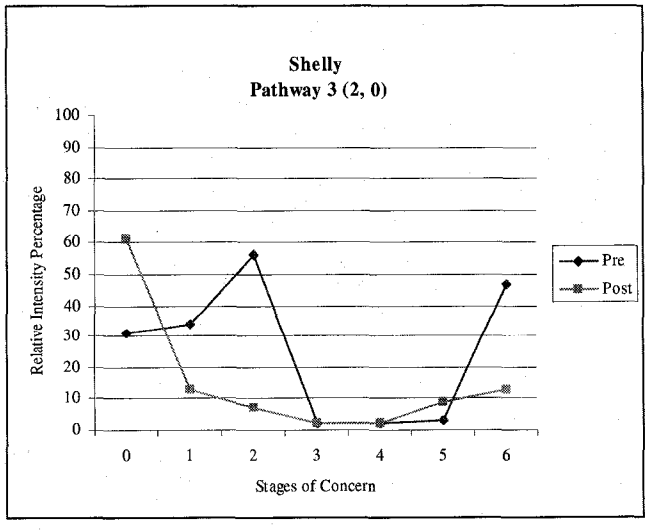

Figure 7. Shelly's Pre-Posttest Profile.

Mariah's Journey

Mariah, a quiet and soft-spoken African American female, was the identical twin sister of Michelle, also in this study. While Mariah made a backwards jump from Stage 6 and ended in Stage 1, her twin began in Stage 0 and ended in Stage 2, thus exhibiting a very different path through the stages (Figure 3). Mariah recalls her first introduction to the tablet:

> In 6th grade, it was before school even started, we got a letter in the mail, talking about the tablet, what it does and what it is supposed to be used for...[then there was] a short meeting for the parents and the students. It [the tablet] was in a cardboard box case. That was it. I didn't know how to use it and I kept asking the people next to me how to use it. It made me feel kind of confused. What happened was we had to use them a lot. It took a long time to link to the website. It took almost until the 7th grade and I've [how to use it] ever since.

Some of most impressionable first activities for Mariah were how to make a website and how she could successfully navigate to everything online:

> You get all the links on there, and then learn how to do email, and PowerSchool, and Excel, and all those other documents, and how to go on the Favorites [saved websites in the browser]. The learning portal [the password secured district website] was kind of different.

Despite Mariah's quiet demeanor, she had a lot to say about her experiences during the first year of the program and about daily activities with the tablet. What was most revealing about Mariah is that she sincerely believed that by using the tablet, her academic destiny in middle school was changed. "In sixth grade I felt good; *the tablet* really improved my grades, 4th quarter. In 7th grade my grades are almost all straight A's. In 8th grade I have all A's." In 8th grade, Mariah perceived her computer skills as exemplary, rating them a 9 or 10 (out of 10).

Of all of the students in this case study, Mariah exhibited the most concern regarding the eminent end of the tablet program. She discussed how it would feel without the tablet and feared how access to the technology next year would be limited. "It is going to be very hard. I am not used to working without it...I will have to go to the media center to do my homework early." Without a computer in the home, Mariah and her twin sister's technology experiences in 9th-grade at high school would definitely be a challenge.

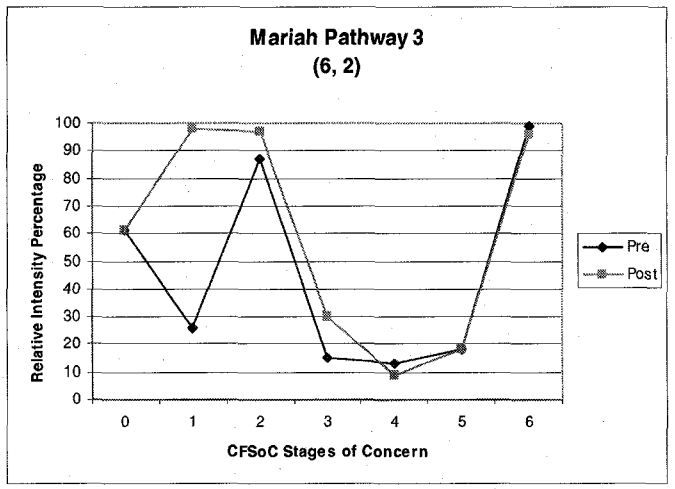

Figure 8. Mariah's Pre-Posttest Profile.

Shared Perceptions

During the interviews, three shared perceptions emerged from the students. As a reminder, the interview protocol, as presented in Appendix H, contained a series of nine open-ended questions that asked students to comment on their journey of adopting the tablet as well as general perceptions they may have held about their growth in using the innovation.

WRITING AND HANDWRITING

The two most commonly shared perceptions, universally held by all whom I interviewed, were perceptions that pertained to the mechanical use of the tablet computer. The most important skill they had acquired was the ability to type everything, using the word processor to spell check, format, and polish their work. (Although they did comment on other applications they readily used, discussion about the word processor was predominant). Several of the students shared how they taught themselves to type and how they preferred to type rather than hand write all of their assignments. Shelly stated, "We learned a lot more on the computers than when [we submitted] hand-written essays. You don't have to print everything out." Shelly was referring to the online essay-generating tool, which was implemented in Year 2 and in Year 3 of the program. Discourse (Year 2) and Criterion (Year 3) are a new generation of online writing tools that has allowed students to submit their work online while having it automatically evaluated by the system.

Michelle also commented that the tablet and all of its tools helped her with her schoolwork, particularly with typing and with the revision and submission process of handing in work to her teachers. Michelle said, "[The tablet] helps me finish my assignments for school…I am able to type my assignments…in high school you will have to go to the library and print everything out [then hand it in]."

Michael also added his thoughts about writing, "In high school, you will probably get writing cramps. I don't have very good handwriting. I am not looking forward to writing everything."

In addition, Ariel commented on the fact it would be hard to get used to writing by hand again. She even went so far as to say, "The computer really does improve what people do." She shook her head with disdain stating, "People really don't write these days." It seemed almost ridiculous to her that people would have to write by hand rather than type in high school, and in life. Adding to the sentiment, Justin commented "I want to use it [the tablet] in high school. It would be easier for me to type everything up [at school]."

After two and a half years, students were still concerned with how the computer functioned; after all, it had been by their side almost all of their waking hours. All eight students alluded to how the tablet had helped them become proficient in the act of writing and also how it was easier to type than to write. It was the shared perception that the tablet provided the ease with which they could, write and compose their essays and complete assignments.

THE GPA CONNECTION AND GRADES

Another recurring perception was that using the tablet directly impacted and improved their grades. Five of the eight students revealed that the tablet directly affected their overall grade-point averages (GPA). Wendy proudly admitted, "My grades really improved a lot. I have a higher GPA in eighth grade…my parents can check the grades online." Wendy's GPA in 6th grade was (3.23) and in 7th grade (3.87). Ariel was also proud of her grades and said, "I got an A+ in that class [science]…I can check PowerSchool online…it is like a progress report…I login for my mom and she sees my grades." Ariel's GPA's were 2.55 in 6th grade and 3.11 in 7th grade, and continued to improve in eighth

grade. Teresa's GPA had also gone up (from a 3.00 to a 3.14). She shared, "The tablet has been good for me...my mom thinks it helped my grades."

Mariah, who you may remember began in Stage 6 and ended in Stage 1, felt that the tablet directly contributed to her overall success, "In 6th grade, the tablet really improved my grades, [especially] 4th quarter...in 7th grade my grades were almost all straight A's. In 8th grade, I have straight A's."

Summary

This chapter reported both quantitative and qualitative data for the study's three research questions. The CFSoCQ, an instrument that measures the Stages of Change for adults, was used with 45 students from a one-to-one tablet computer program. In Year 1 of the implementation of the program, data were collected from students' Pre- and Posttests. After the data was statistically analyzed in Year 2, eight students were purposively selected for a subsequent qualitative case study. Interviews were conducted with those eight students in the summer following Year 2 and during the fall of Year 3. After the interviews were completed, the quantitative data were again analyzed and compared to the qualitative data.

Statistically, evidence was found to support several findings. Descriptive statistics revealed an absence of high stage scores in two of the stages of change, Stage 3 and Stage 4, in both the Pre- and Posttests. After that first year of the program, more students moved from lower stages to higher stages of concern. Notable differences between the Pre- and Posttests *second* high stage scores were approximately two stages higher for male adolescents than for female adolescents. At the end of Year 1, only one other significant variable was found in this group; free and reduced lunch students did not show as much movement to higher stages of change as their full pay counterparts.

In the qualitative data section pertaining to Question 3, over the course of the one-to-one program, eight students have richly described how they have adapted to using their thin client tablet computer at school and at home. The individual Pre- and Posttest scores were analyzed and the qualitative data were organized into 3 representative pathways of change: Path One—a group of 3 students who made consistent, upward gains as they progressed through the stages; Path Two—a group of 3 students who made no change; and Path Three—

2 students who reversed their direction in how they moved through the stages, ending in a lower stage than when they began.

Through the reports of the three pathways and their eight journeys, each of the 8 students in the case study reflected on his or her unique progress in adapting to using the tablet at school and at home. Although the students could be categorized by 3 distinct paths, they shared similar growth patterns along with many of the concerns and realities of adapting to an innovation in the one-to-one program. Further interpretations of this data will be reported in Chapter 5.

CHAPTER 5

CONCLUSION

In the previous chapters, an overview of this study and a literature review were presented, followed by a discussion of the methodology, and a description of the findings. This chapter briefly reviews the purpose of the study, reports the major findings from Chapter 4, and establishes relevant connections to the literature. The focus of the chapter then shifts to policy implications, discusses the limitations of the instrument, and presents implications this study has for future research with adolescents, specifically as it pertains to the application of Concerns Based Adoption Model, otherwise known as (CBAM) theory for the adoption of an innovation in an educational setting.

As was discussed in Chapter 1, the application of CBAM methodology and the use of instruments designed to measure stages of concern continue to be a useful tool in analyzing the stages of change for the adoption of an innovation. As adults become more familiar with an innovation, particularly with the adoption of a new technology, distinct changes can be noted (Hall et al., 1991). Although there is a sufficient amount of validated research in the literature that notes the stages of change for adults, unfortunately we currently have a limited understanding of how adolescent students adapt to innovation and how these students adopt change behaviors when an innovation is introduced.

Thus, the overarching purpose of this mixed methods study was to apply a CBAM instrument to an adolescent population, to statistically examine its effects, and to gather perceptions from the students to qualitatively analyze the process. In doing so, the intent was to ultimately deepen the understanding of adolescent patterns of change over the course of a technology adoption.

Central to the methodology of this study was the Change Facilitator Stages of Concern Questionnaire (CFSoCQ), developed by Hall et al. (1979) and modified by the researcher; the CFSoCQ was used to gather the quantitative data from 45 adolescents for this study. In addition, data from 13 students who took only the pretest or posttest were also used in at least part of the analysis. As previously stated, this instrument typically has been

administered almost exclusively to adults, specifically educational facilitators who are implementing an innovation.

For the first question, Pre- and Posttest data were computed and analyzed. The stages of change, Stages 0 through 6 were reported using descriptive statistics, for the Pretest high stage scores, for the Posttest high stage scores, and for the difference between the high stage scores. The process was then repeated using the second highest stage scores. Data were represented by percentages: (1) the percentage of participants who represented each stage of concern, and (2) the percentage of participants who represented each dimension (Self-Use, Task, and Impact). Two groups were analyzed and presented for the population (N=45) and then later, profiles from the sample of eight students reflected individual stages of concern for Pre and Posttest, first High Stage and for second High Stage scores.

Analysis of the quantitative data further informed the case study analysis of qualitative data from eight purposively selected respondents. Six female and two male respondents were observed and interviewed over the course of two and half years; the purpose of these interviews was to reveal the process the students experienced as they learned to use their thin client, tablet computers at school and at home.

The qualitative data is presented in two parts; first as a discussion of corresponding themes from the interview data and their associated stages of concern, and second, as themes from the literature.

Discussion of the Findings

This section briefly summarizes the research findings and includes discussion on three research questions from the study. The research questions that guided this study were: (a) During the first year of the adoption, what stages of concern were evident among the students at the beginning of the year as well and at the end of the year; (b) To what extent can variation in these stages of concern, as well as the progression throughout the year be explained by select demographic measures (gender, race/ethnicity, free/reduced lunch and GPA); and (c) Based on the qualitative interviews, how did select students describe their adoption of this innovation in Year 1, Year 2, and midway through Year 3?

Research Question 1

During the first year of the adoption, what stages of concern were evident among the students at the beginning of the year as well as at the end of the year?

There were two findings for Question 1, first and most importantly, there was a glaring absence of Stage 3 and Stage 4 high stage scores and, secondly, there was a general tendency for participants to move upward through the stages in a "typical" progressive movement, beginning in lower stages and ending in higher stages.

FINDING 1

Most notably, descriptive statistics revealed an absence of high stage scores in both the Pre- and Posttests for 2 of the 7 levels of change. Surprisingly, there was no high Stage 3 or high Stage 4 scores reported for ***any*** of the students. This glaring absence of Stage 3 and 4 scores was a particularly unusual finding in that there was not one high stage score reported for any of the students in the population (N=45).This finding is contrary to dozens of CBAM studies that are reported in the literature for adults.

As was discussed in Chapter 1, Stages 3 and 4 are described as "task-oriented"— in that these stages focus on the process of learning how the innovation works and how it functions mechanically. Specifically, Stage 3 is classified as the Management Stage where "time, logistics, available resources, and energy involved in facilitating others in use of the innovation are the focus (Hall et al, 1991, p.17)." Similarly, Stage 4 is a task-oriented stage that addresses the relationship between self-analysis of change and the consequences that change has on others: "The attention is on improving one's own style of change facilitation and increasing positive innovation effects (Hall et al, 1991, p.17)."

Two aspects of the absence of Stage 3 and Stage 4 phenomenon will be addressed. First, how these two stages focus primarily on the mechanical or management issues of the innovation, and secondly, how these two stages involve a level of self-analysis that may not be a typical adolescent behavior.

For this population, the mastery of skills associated with the mechanical task of using the innovation may have been assumed, pre-existing, or implicit. Initially, tablet management skills were taught in class during social studies, science, math or English, not as a separate

class; skills will integrated throughout the curriculum. Management issues relating to efficiency, organization, scheduling, and time management were continuously dealt with, so perhaps, each student's attention was not focused on the processes and tasks of using the innovation. For many of the adolescents in this study, Stage 3 and 4, task-oriented change may not exist because the task of learning how to use the innovation is a skill that had already been mastered. It is also important to note, the majority of the students in this school district learned how to use a desktop (Winterm) computer as early as 3rd grade. Therefore, it may be that past experience in using computers may have influenced the students' ability to perform tasks on the thin client computer without any level of concern in these two stages.

Descriptions associated with Stages 3 and 4 generally include the act of analyzing and applying skills through self-reflection and through self-analysis, in particular, how this analysis affects others. Can adolescents effectively self-reflect and analyze on how personal interactions with the innovation and how it affects others? For Stage 3 and 4 thinking to manifest, the attention is on "improving one's own style of change facilitation [through reflection, analysis, and application of such] and increasing positive innovation effects (Hall et al, 1991, p.17)." Heaven (2001) in analyzing the social psychology of adolescence describes this process of self-evaluation and analysis as one that is reserved older children.

> An important process in the development of a psychological self is the ability to accurately perceive what others think of us. Such an ability is more evident with older and more cognitively mature adolescents (Heaven, 2001, p. 42).

Although there is little evidence to support the absence of Stage 3 and 4 phenomenons with adolescents, Loucks (1977), in one of her earlier studies conducted a longitudinal study with 38 elementary teachers which illuminated the absence of the management stage (Stage 3). She reports "that management concerns never predominated any group (Loucks, p. 1)."

FINDING 2

The second major finding associated with this research question, as evidenced in Stages 3 and 4, involves the number of students who seemingly moved through the Stages of Concern, specifically, between the Pre- and Posttests. After the first year of the study, more students moved from the lower numbered stages of concern (particularly from Stages 0-2) to higher numbered stages of concern (to Stages 5 and 6). For example, at the beginning of the

study, 74% of students were in one of the lower three stages (0, 1, or 2) but by the end of Year 1, this decreased to 54% thus increasing the number of Stage 5 and Stage 6 students from 23% in the Pretest to 46% in the Posttest.

Throughout the CBAM literature, this upward movement through the stages consistently appears as a dominant finding, one that confirms movement as a developmental process. As the innovation is used, the individual moves from a lower stage to a higher stage. As an example to support the upward movement through the stages and the possible absence of Stage 3 and 4, Loucks (1977), in one of her earlier studies conducted longitudinal research with 38 elementary teachers notes that:

> Individuals in the sample followed a general developmental trend from being more intense at the lower stages of concern to becoming more intense at the higher stages of concern (Loucks, Abstract, ED250163).

Furthermore, Gray (2001) also found in a study of teachers that the relative intensity of Stages 0, 1, and 2 decreased, much like this 1: 1 study.

Research Question 2

To what extent variation in stages of concern among students—as well as stage changes during the first year of the innovation—can be explained by select demographic measures such as gender, race/ethnicity, GPA, and free/reduced lunch?

Results for two independent variables were significant: (1) the Posttest for free and reduced lunch, and (2) the gender difference for Pre- and Posttests and their differences for the second high stage score.

FINDING 1

In analyzing the high stage scores, only one significant finding was found in this group; free and reduced lunch students had a tendency to stay in lower stages in that progressions to higher stages of change did not occur as frequently as their full pay counterparts.

It is a common phenomenon that students receiving free and reduced lunch or students of lower socioeconomic means generally exhibit lower scores and report significantly lower rates in the adaptation of technology tools in school and at home (Levin & Arafeh, 2002).

Contributing to the research, the relationship between poverty and school success is another well-known fact; most social scientists have recognized the importance of an individual's family socioeconomic status (SES) as an influence on the academic achievement of children. Evans (2005) further defines the achievement gap as having a direct correlation to social and economic factors. A growing body of research has documented that children and adolescents who live in poor neighborhoods do less well on a variety of developmental outcomes compared with peers from more advantaged neighborhoods (Brooks-Gunn, Duncan, & Aber, 1997; Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000). Research in this area has demonstrated the enduring effect of SES on school achievement (Caldas in Bankston & Caldas, 1997).

FINDING 2

Statistically, differences between the Pre- and Posttest second high stage scores, revealed significant differences in stages of change for males and females which were evidenced as approximately two stages higher for male adolescents than for female adolescents. What is interesting about this finding is that Hall et al. (1986) in prior studies with adults have found "no outstanding relationships between demographic variables and concerns data. CBAM results indicate that variables such as gender have not had any bearing on peak stage concerns (Hall, 1979, p.17)."

For adolescent males who have been exposed to technology tools since 3rd or 4th grade in generally the same school environment as females, one possible explanation for the difference (males two stages higher than females) may be attributed to a "reporting error". There may be a tendency for adolescent males to self-assess, self-report or boast about their perceived levels of competency more so than their female counterparts. Wilgenbusch and Merrell (as cited in Heaven, 2001) conducted a meta-analysis of studies on gender differences and the connection to self-concept. They reported: "Boys have significantly higher reported self-esteem in physical ability, job competence, emotional/affect anxiety and mathematics while females had higher self-esteem on verbal, same sex peer relationships, close friendships, honesty and religion (Heaven, 2001, p. 45)." What the research may reveal is an apparent disconnect between the interpretation of the instrument and the ability for adolescent males to "honestly" report concerns on a Likert Scale. Another possible

explanation related to the instrument, may be indicative of the examination of both the first High Stage Score and the second High Stage score.

Research Question 3

How did specific students describe their adoption of the thin client tablet computer (the innovation) in Year 1, Year 2, and halfway through Year 3?

Results for research Question 3 focus predominantly on the qualitative analysis of data from a small case of eight specific students. After the qualitative data was analyzed further quantitative analysis occurred as comparisons were made to the larger population. Two analyses are reported in this section, 1) examination of pathways, and 2) analysis of interview data matched with Stages of Concern and Paths.

As was discussed in Chapter 4, three classifications of participants emerged from the data analysis, thus resulting in three distinct pathways: Pathway 1 (P1), progressions through the stages from lower to higher stages (P1); Pathway 2 (P2), no change in stage between Pre- and Posttests; and Pathway 3 (P3), a backwards movement through the stages. As previously stated Pathway 1 (P1) is a typical pathway for adults who are exposed to innovation and is quite consistent with the literature. Pathway 2 (P2), and Pathway 3 (P3) are generally inconsistent with the literature with regards to posttest data reflecting upward movement and growth through the stages.

Pathway 2 proved to be the dominant pathway for the study; 19 (44%) of the population reported a no change pathway. Examples in the literature do in fact exist that may support an explanation for a P2, a pathway with no change. In her posttest analysis, Gray (2001) confirmed Stage 0 Awareness remained the greatest area of concern. She, like Hall, (1980) attributed this lack of movement (no change) to "distractions many of the individuals were facing during the school year (Gray, 2001, p.33). Hall 1980 as cited in Gray (2001) stated, "High stage 0 scores for users indicate that the innovation is not of high priority for the respondents (p. 33)."

Examination of the CFSoCQ instrument and at the posttest data also revealed that out of the total population (N=45), fewer students remained in lower stages, nevertheless, 15, or one third (33%) of the total still ended in Stage 0.

Hall and Hord (1987) believed progression through the stages: "is a developmental process taking years to progress from initial implementation to integration." Since Pre- and Posttest data for this study only reflected Year 1 of the implementation, the question remains, would these three pathways reported in this One-to-One study be evident if the CFSoCQ was administered in Years 2 and 3?

STUDENT VIGNETTES WITH CORRESPONDING STAGES

In analyzing and coding the "ex post facto" interview data obtained from at beginning of Year 3, interviews with the eight students from the case generally corresponded with their Year 1 Stage of Concern. Students revealed a "kind of thinking" one might apply when engaged in the state of adopting the innovation. All but one student had a tendency to share thoughts and ideas that reflected a corresponding stage of concern or a dimension. Table 17 includes the student, the Post Stage of Concern level (0-6) the corresponding dimension, a summative and descriptive student vignettes, and a report for match or no match.

Table 17. Qualitative Data Matched with Posttest Descriptions

Student	Post SOC and Dimension	Pathway	Descriptions	Match
Shelly	0 Self-Use	P 3	Shared detailed descriptions about the tablet which focused on issues with use; she also showed tremendous insight and "refocusing" which was not typical of Stage 0 thinking. (2, 0) remained in same dimension.	No
Mariah	1 Self-Use	P 3	Reported many issues with use and focused on how it would feel without the tablet. Mariah feared how access to the technology next year would be limited. "It is going to be very hard. I am not used to working without it…I will have to go to the media center to do my homework early." (6, 1)	Yes
Michael	2 Self-Use	P 2	Discussed cables, cords and function of the tablet. Discussion focused on self. (2, 2)	Yes
Michelle	2 Self-Use	P 1	"It's easier than opening up a book all the time." She offered comparisons between using the computer and not using the computer. (0, 2)	Yes

Table 17. (continued)

Wendy	5 Impact	P 1	Stage 5 Collaborative Behavior: Expressed a need to help others who were struggling with their computer skills. "I like to be able to help kids who are failing." Gained 5 stages (0, 5)	Yes
Teresa	6 Impact	P 1	Detailed discussions about writing capabilities and about how her homework processes could be streamlined by using the tablet. (2, 6)	Yes
Ariel	6 Impact	P 2	"I feel like I know everything now. I can do PowerPoint, make comics, and use Kid Inspiration. I can type faster now because there is an online type helper." No Change (6, 6)	Yes
Justin	6 Impact	P 2	"I learned a lot. That's how I feel. I learned how to get around things. I know how to make things happen. You can figure out different things [he was referring to getting around the issues of blocked websites and other firewall issues]." No Change (6, 6)	Yes

Major Findings in the Literature

As a survey of the literature from Chapter 2 pointed out, there are numerous One-to-One (1:1) programs being implemented worldwide, most predominantly in the United States. What are not evident are 1:1 program evaluation studies that apply change theory to adolescents, particularly as it pertains to Concerns Based Adoption Model (CBAM). The question remains, what happens to adolescents as they learn to use an innovation in a 1:1 setting and can CBAM be applied in this setting? Four themes from themes are presented which address this question.

Four Themes

Four themes emerged that support Chapter II and the review of the literature: (1) the continued efficacy of the 1:1 program; (2) effects on academics and writing; (3) the efficacy of the environment, and (4) the importance of technology integration in the curriculum and in school life.

Theme 1: Efficacy of One-to-One

One study by Gulek and Demirtas (2005) found conclusively that schools that provided all middle school students with their own laptops demonstrated work habits different from their non-laptop peers. Results from another evaluation study (Rockman, et al, 1999) indicated that students with laptops: (a) spent more time involved in collaborative work, (b) participated in more project-based instruction, (c) produced writing of higher quality and greater length, (d) gained increased access to information, (e) improved research analysis skills, and (f) spent more time doing homework on computers.

Jeroski (2005, 2003) in the Wireless Writing Project, reported student attitudes, perceptions, motivation, and work habits all improved as a result of their 1:1 laptop program. Although the students in this 1:1 program were not formally evaluated on collaborative work, project based instruction, writing skills, research skills, and on time spent on homework, students from the qualitative sample did reveal many of the same success attributes evidenced in the Gulek & Demirtas (2005) study, in the Rockman (1999) study, and in the Jeroski (2005, 2003) study.

Theme 2: Effects on Writing and Academics

Academically, students in the Johnston study (2005) outperformed their non-laptop counterparts in standardized tests and in the depth and breadth of written expression. Jeroski in the draft report for the Wireless Writing Progam (2005, 2003) reported improvements in student writing; particularly work from students from Peace River North (SD 60) had "greater depth and substance (p.1)" in their writing than non-laptop students. Rockman (1999) reported that students felt the computers allowed them to write better reports and papers and to do more extensive editing. Since editing was easier on the computer, they did more of it. They also appreciated the spelling and grammar checks. A middle school student wrote: "I take more chances writing big words because of spell check (p. 67)."

In this 1:1 study, many accolades were given to the online writing program, *Criterion*. Wendy discussed some of the attributes of the program:

> Criterion is where you have a login and write or type whatever, like an essay. You can save it or keep writing, and then use the spell check. It tells you this is spelled wrong. Then the teacher puts comments on your work [electronically], you can

> save it and keep the writing to finish later, then you submit and turn it into the teacher.

Again, Shelly attested to the phenomenon that because of the thin client tablet computer, she felt that she wrote more and better:

> We learned a lot more on the computers than when we submitted hand-written essays. You don't have to print everything out. Criterion will grade it [the essay] for you for mechanics and grammar. Your teacher can make comments.

Five of the eight students who participated in one-on-one interviews in this study, genuinely believed the use of the tablets were directly related to their success in school, including improvements in their overall grade-point averages (GPAs). For example Wendy proudly admitted, "My grades really improved a lot. I have a higher GPA in eighth grade...my parents can check the grades online." Wendy's GPA in 6th grade was 3.23 and in 7th grade, 3.87.

Similarly, Ariel was also proud of her grades and stated, "I got an A+ in that class [science]...I can check PowerSchool online...it is like a progress report...I login for my mom and she sees my grades." Ariel's GPA's were 2.55 in 6^{th} grade and 3.11 in 7^{th} grade, and by her reports continued to improve in eighth grade. Teresa's GPA had also gone up (from a 3.00 to a 3.14). She shared, "The tablet has been good for me...my mom thinks it helped my grades."

Mariah also felt that the tablet directly contributed to her overall academic success, "In 6th grade, the tablet really improved my grades, [especially] 4th quarter...in 7th grade my grades were almost all straight A's. In 8th grade, I have straight A's."

Standardized Testing and Reporting (STAR)

Although not published, the school district collected reading and mathematics results from the STAR tests: California Achievement Test, Sixth Edition (CAT/6), a norm-referenced test (NRT) adopted by the State Board of Education and California Standards Tests (CST) which indicated how well students are doing in relation to the state content standards. In Year 3 of the program, final test data was gathered by an outside evaluator (Johnston, 2005-06) that showed the laptop students from Cohort 1 received higher standardized test scores than the non-laptop students (From personal interview, Allen, 2006).

Table 18. Perceptions about Grades

Student	Discussion on Grades and Grading	GPA 6th	GPA 7th
Shelly	No comment	3.60	3.98
Wendy	My grades really improved a lot. I have a higher GPA in eighth grade [currently]. The tablet parents can check the grades [online].	3.23	3.87
Michelle	It [the tablet] really brought my grades up.	3.23	3.77
Ariel	I got an A+ in that class [in Science eighth grade using motion and animation to show people running]. I used Excel. You just graph it and it does it automatically. I can check Power School online. It is like a progress report. I login for her [my mom] and she sees my grade.	2.55	3.11
Mariah	In sixth grade, the tablet really improved my grades, fourth quarter. In seventh grade, my grades are almost all straight A's. In eighth grade, I have all A's.	3.01	3.37
Teresa	Most people think their grades are down, they can't blame the tablet for the grades, it's just because some people don't like the teachers. [She was referring to students who dropped out of the program at the beginning of Year 3]. The tablet has been good for me [my mom thinks it helped my grades].	3.00	3.14
Justin	No comment	2.59	2.98
Michael	No comment	2.54	2.70

In all cases, GPA's in the sample improved from 6th to 7th grade.

Theme 3: Efficacy of the Environment

Another aspect of that has attributed to the success of the 1:1 programs emphasizes the importance of the environment. It is important to note that the adoption of innovation does not take place without influences from the teacher, the school, peers in the tablet program, peers not in the tablet program, the student's family, and from the community. Rogers' diffusion of innovation (DOI) theories pertaining to adoption describes the change process from a systems perspective (Bhola, 1984; 1986). How the students make changes in their lives to adapt to the tablet is highly dependent upon the all aspects of school, home, and the community environment. In addition, the role of the individual is integral in the change process. In fact, researchers have found that "younger children and adolescents tend to be

more influenced by the beliefs of parents and teachers, whereas older adolescents are more likely to be sensitive to the opinions of their peers, Heaven, 2001, p. 42)."

Teachers in this study held technical knowledge or possessed a strong commitment to learn how the tablets functioned in a classroom setting in fact; their enthusiasm and technical curiosity was contagious. On numerous occasions, students commented that their tablet teachers encouraged them to learn, explore, and discover on their own.

As with the Jeroski studies (2005, 2003), all parents who were interviewed for this study were strong supporters of the use of the laptop in the home and at school. This is hardly surprising since the effective use of the computer at home impacts the productive use of the computer at school (Lauman, 2000).

Parents interviewed for this study all gave positive remarks regarding the program and the use of the tablet in the home. Parents generally perceived the tablet was directly related to the success their son or daughter had in school. By having the computer at home (24-7) this allowed the student to do all of their homework, helped increase the level of research conducted, and helped to eliminate overall frustration with completing assignments. Justin's mom commented:

> He seems a lot less frustrated when he can do his homework on the tablet. The tablet has particularly been helpful for him because of his handwriting [which is illegible]. I like that we can check his homework and that I can get any information I want from that computer. Having the tablet has opened him more [to new possibilities] (Interview, Dec. 2005).

Theme 4: Technology Integration and the Curriculum

Another important aspect which can be attributed to the tablet program is that the curriculum is not independent from the innovation. Students repeatedly described how they used their thin client tablet computer for a variety of curriculum-based activities in school and at home. Students used their tablets for: conducting research, for studying concepts, for practicing skills, for writing and composing word processed assignments, and for a variety of class projects (PowerPoint presentations, website design, creating tri-fold brochures, posters, spreadsheets, et al).

Muir (2005) at the Maine Center for Meaningful and Engaged Learning identified three basic criteria for the success of integrating 1:1 laptops in a school setting: (1) by

curriculum fit [the activity using the technology clearly addresses the curriculum]; (2) by the level of technology integration [how well the technology activity relates to the lesson objective]; and 3) by the cognitive level of the lesson on a scale associated with Bloom's Taxonomy.

Limitations of the Study

There are at least two possible limitations for this study: (1) the appropriateness of adapting the instrument for adolescents and its resulting reliability, and (2) the lack of recommended limitations typically recommended as part of the CFSoCQ process.

As previously mentioned, the predominant limitation of this study pertains to the appropriateness of the CFSoCQ instrument and its use with an adolescent population. The 35-questions of the CFSoCQ were selected by Hall et al. to represent the different types of concerns that teachers and other educators have as they are first introduced to an educational innovation, as they begin to use it, then as they move on to more experiences that reflect an increased confidence in use of an innovation. Specifically, the CFSoCQ is an instrument that was designed for "adult change facilitators", those individuals who are responsible for facilitating "front line" use of an innovation (Section II of the CFSoCQ manual). Adolescent students who have been using computers since early elementary grades in a technologically rich classroom environment may not qualify as individuals who fulfill the role of "facilitator." Most obvious might be the inability for the adolescent to express concern for all 7 levels and cognitively reflect on each stage in a presumably hierarchical manner.

With 44% of the population in Pathway 2 (the no change path) of which two students in the case began in Stage 6 and ended in Stage 6, it brings into question another flaw with the instrument. Is it necessary to add stages above and beyond Stage 6 (the Refocusing stage)? Furthermore, the creators of the Stages of Concern Questionnaire (SoCQ) instrument caution, that the reliability and validity of the (SoCQ) as it is applied to non-teachers is somewhat questionable (Hall et al., 1987). Although the SoCQ has been described as a "psychometrically rigorous way of assessing stages of concern", until the SoCQ or the CFSoCQ has been used with a large sample of adolescents, the effectiveness remains questionable.

The CFSoCQ instrument has typically been used as an evaluation and discussion tool

by facilitators who conduct and coordinate workshops that involve innovation. For example, workshop coordinators Bond and Preece (1984) asked their participants (teachers) to apply specific strategies and to discuss the management of specific stages of concerns while making suggestions on how to apply them to their practice of teaching. In this advisory role, CBAM facilitators have designed interventions for their participants, based on the reported CBAM levels and their respective clusters. Discussion and intervention strategies with participants, who are experiencing lower levels of concern, can further assist the facilitator and the participant in helping to solve issues with technological adoption.

Unfortunately, students, who were involved with this study, did not receive interventions based on their CFSoCQ scores at the end of Year 1. Most facilitators who have used either, the LoU, SoCQ, or CFSoCQ have used them in conjunction with ongoing intervention and periodic interviews.

Policy Implications

As noted, the purpose of this dissertation study was to identify the levels of concern as measured by the CFSoCQ, to research its applicability to adolescents, and to develop a rich understanding of the adoption process in this unique population. How can we move from a deep understanding of how individual adolescents adapt to and adopt change how to support the growth of thousands of one-to-one programs?

Change theory and concerns are not unique to an adult population. Adolescents and their concerns about their role may have the same dynamics as the concerns of teachers about their use of an innovation. If an effective means for identifying concerns in adolescent populations could be developed, then this information could be used by technology coordinators, teachers, and administrators involved in planning the implementation of a one-to-one program. It is the hypothesis of the creators of this instrument that "change facilitators concerns have similar dynamics to the stages of concern of a front-line user of an educational innovation (Hall et al., 1979, p.12)." Students are front line users of this technology, and in some cases, the innovators who change the technology. (Who knew that social networking in My Space would hold the same power as the telephone in the 21st century?)

The findings from this study resulted in additional questions pertaining to the adoption attributes of adolescent students in the era of one-to-one computer technology.

There are complex issues that influence the success of a one-to-one program that involve influences from the community on the effectiveness and success of the individual; and the suitability of the curriculum tools used in a wireless, networked, 1:1 environment.

Implications for Future Research

For future studies, there are three recommendations: (1) expand the study to include larger sample, (2) explore the need to use an alternate instrument, (3) collect additional qualitative data to support and verify the quantitative data.

The first recommendation is the need to explore the overall strength of the instrument and its use with adolescents who are involved with 1:1 implementations. In order to effectively evaluate the CFSoCQ, the study needs to be expanded to include a larger sample and population and needs to be given more frequently throughout the evaluation.

The second recommendation brings into question the overall application of the CFSoCQ instrument to individuals who are not change facilitators. Can this instrument be revised or should it be substituted with another CBAM like instrument?

Lastly, it is important to recognize the "millennial" population as a unique group of individuals and agree that change theory may be applied to this population by understanding and observing their unique behavior. To support this, qualitative data needs to be collected along with quantitative data so that the research can be triangulated and empirically analyzed.

Expand the Study and Increase the Frequency of the Instrument

The CBAM and CFSoCQ instruments have typically been administered to adults, more specifically to adult educators who have a facilitation or teaching goal in mind. What is generally understood is that it is the primary goal of the individual involved with an innovation is to have that individual move from the Awareness cluster (Stages 0 through 2) to the higher stages of the Personal Impact cluster (Stages 5 & 6). If the CFSoCQ, Levels of Use (LoU) as shown in Appendix A or other CBAM like instrument is to be used, these instruments need to be further modified to address concerns specific to adolescents and be applied to a larger adolescent population.

Finding the right instrument to measure the attitudes of adolescents towards using an innovation and how they move from a state of low-level comfort to a higher stage of comfort

(use) may be dependent on creating another CBAM like instrument. Knezek, Christensen & Miyashita (1995) developed a 65-item Likert instrument for measuring secondary school students' attitudes about computers and computer use in a laptop program. This Computer Attitude Questionnaire (CAQ), in 1999 and 2000, measured trends in attitudes toward computers and attitudes toward school for 1,507 7-12th grade students in Allen, Texas. A closer look at these two instruments might be advisable since attitude may influence the student's ability to adapt and change.

In addition to the CFSoCQ being given as a Pre- and Posttest, the modified version of the CFSoCQ may also need to be administered mid-year to determine if there are any students who may reflect Stage 3 or Stage 4 concerns. It is my hypothesis that a second year of data collection be conducted to support Hall and Hord's hypothesis of change, that it indeed takes a full two years to adopt a new technology or innovation. By doing so, a second year of data will undoubtedly enhance or reject this hypothesis.

We know that adolescents are comfortable with technology. This may in fact be evidenced by the absence of Stage 3 and 4 scores, which eliminated the task-oriented concerns for all of the students in this study. When considering this unique population, key findings from the Pew qualitative study (2006) confirm that instant access to technology and to the Internet is changing the way students adapt to technology and how they are changing their social perceptions and habits. What we need to remember, inherent in the social behavior of millennial adolescent is their innate ability to interact with their community; social psychology reminds us that social influence deeply impacts their lives. We still do not know how adolescents are adapting and adopting technologies.

Summary

This research studied relationships between the concern levels of adolescents undergoing a technology innovation and the effects of demographic variables by the application of statistical analysis. One of the most notable findings from this study was the emergence of categories that supported traditional CBAM patterns, i.e. patterns of the adoption of innovation and the tendency for the user to migrate from lower stages to higher stages of concern. Although these patterns of adoption with adolescents were not unique, if compared with adult studies clearly, what emerged were evidence of five of the seven stages

of change and the effects of certain demographic variables on how students are adapting to change.

As the need to implement one-to-one computing models continues to grow, laptop and computer enhanced programs continue to be highly criticized by the general public as an unnecessary expenditure for schools today. Yet despite the criticism, undeniably, children are motivated to achieve, motivated to succeed in school, and able to apply their knowledge immediately and instantaneously when they use technology. They are accustomed to immediate access of media, audio, voice, text, and video. Further research is needed to help understand not only the sustainability of 1:1 laptops for middle school students who go on to high schools without the benefit of the tool. Just like the cellular phone has revolutionized communication, a 1:1 laptop or thin client tablet for adolescents may revolutionize the way all students perform in middle and in high school.

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APPENDIX A

CBAM MODEL

APPENDIX A

Concerns-Based Adoption Model (CBAM)

Levels of Use of an Innovation (LOU)

	Level 0: Non-use I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved.
	Level 1: Orientation I am seeking or acquiring information about information technology in education.
	Level 2: Preparation I am preparing for the first use of information technology in education.
	Level 3: Mechanical Use I focus most effort on the short-term, day-to-day use of information technology with little time for reflection. My effort is primarily directed toward mastering tasks required to use the information technology.
	Level 4 A: Routine I feel comfortable using information technology in education. However, I am putting forth little effort and thought to improve information technology in education or its consequences.
	Level 4 B: Refinement I vary the use of information technology in education to increase the expected benefits within the classroom. I am working on using information technology to maximize the effects with my students.
	Level 5: Integration I am combining my own efforts with related activities of other teachers and colleagues to achieve impact in the classroom.
	Level 6: Renewal I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school or district.

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APPENDIX B

DEFINITIONS OF CHANGE FACILITATOR STAGES OF CONCERN

APPENDIX B

"Definitions: Change Facilitator Stages of Concern" (Hall, et al., p. 17)

(Adapted for interpretation of use with sixth grade students)

SELF-USE DEFINITION
Stages 0-2 are more focused on self-use of the innovation

Stage 0 Awareness

Change facilitation in relation to the innovation is not an area of intense concern. The student's attention is focused elsewhere.

Stage 1 Informational

There is an interest in learning more about the innovation. The concern is not self-oriented or necessarily change facilitation oriented.

Stage 2 Personal

Uncertainty about one's ability and role in facilitating use of innovation is indicated. Lack of confidence in oneself or in the support to be received from superiors, nonusers, and users are part of this stage.

TASK CATAGORIZATION DEFINITION
Stages 3-4 are more focused on the task of the innovation

Stage 3 Management

The time, logistics, available resources, and energy involved in facilitating others in use of the innovation are the focus.

Stage 4 Consequences

Attention is on improving one's own style of change facilitation and increasing positive innovation effects.

IMPACT CATAGORIZATION DEFINITION
Stages 5-6 are more focused on the impact of the innovation

Stage 5 Collaboration

Coordinating with other change facilitators (or students) to increase one's capacity in facilitating use of the innovation is the focus.

Stage 6 Refocusing

Ideas about alternatives to the innovation are a focus.

APPENDIX C

CFSOCQ ADAPTED INSTRUMENT

APPENDIX C

CFSoCQ Adapted Instrument Administered in 2003

Student Number: (Write that here) _____

If you do not know it, please write your first initial and last name initial.

Directions for the Questionnaire: Circle the appropriate response. Only circle one. If you change your mi

cross the other one out with an X and continue listening.

	N/A	not true a little more very extremely					
	0	1 & 2	3 & 4	5 & 6 & 7			
1. I would like more information about the why we are using this computer.	0	1	2	3	4	5	6 7
2. I am more concerned about using other types of computers/technology.	0	1	2	3	4	5	6 7
3. I would like to work with other students who will be using these computers.	0	1	2	3	4	5	6 7
4. I am concerned because our class will need to spend so much time learning how to use the computer.	0	1	2	3	4	5	6 7
5. I am not concerned about using the computer right now	0	1	2	3	4	5	6 7
6. I am concerned about how my using the computer affects my classmates.	0	1	2	3	4	5	6 7
7. I would like to know more about the computer.	0	1	2	3	4	5	6 7
8. I am concerned about how my work will be criticized or evaluated when I use this computer.	0	1	2	3	4	5	6 7
9. It is important to me to work with other students and my teacher when I use the computer.	0	1	2	3	4	5	6 7
10. I am busy with other things at school that are more important than using this computer.	0	1	2	3	4	5	6 7
11. I wonder whether using this computer will help or hurt my relationships with my classmates.	0	1	2	3	4	5	6 7

12. In order to understand how the computer works, I need more information.	0 1 2 3 4 5 6 7
13. I think that this computer could be replaced with better computer.	0 1 2 3 4 5 6 7
14. I am concerned about using this computer because of the cost the school pays.	0 1 2 3 4 5 6 7
15. I would like to work with other students who will be using these computers.	0 1 2 3 4 5 6 7
16. I would like to know what kinds of help I will need to make this computer work.	0 1 2 3 4 5 6 7
17. I want to know how important my parents and teachers think it is for me to work on this computer.	0 1 2 3 4 5 6 7
18. I would like to excite people at school and at home about this computer.	0 1 2 3 4 5 6 7
19. I may want to use another kind of technology that would be better than the one we are using now.	0 1 2 3 4 5 6 7
20. I would like to help others in using this computer.	0 1 2 3 4 5 6 7
21. I would like to find out how to help others learn about this computer.	0 1 2 3 4 5 6 7
22. I spend little time thinking about how I will use this computer in class or at home for my schoolwork.	0 1 2 3 4 5 6 7
23. I see a possible problem between using this computer in the classroom and at home.	0 1 2 3 4 5 6 7
24. I am concerned about being held responsible for using this computer.	0 1 2 3 4 5 6 7
25. Currently, other priorities prevent me from focusing my attention on this computer.	0 1 2 3 4 5 6 7
26. I know of another computer that I would like to see used in place of this computer.	0 1 2 3 4 5 6 7
27. I am concerned about how my use of this computer affects others.	0 1 2 3 4 5 6 7
28. Learning how to use the computer to email and solve problems takes too much time.	0 1 2 3 4 5 6 7
29. I wonder who will get the credit for how well I work on this computer.	0 1 2 3 4 5 6 7
30. I would like to know where I can learn more about this computer.	0 1 2 3 4 5 6 7

We are almost finished.	
31. I would like to use the computer and learn from other students how they are using the computer.	0 1 2 3 4 5 6 7
32. I know about other computers that I think would be better for our class or for our (school).	0 1 2 3 4 5 6 7
33. I would like to teach other students or classes about this computer.	0 1 2 3 4 5 6 7
34. I am concerned about finding time to use this computer.	0 1 2 3 4 5 6 7
35. I have information about another kind of computer that I think would be better than the one we are using.	0 1 2 3 4 5 6 7

Demographic Information

Directions: Please answer the following questions by circling the correct response.

Please indicate your gender:		Female/	Male
How old were you when you first started using a computer? Write the age you think you started using it.			
Before this study, was there a computer in your home?		Yes	No
Would you like to participate in a study in how you are using the computer at home and at school? (We would be interviewing you at home and at school. We would also like to interview your mom, dad, or guardian.)			
I would like to participate in this study:	Yes	No	Maybe
If yes, please write your parent's name and phone number so we can get permission from them:			

APPENDIX D

DECISION MATRIX FOR SAMPLE SELECTION

APPENDIX D

Decision Matrix for Criterion Based Sample of Four Students/Gender Balanced Sample

Desired Two Males-Two Females

Student Subject Selection			
Male		Female	
Interest	Yes	Interest	Yes
Parent and Student Signed the Consent:		Date:	
Parents' Interest (yes or no) If answer is yes, continue.			
One parent available (yes) Name and Contact Information:			
Both parents available (yes or no)			
Demographic Information			
Ethnicity of the Student: Latino or Hispanic ☐ African American or African ☐ Asian or Pacific Islander ☐		Middle Eastern ☐ Caucasian ☐ Other ☐	
Computer Use at Home before 2003			
Yes		No	
Student CBAM Ratings from Pretest:			
Desired Level (s) one of Non-Use (0-1) and one Level 4 or above			
Level on Pretest for CFSoCQ			
Level 0 or Level 1 ☐		Level 4 or above ☐	

APPENDIX E

INTERVIEW GUIDE FOR QUALITATIVE DATA COLLECTION WITH STUDENTS

APPENDIX E

Interview Guide for Qualitative Data Collection Student

Date of Interview:

Name: Student ID #:

Student Interview/Questionnaire Guide

Directions: I will read a question about your computer and I would like for you to tell me everything that comes to mind. If you need me to repeat the question, or need clarification, don't worry about asking me questions.

I will be using a tape recorder to take notes (digitally) so your voice will be recorded. This is so that I can later look at my notes in case I did not write everything down.

Do you give me your consent to be recorded? Yes / No

Your responses are completely confidential and you can stop the interview at any time.

Do you understand the directions? Yes / No

Question #	Question	Response/Notes
Question 1	When did you first receive your thin client, tablet computer? Think back and describe what you did those first few days.	
Question 2	What kind of training did you receive on the computer? Describe how you first learned to use it.	
Question 3	What were some of the first assignments for class that you had with the computer? How did you feel about using the computer when you first received it?	
Question 4	How do you feel now about using the computer?	
Question 5	Rate your computer skills now compared	

	to the beginning of the school year. Have you improved, in what way?	
Question 6	What kinds of things are you doing with your computer now?	
Question 7	What would you like to do with the computer that you cannot do now?	
Question 8	Do you have any concerns about what will happen to the computer in the future?	
Question 9	Is there anything you would like to tell me about how it has felt to use this computer at school and at home?	

Thank you for your time today!

APPENDIX F

PARENT GUARDIAN QUESTIONNAIRE

APPENDIX F

Parent/Guardian Questionnaire

Name:

Contact Information: Date of Interview:

Directions: I will read a question about your child's computer and I would like for you to tell what comes mind. If you need me to repeat the question, or need clarification, I will repeat the question. The purpose of these questions is to get a sense of what your thoughts and perceptions are about the tablet computer.
I will be using a tape recorder to take notes (digitally) so your voice will be recorded. Do you give me your consent to be recorded? Yes / No
Your responses are completely confidential and you can stop the interview at any time.
Do you understand the directions?

Question #	Question	Response/Notes
Question 1	When did your son/daughter receive their thin client, tablet computer? Think back and describe what you did those first few days, weeks, and months.	
Question 2	What kind of training did the family receive on the computer? Describe how your son/daughter first learned to use it.	
Question 3	Rate your son/daughter's computer skills now compared to the beginning of the school year.	
Question 4	Describe how your son/daughter is currently using the computer?	
Question 5	Have you had any changes in your household or lifestyle during the course of this project?	
Question 6	Describe your feelings about how the computer has affected your child academically this year.	

Question 7	Tell me how you think the One-To-One Project has gone so far?	
Question 8	Would you like to say anything about how this computer has changed your life or your child's life?	

APPENDIX G

TEACHER INTERVIEW QUESTIONNAIRE

APPENDIX G

Teacher Interview/Questionnaire Guide for Qualitative Data Collection

Name:

Contact Information: Date of Interview:

Question #	Question	Response/Notes
Question 1	What kind of training did you receive on the computer? Describe how you first learned to use it.	
Question 2	Describe the first month of the adoption of the thin client tablet computers (TCTC). What were your students' reactions?	
Question 3	Describe some of the first assignments you gave to your class using the TCTC?	
Question 4	Do you have any concerns about what will happen to the computers that your students have in the future?	
Question 5	Comment on this statement: My personal ability to use the computer influenced how well my students adopted this technology.	
Question 6	What suggestions do you have for future adoptions of this technology particularly with middle school students?	
Question 7	Given the list of student participants in this study, what comments do you have for each of them regarding their own level of adoption of the computer (use and ability to use)?	

APPENDIX H

QUESTIONNAIRE FOR STUDENT INTERVIEWS

APPENDIX H

Questionnaire for Student Interviews

#	Interview Questions
1	When did you first receive your thin client, tablet computer? Think back and describe what you did those first few days.
2	What kind of training did you receive on the computer? Describe how you first learned to use it.
3	What were some of the first assignments for class that you had with the computer? How did you feel about using the computer when you first received it?
4	How do you feel now about using the computer?
5	On a scale of 1 to 10, 10 being the highest, rate your computer skills now compared to the beginning of the school year when you first received your tablet in 6th grade. Have you improved, in what way or ways?
6	What kinds of things are you doing with your computer now?
7	What would you like to do with the computer that you cannot do now?
8	Do you have any concerns about what will happen to the computer in the future?
9	Is there anything you would like to tell me about how it has felt to use this computer at school and at home?

APPENDIX I

NETS STANDARDS

APPENDIX I

NETS Standards, International Society for Technology in Education (1998)

PERFORMANCE INDICATORS FOR TECHNOLOGY—LITERATE STUDENTS

GRADES 6-8

Prior to completion of Grade 8, students will:

1. Exhibit legal and ethical behaviors when using information and technology, and discuss consequences of misuse. (2)
2. Use content-specific tools, software, and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research. (3, 5)
3. Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum. (3, 6)
4. Design, develop, publish, and present products (e.g., Web pages, videotapes) using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom. (4, 5, 6)
5. Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues, and information, and to develop solutions or products for audiences inside and outside the classroom. (4, 5)
6. Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems. (5, 6)
7. Demonstrate an understanding of concepts underlying hardware, software, and connectivity and of practical applications to learning and problem solving. (1, 6)
8. Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems. (2, 5, 6)

APPENDIX J

LEMON GROVE SCHOOL DISTRICT CBEDS DATA

APPENDIX J

2006 Lemon Grove School District

CBEDS Data 2006

Racial and Ethnic Subgroup	Number of Students	Percent of Students
African American	260	29.2
Hispanic or Latino	339	38.1
American Indian or Alaska Native	6	0.7
Pacific Islander	14	1.6
Asian	29	3.3
Filipino	30	3.4
White (Not Hispanic)	211	23.7
Multiple or No Response	1	.01

APPENDIX K

ASSENT FOR MINOR STUDENTS

APPENDIX K

Assent for Minor Students under the Age of 18 (45 CFR 46.408)

San Diego State University

Title of Study: "Change Behavior in Adolescents: A Mixed Methods Study Describing the Adoption of Thin Client Computers in an Urban Middle School"

1. My name is Cynthia Sistek-Chandler and I am a doctoral student from San Diego State University and the University of San Diego. My supervising professor is Dr. Fred Galloway from the University of San Diego.
2. We are asking you to be part of a research study. We are trying to learn more about the" One to-One" program and to find out how you used the thin client, tablet at home and at school during sixth grade or during sixth and seventh grade.
3. If you agree to be in this study, this is what you will need to do:

    1) You will ask your parent to sign the consent forms and we will arrange for a family interview at a later date during the summer. This will take place at school or at a location you and your parents select.

    2) You will then be interviewed using the same questions I will use with other students in the program.

    3) You may be asked to allow me to observe you using your computer at home or at school while I take notes.

4. Risks or Discomforts:

If you at any time during the interview or the observation you feel uncomfortable talking about your feelings, you can stop the interview and not continue with the study.

5. Benefits

As a middle school student, your opinions and feedback are important. This information will help other people who are studying teenagers who use technology as often as you have over the last two years.

6. Parent Permission

Please talk to your parents about this study before you decide whether or not to participate. We will also ask your parents if it is all right with them for you to take part in this study. If your parents say that you can be in the study, you can still decide not to participate.

7. You can ask me any questions you have about this study and I will try to answer them for you. If you have questions that you think of later, you can call me at 619-992-3750.

8. Being Part of the Study is Up to You. No one will be upset if you don't want to participate. If you decide to be in the study, you can even change your mind in the middle and stop any time you want.

Please mark one of the choices below to tell us what you want to do:

____ No, I do not want to be in this study

____ Yes, I want to be in this study

_____ _____

Print your name here Date

_____ _____

Signature of Student Date

Note: As a student who is 18 years of age or younger, your parent must also sign this form agreeing for you to be involved with this research.

Parental Permission

I agree my son/daughter has permission to participate in the Thin Client Tablet Study by Cynthia Sistek-Chandler, which will take place at Lemon Grove Middle School in June 2005 and over the summer, 2005.

APPENDIX L

PARENTAL PERMISSION

APPENDIX L

Parental Permission/Informed Consent of Minor to Participate in Research
Informed Consent for Parent to Participate in Research
San Diego State University
May, 2005

Title of Study: "Change Behavior in Adolescents: A Mixed Methods Study Describing the Adoption of Thin Client Computers in an Urban Middle School"

You are being asked to allow your child to participate in a research study. Before you give your permission for your child to participate, it is important that you read the following information and ask as many questions as necessary to be sure you understand what your child will be asked to do.

Investigators:

The main investigator is a doctoral student from University of San Diego and San Diego State University, Cynthia Sistek-Chandler, MA, and the supervising dissertation chair is Dr. Fred Galloway from the University of San Diego Leadership Studies Department.

Purpose of the Study:

The study is designed to gain information about the use of a thin client, tablet computer which was used either in (2003-2004) in sixth grade or is currently being used (2003-2005), in sixth and in seventh grade.

Description of the Study:

Of the 60 students who have participated in the thin client tablet program during last two years (2003-2005) we would like to conduct a group interview with all students and then conduct a more in depth interview with up to five girls and up to five boys, at least two students who **only** participated in the program in sixth grade and at a minimum, at least two students who are currently participating in the program during **both in sixth and in seventh grade**.

If you agree to allow your child to participate, he/she will be asked to participate in the following activities:

Interview- Student will be interviewed regarding their experiences with the One-to-One program. The student interviews will take place at Lemon Grove Middle School and will take approximately one hour.

At least two students will be "shadowed" by the investigator while they take notes of the interaction with the thin client tablet computer while at school.

Students will need to bring the signed consent form before the initial in depth interview and to later arrange for a family interview during the summer 2005.

Parent Interview:

After the student interviews and observations are finished, you as the parent or guardian will be then be interviewed. The questions will include opinions and other comments about the thin client, tablet and how it was used at school and at home. This interview will take approximately 1 hour.

Only one parent or guardian will need to be interviewed from the family. The family interviews will take place either in the home of the family or at Lemon Grove Middle School and will involve note taking by the interviewer and also a digital recording device to record the interview.

None of the procedures or questionnaires used in this study is experimental in nature. The only experimental aspect of this study is the gathering of information for the purpose of analysis."

Risks or Discomforts:

There is minimal risk and discomfort associated with this study. If the student or parent at any time during the interview or the observation feels uncomfortable talking about his/her feelings or behaviors he/she may discontinue participation, either temporarily or permanently.

Benefits of the Study:

Students and parents are an important part of the technological community. This information will assist other researchers in getting important opinions and perceptions of teenagers and their parents in this changing, technological society.

Confidentiality:

School records and interview data will remain confidential and will only be used to conduct statistical correlations without student names or student ID numbers. All records identifying the participants in this study will use a pseudonym to protect the identity. Audiotapes, which will be used to record information, will be used to accurately report answers to the interview questions. A third party who will verify the accuracy of the taped sessions and compare the written responses, which will be contained in the dissertation, will utilize the recordings. Audiotapes will be stored for 2 years after the interviews. Parent subjects will be able to review the included text from the interview prior to any publication. Confidentiality will be maintained to the extent allowed by law.

Incentives to Participate:

The students will receive a $25.00 video store gift certificate after the interview has been conducted.

Costs and/or Compensation for Participation:

There are no costs associated with participation (e.g., tests, office visits, etc.).

Compensation for Injury

It is unlikely that participation in this project will result in harm to participants. If any complications arise, we will assist your child in obtaining appropriate attention. If your child needs treatment or hospitalization as a result of being in this study, you are responsible for payment of the cost for that care. If you have insurance, you may bill your insurance

company. You will have to pay any costs not covered by your insurance. San Diego State University will not pay for any care, lost wages, or provide other financial compensation. However, if you feel you have a claim, which you wish to file against the State [or the Foundation], please contact the Office of Research Administration at (619) 594-6622 to obtain the appropriate claim form.

Injury:

It is unlikely that participation in this project will result in harm to any of the participants. If your child needs any treatment or hospitalization as a result of being in this study, all reasonable and customary medical expenses, above what your insurance will cover, will be paid by the investigator, as long as:

- You/your child have followed all of the directions of the study investigator,
- You/your child have notified the investigator immediately of the injury,
- You/your child have followed medical advice regarding the injury, and
- You/your child have not deliberately caused the injury.

Voluntary Nature of Participation:

Participation in this study is voluntary. Your decision of whether or not to allow your child to participate will not prejudice your future relations with San Diego State University and the University of San Diego. If you decide to allow your child to participate, you are free to withdraw your consent and to discontinue his/her participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Questions about the Study:

If you have any questions about the research now, please ask. If you have questions later about the research, you may contact Cynthia Sistek-Chandler, work phone: 858.571.1199.

If you have questions regarding your child's rights as a human subject and participant in this study, you many call the Institutional Review Board at San Diego State University for information. The telephone number of the Committee is 619-594-6622. You may also write

to the Committee at: SDSU Institutional Review Board, 5500 Campanile Drive, San Diego, CA 92182-1643.

Agreement:

The San Diego State University Institutional Review Board has approved this consent form as signified by the Committee's stamp. The consent form must be reviewed annually and expires on the date indicated on the stamp.

Your signature below indicates that you have read the information in this document and have had a chance to ask any questions you have about the study. Your signature also indicates that you agree to allow your child to be in the study and have been told that you can change your mind and withdraw your consent to participate at any time. You have been given a copy of this agreement. *You have also been given a copy of "The Research Participant's Bill of Rights." You have been told that by signing this consent document you are not giving up any of your legal rights.

_____

Name of Student Participant (please print)

_____

Name of Parent Participant (please print)

_____ _____

Signature of Parent or Guardian Date

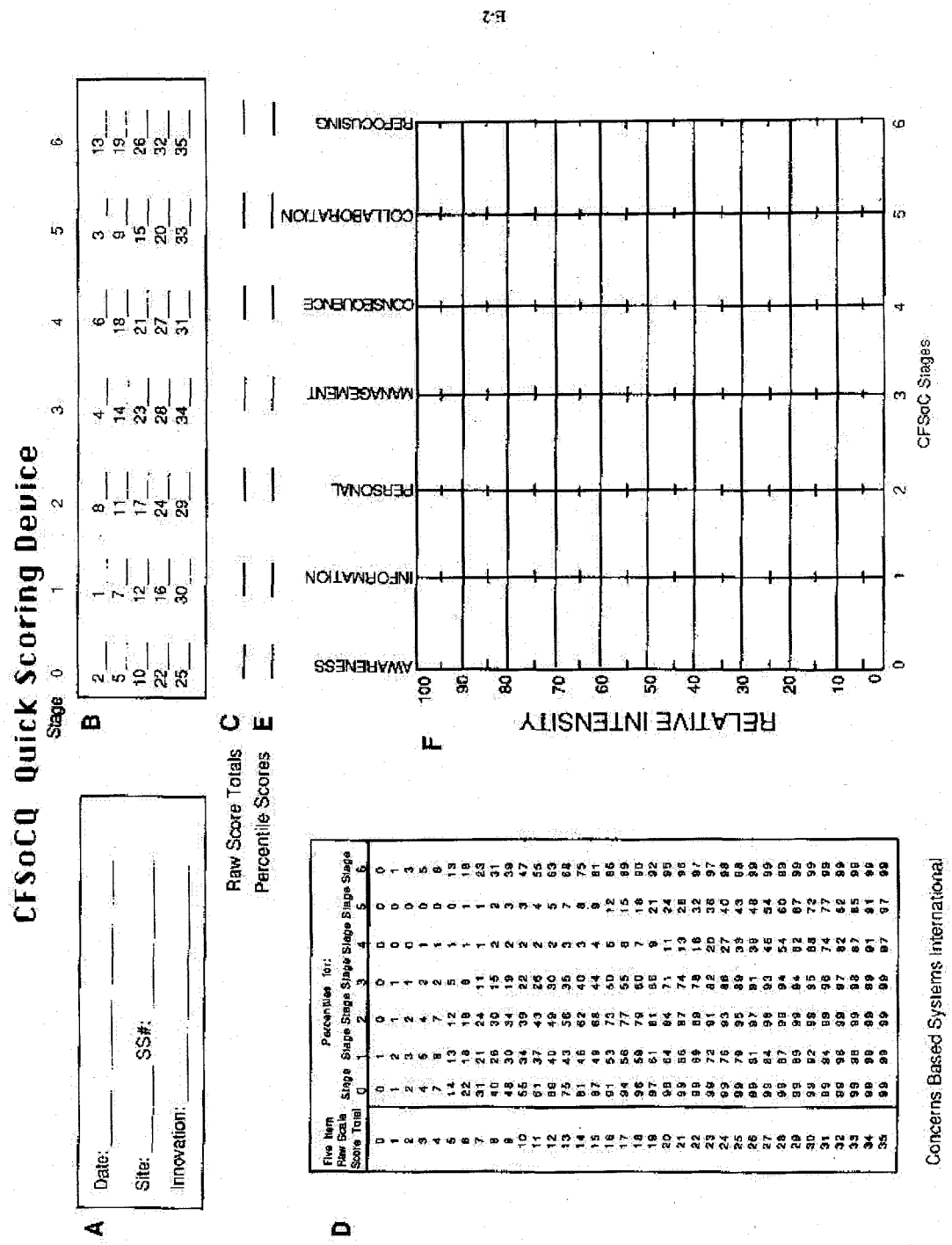
_____ _____

Signature of Investigator Date

APPENDIX M

SCORING DEVICE

APPENDIX M SCORING DEVICE



APPENDIX N

POSTTEST STAGE COMPARISON SAMPLE COMPARISON OF DIMENSIONS

APPENDIX N

Table 18. Posttest Stage Comparison to Sample

	Population *N*=50		Sample *n* = 8	
Stages of Concern	Frequency	Percent	Frequency	Percent
Stage 0 Awareness	15	30.0	1	12.5
Stage 1 Informational	4	8.0	1	12.5
Stage 2 Personal	8	16.0	2	25
Stage 3 Management	0	0.0	0	0.0
Stage 4 Consequence	0	0.0	0	0.0
Stage 5 Collaboration	2	4.0	1	12.5
Stage 6 Refocusing	21	42.0	3	37.5
Total	50	100.0	8	100.0

Comparison of Stages of Concern evident at the End of Year 1

Table 19. Comparison of Dimensions

3 Dimensions	Percent Population	Percent Sample
Self-Use	54	50
Task	0	0
Impact	46	50
Total	50	100.0

Stages of Concern evident at the End of Year 1

APPENDIX O

LETTER HOME

APPENDIX O

Lemon Grove School District

8025 Lincoln Street • Lemon Grove, California 91945-2515
(619) 825-5600 • FAX (619) 462-7959
www.lgsd.k12.ca.us

September 10, 2003

Dear Parent or Guardian:

As part of One:One @School and Home program, publicity for the project will involve periodic photographing, filming or interviewing of students participating in the program. These materials may appear on television, in newspapers or magazines and informational materials describing the program. In order for you child to be present during publicity events, your signature is required on the attached form in order to include your student. Please contact me if you have questions regarding these activities.

Sincerely,

Barbara Allen
Director, Project LemonLINK

APPENDIX P

LETTER HOME

APPENDIX P

8025 Lincoln Street • Lemon Grove, California 91945-2515
(619) 825-5600 • FAX (619) 462-7858
www.lgsd.k12.ca.us

I, _____, as parent or legal guardian of _____, a minor, hereby authorize you, without restriction of any kind, to use on one or more occasions, his or here name, photographic likeness as part of the dissemination of the Lemon Grove School District's One@One @School to Home program. Material may appear on television, in magazine publications, newspapers or printed material describing the program.

I further agree that my participation and that of my son and/or daughter in the aforementioned recording confers us no rights of ownership or rights of remuneration whatsoever. I, individually and on behalf of my minor son or daughter, release the Lemon Grove School District , employees, and assigns from liability for any claims by us or any third party in connection with our participation in the above publicity.

Child's Name_____
(Please print)

Parent or Guardian Name _____
(Please print)

Signature_____

Street_____

City, State and Zip Code_____

Date_____

ABSTRACT OF THE DISSERTATION

A Mixed Methods Study on CBAM and the Adoption of Thin Client Computers by Middle School Adolescents

by
Cynthia Sistek-Chandler
Doctorate of Education
San Diego State University and the University of San Diego, 2007

Although stages of change and adoption of innovation dynamics have been examined for adult populations, comparable research for adolescents is limited. Applying a change instrument grounded in Concerns-Based Adoption Model (CBAM) to an adolescent population, this study investigates perceptions of 45 middle school students who used thin client portable computers in a one-to-one program at home and at school for 3 years.

A mixed methodology design identified which of the 7 stages of concern students passed through and why some students adopted the innovation more readily than others. The Change Facilitator Stages of Concern Questionnaire, a modified version of CBAM, was used to collect quantitative data from students at the beginning and at the end of 6th grade. Qualitative interviews from 8 purposively selected students, their parents, and their teachers supplemented the survey data in the final year of the program.

To guide this study, three questions were investigated: (1) What stages of concern were evident? (2) To what extent can variation in these stages of concern be explained by select demographic measures? (3) Based on the qualitative interviews, how do select students describe their adoption?

Three distinct adoption pathways emerged in both the population and the sample. In Pathway 1, progressions occurred from lower to higher stages; in Pathway 2, no change between Pre- and Posttests; and in Pathway 3, backwards movement occurred through the stages. Unexpectedly, only 5 of the 7 stages of change were high stage scores.

Regression analysis also revealed two significant findings: first, in the posttest analysis, the dependent variable (free lunch) suggested that poverty levels may influence a slower progression through CBAM stages; and second, there was a significant difference in pre- and posttest second high stage scores for the dependent variable (gender), suggesting that adolescent males gained nearly two more stages of change than did females.

This study appears to be the first adaptation of the Change Facilitator Stages of Concern for adolescents. Both quantitative and qualitative evidence explained that adolescent pathways differ fundamentally from those of adults.