Exploring relationships between configurations of laptop use and student off-task behavior

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EXPLORING RELATIONSHIPS BETWEEN CONFIGURATIONS OF LAPTOP USE
AND STUDENT OFF-TASK BEHAVIOR

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ABSTRACT

Exploring Relationships Between Configurations of Laptop Use and Student Off-Task Behavior

by

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This study had three purposes: to explore configurations of laptop use in the middle school setting; to explore the range of student off-task behavior during laptop-based learning experiences; and to explore the relationships between the configurations of use and student off-task behavior. Through a framework of educational change and guided by methodologies of the Concerns-Based Adoption Model of change, an Innovation Configuration Map was developed and used to collect data for this study. Three unique configurations of use were identified: The Jetsons, in which technology is fully integrated and a natural part of teaching, learning, assessment, and communication; Star Trek in which technology, dependant on student access and lesson content, is used predominantly for word processing and Internet-based research, and; Lost in Space, in which access was minimal at best, and uses of technology were limited to word processing.

The range of off-task behavior was described through categories: discussion topic, use of learning tools for purposes other than intended, not completing any task at all, and
completing an entirely different task to the one assigned. An additional descriptor of off-
task behavior centered upon whether it was laptop-based or not. Off-task behavior
identified in this study covered the range of criteria. The most frequent off-task behavior
observed and reported during teacher interviews was discussion of non-task related topics
and using the laptop computers for non-task related activities, in particular playing of
computer games.

Exploration of relationships between configurations of use and off-task behaviors
revealed that the Lost in Space configuration covered the complete range of behavior but
on a relatively minimal level. The Jetsons configuration covered a narrower range, but
off-task behavior was more occasional. The Star Trek configuration covered the range of
off-task behavior on a more frequent level than the other configurations.

Conclusions drawn from this study include a proposal that increased access to
technology does not necessarily lead to greater academic engagement, however in a
constructivist learning environment, the impact of the student off-task behavior is less
pronounced than in environments with less computer use.
# TABLE OF CONTENTS

ABSTRACT ................................................................................................................................. iii

TABLES ......................................................................................................................................... v

ACKNOWLEDGEMENTS ........................................................................................................ ix

CHAPTER 1  INTRODUCTION ............................................................................................. I
   Purpose of Study .................................................................................................................... 1
   Background ........................................................................................................................... 1
   Statement of Problem ......................................................................................................... 11
   Questions Guiding the Study .............................................................................................. 12
   Significance of the Study .................................................................................................... 12
   Theoretical Framework ....................................................................................................... 13

CHAPTER 2  REVIEW OF RELATED LITERATURE .................................................... 17
   Literature Review Procedures ............................................................................................ 18
   Educational Change ............................................................................................................. 19
   One-to-One Computing in the Educational Setting .......................................................... 35
   Student Engagement .......................................................................................................... 53
   Gaps in Existing Research ................................................................................................... 60

CHAPTER 3  METHODOLOGY ......................................................................................... 65
   Research Design .................................................................................................................. 65
   Setting .................................................................................................................................. 66
   Participants .......................................................................................................................... 67
   Instrumentation and Procedure .......................................................................................... 68
   Treatment of Data ................................................................................................................ 72

CHAPTER 4  RESULTS ........................................................................................................ 78
   Development of Innovation Configuration (IC) Map ....................................................... 78
   Identification of Configurations of Laptop Use and Student Off-task Behavior .................. 93
   Exploration of Relationships between Variations in Student Off-Task Behavior and Configurations of Laptop Computer Use .................................................. 116
   Summary ............................................................................................................................ 123

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LIST OF TABLES

Table 1  Summary of research using the CBAM tools .................................................. 32
Table 2  AAL Implementation models after year one .................................................. 40
Table 3  Summary of reported findings of small-scale studies .................................... 52
Table 4  Summary of findings of student engagement studies related to the current study .......................................................... 62
Table 5  Summary of data analysis ................................................................................. 75
Table 6  Domain analyses of interview and observation data ........................................ 86
Table 7  Summary of IC Map development ................................................................... 92
Table 8  Percentage of students engaged in specific off-task behavior .................... 115
Table 9  Summary of relationships between categories of off-task behavior and configurations of laptop use .......................... 114
LIST OF FIGURES

Figure 1  The Concerns-Based Adoption Model ............................................................. 10
Figure 2  Fullan's representation of the cyclical nature of change ............................... 19
Figure 3  Innovation Configuration mapping ................................................................. 68
Figure 4  Example of evolution of components and dimensions during IC Map development ............................................................................ 83
Figure 5  Example of evolution of variations during IC Map development ............... 89
Figure 6  Percentages of variations in teacher actions and instructional uses of technology as recorded in interviews and observations .......... 95
Figure 7  Percentages of teacher uses of laptops reported in focused interviews .... 97
Figure 8  Percentages of variations of student behavior and actions at commencement of lesson as identified in interviews and observations . 100
Figure 9  Percentages of variations of student laptop behaviors before and during learning experiences as reported in interviews and observations ........................................................................... 101
Figure 10 Student uses of laptops during learning experiences as reported in focused interviews .................................................................. 104
Figure 11 Percentages of variations of student off-task behavior as reported in interviews and observations .................................................. 112
Figure 12 Percentages of variations of student technology-based off-task behavior as reported in interviews and observations .......... 113
Figure 13 Relationship between degrees of off-task behavior and one-to-one computing access ................................................................. 144
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CHAPTER 1

INTRODUCTION

Purpose of Study

This study has three purposes: First, this study will describe configurations of laptop computer use in the middle school setting. Second, this study will describe student off-task behavior during laptop computer based-learning experiences. Third, this study will explore the relationship between variations in student off-task behavior and configurations of laptop computer use.

Background

The Need for Effective Technology Integration in K-12 Education

"Today’s kids are different than kids were 15 years ago. They learn differently and as a result feel disconnected from schools that were designed for another time" (Apple, 2004). Students of all ages are losing interest and lack motivation to learn material they consider irrelevant, delivered in ways they consider uninspiring. Curriculum and pedagogy in the K-12 setting needs to be updated to better align with the curiosities and learning needs of digital kids. However, the No Child Left Behind (NCLB) Act of 2002 has been interpreted by school districts and state departments of education as pushing traditional pedagogy and a curriculum based on content standards. As a result, skills-
based instruction and *back to basics* curriculum are being promoted nationwide. A less known element of NCLB is the encouragement of states and districts to improve academic achievement of all children though effective use of technology (Office of Educational Technology, n.d).

The *School Technology and Readiness Report* (2001) formulated by the CEO Forum (consisting of CEOs of technology corporations such as America Online, Apple Computing, Classroom Connect, and Hewlett-Packard, and educational organizations including National Education Association and National School Boards Association) was created after five years of examining the impact of technology on education. The report included among other recommendations and findings, that increased access to technology leads to improved student achievement (CEO Forum, 2001). Similar recommendations were reported by the Partnership for 21st Century Skills (2002): Educators and educational agencies must stress curriculum that is relevant to students and pedagogies that apply strategies and technologies better reflecting the society in which students live and will work. In addition to the recommendations for increased access, the recommendation of these reports most applicable to this study is that strategies to measure technology integration in education are limited and in need of development and promotion.

In the 2001 report *How are Teachers using Computers in Instruction*, Becker analyzed over 4,000 surveys of teachers of grades 4-12 and reported that the primary uses of computers were in computer education courses and courses requiring students to word process assignments. In addition, classrooms with five to eight computers utilized computer-based learning strategies more than classrooms with one to four computers or
classes assigned to school computer labs on a regular basis. Most relevant to this study is that although reports of more frequent integration occurred in schools of low socio-economic status (SES), the type of integration was low level and not authentic (e.g. for remediation, drill and practice, or word processing).

In summary, some evidence indicates that effective technology integration can lead to greater student achievement. However, the wide range of possible implementations limits the generalizability of such a statement. For example, despite the encouragement that technology be used for authentic and meaningful purposes, in low SES populations integration efforts often result in students using computers for lower level cognitive activities. Possible explanations for this include lack of teacher expertise and inadequate access. The development of national standards is an attempt to assist teacher education institutions in preparing teachers to integrate technology effectively and provide a clearer description of effective integration strategies.

*International Society for Technology in Education (ISTE) National Educational Technology Standards (NETS)*

In recognition of the need for clear and consistent implementation heuristics, the International Society for Technology in Education began the development of the NETS in 1998. The underlying premise of the ISTE NETS is to change the learning environment from a traditional teacher-centered one to a student-centered one that better reflects the society in which students live and will eventually work (ISTE, 2000). Essential conditions for an effective technology rich learning environment include consideration of alignment between learning and assessment, technology skilled teachers, implementation of content standards and curriculum resources, and student-centered approaches to
teaching. Of critical importance to this study, the NETS stress that students need access to contemporary technologies and telecommunications (ISTE, 2000).

The technology standards for students and teachers are complex and comprehensive. Student NETS are organized by grade level group (preK-2, 3-5, 6-8, and 9-12) and topical area. These areas include (a) basic operations and concepts, (b) social, ethical, and human issues, (c) technology productivity tools, (d) technology communication tools, (e) technology research tools, and (f) technology problem-solving and decision-making tools (ISTE, 2000). A typical performance indicator requires students demonstrate the capacity for designing, developing, and presenting multimedia products for communicating curriculum concepts (ISTE, 2000).

The NETS for teachers are similarly well conceived and stress the importance of teachers meeting standards in the areas of: (a) technology operations and concepts, (b) planning and designing learning environments and experiences, (c) teaching, learning, and the curriculum, (d) assessment and evaluation, (e) productivity and professional practice, and (f) social, ethical, legal, and human issues (ISTE, 2000). Specific examples of teacher standards include applying technology to assess student learning, promoting safe and healthy uses of technology, and managing student learning while engaged in technology based experiences (ISTE, 2000). In addition to establishing expectations for use, the NETS can be used to help establish a more concrete image of different ways to effectively integrate technology into the K-12 setting. The success of implementing the ISTE NETS for teachers and students is dependent, in part, on high quality access to computers.
One-to-One Computing Access

Access to technology in K-12 education has often meant access to one or two computers in the classroom or access to a computer lab. However some have argued that it is critical that each student have their own computer (Norris and Soloway, 2004). Laptop initiatives are one way schools, school districts, and entire states are making an effort to increase access. One of the most notable initiatives described in the literature is the 1980's Apple Classrooms of Tomorrow (ACOT) initiative. ACOT was a project that provided students and teachers each with personal computers. The project set out to examine the impact of routine use of technology on teaching and learning. The goal was to positively change education by integrating technology into the structure of schooling through a saturation of classrooms (and homes) with computers (Sandholtz, Ringstaff, & Dwyer, 1997).

Today the concept of one-to-one access to technology in K-12 classrooms is not as novel as it was in 1985. In recent years, the face of one-to-one computing access has changed dramatically. Where the ACOT project provided participants with two computers, one for home and one for the classroom, the new image of one-to-one computing access has students and teachers using laptop computers at home and school. The Microsoft Anytime Anywhere Learning (AAL) initiative and the Maine Learning Technology Initiative (MLTI) are large-scale examples of one-to-one access to laptop computers in the school setting.

Large-scale initiatives have been instrumental in promoting the concept of one-to-one educational technology access in the K-12 setting. Although primarily anecdotal, the reported findings of ACOT, AAL, and MLTI highlight improved student achievement.
(Rockman et al., 1998; Sandholtz, Ringstaff, & Dwyer, 1997), overall satisfaction with involvement in a one-to-one computing program (Rockman et al., 1998; Sandholtz, Ringstaff, & Dwyer, 1997; Silvernail & Lane, 2004), and increased student motivation (Rockman et al., 1998; Sandholtz, Ringstaff, & Dwyer, 1997; Silvernail & Lane, 2004). What is generally missing from these and other one-to-one related studies is a description of how computers are being used from a standards perspective and a systematic evaluation of the implementation strategies of the teachers.

**Student Engagement**

Increase in student engagement, the level of cognitive and physical engagement a student has with an assigned task (Slavin, 1997), has been reported as one of the benefits of providing students with one-to-one computing access. An examination of how technology is being implemented in the classroom is a vital component of understanding the dynamics of the one-to-one computer classroom and its impact on student engagement. Studies of student engagement, though not specifically referring to computer-based environments, focus on ways to improve or enhance engagement via innovative curriculum, pedagogy, and classroom management strategies. Studies of student engagement in which technology is a focus predominantly investigate engagement of students in higher education and not of students in the K-12 environment.

Researchers of student engagement generally rely on the subjectivity of an observer who looks for identifiable student behaviors associated with being on-task. Students actively seeking assistance relative to the task or persisting with the task by completing assigned learning activities are exhibiting on-task behavior (Doyle, 1986). More specifically, Linnenbrink and Pintrich (2003) identified cognitive and motivational
characteristics that indicate student on-task behavior. Students who are cognitively engaged with the learning activity can be identified by a high degree of eye contact with the teacher or discussing lesson content in an in-depth or coherent way. The cognitively engaged student using a computer could be engaged in the content by organizing his or her notes or investigating relevant web sites for additional information. Motivational engagement can be considered in terms of students’ interest and value in a given subject or topic as indicated by the extent of questioning. Depth of questioning, which is often an indicator of how metacognitive and interested a student is about the learning, is in many instances impacted by student motivation. Perhaps most relevant to this study, is the reporting by Doyle (1986) that low ability students and students from low SES backgrounds are less likely than higher ability students to be engaged in learning when assigned seatwork, recitation activities, or lower level cognitive tasks.

Student disengagement in learning, or off-task behavior, is less researched and less documented; perhaps because the range of student-off task behaviors is extensive. Goffman (1967) suggested that people may be physically present and even appear actively present, but in reality are disengaged from interaction. Ways in which people may be disengaged include external preoccupation, self-consciousness, and interaction and other consciousness. Relevant to this study is the concept that students may appear to be fully engaged in learning, but are in fact off-task.

Off-task behaviors include (a) involvement in an entirely different task to the one assigned, (b) discussing topics that are not relevant to the assigned task, or (c) not completing any task at all (Linnenbrink and Pintrich, 2003). In addition, (d) use of learning tools for purposes other than intended or specified for the learning activity (such
as surfing the Internet for movie information or using a computer to email friends during class time) could be considered off-task behavior. Baker, Corbett, Koedlinder, and Wagner (2004) used similar categories of off-task behavior when investigating computer-based tutorials and student achievement. For the purpose of this study, student off-task behavior will be identified using the four criteria listed in this paragraph.

In discussing classroom management, Jones (1996) highlighted the importance of meeting student needs, both culturally and academically, to enhance student engagement in learning. Types of activities, physical characteristics of the classroom, and more importantly, types of work assigned to students are all listed as influencing student cooperation in the learning experience. Additionally, it was suggested that student behavior and engagement in learning is influenced by the fact that oftentimes, students are assigned lower level cognitive tasks that have no meaning to the individual. Studies of differential treatment of low achieving students and students from low SES backgrounds highlight that this is often the predominant learning environment for these populations (Doyle, 1986). Research on teacher assignment of tasks during computer-based learning is consistent. Becker (2001) reported that in at-risk populations, use of technology for learning primarily focused on drill and practice and word processing. Thus, how the technology is used is a critical factor for student engagement (or disengagement) and subsequent learning in the middle school setting.

In a technology rich classroom, increased engagement in learning is often assumed as access is increased; yet with the introduction of technology into education, measuring student engagement has become more complex. Student learning needs, behaviors, classroom roles and relationships all change in a technology rich environment. It is often
assumed that changing the classroom by introducing technology will result in better
teaching and student motivation, which ultimately means more effective student learning
(Richardson & Placier, 2001). Unfortunately, this assumption does not take into account
the significant complexity that is concomitantly introduced with any innovation.

*The Concerns-Based Adoption Model (CBAM) of Change*

The CBAM is a comprehensive model of change that centers on the individual. This
model was founded on sound educational practice and research, and has applications in
all education and training settings. Figure 1 depicts the all-inclusive nature of Concerns-
Based Adoption Model of change. The three primary diagnostic tools of this model are
the Stages of Concern (SoC), Levels of Use (LoU), and Innovation Configuration (IC)
Maps. Each tool is unique and is designed for use at different stages of the change
process (Hall & Hord, 2001). In addition to the diagnostic tools, this model
acknowledges that there are many factors, including system culture and change
facilitators that impact a changing educational context. With the understanding that
documentation of how an innovation is being implemented should precede reporting of
student outcomes (Hall & George, 2000), this study developed an IC Map to illustrate all
the ways laptop computers are being used (both appropriately and not) by 7th grade
teachers and students.

*Innovation Configuration (IC) Maps.*

Innovation Configurations as a construct is an acknowledgement that during the
change process implementation of an innovation takes many forms. Traditionally, use of
an innovation was determined by simply tallying the number of situations (e.g. classrooms) in which the innovation was being implemented and assuming use automatically followed training. While conducting research on innovation adoption and use, the developers of the CBAM discovered that how an innovation is designed or intended to be implemented and how it actually is implemented are not always the same (Hall & Hord, 2001). The purpose of IC Maps is not to judge variations on implementation but to provide a rich description of the different configurations that can then be used for future developments and trainings: “An IC Map is a summary in words of the different ways the key components of an innovation can be made operational” (Hall & George, 2000, p.3).

The IC Map construct was developed in the 1970s (Hall & Loucks, 1977) and immediately became an integral part of the CBAM. Guidelines for the creation of IC
Maps have been refined over the years, however the basic steps have remained the same. Creating an IC Map is a multi-step process. Initial analysis of interviews, documents, and observation data is used to create a Cluster Map representing all the intended and observed uses of the innovation. The Cluster Map is then used to identify exact components or major features of the innovation. Components can be materials, or actions and behaviors and in most cases are multidimensional (Heck et al., 1981). For the purpose of this study, components of the uses of laptop computers configuration will be clustered or grouped by teachers and students. Once critical and related components have been clearly identified, the next step is to add to the Cluster Map variations of use for the components. For example, Heck, Stiegelbauer, Hall, and Loucks (1981) suggested that when considering an instructional materials component of an innovation, the different variations could be innovation material only, innovation material and supplemental text, text only, or teacher made only. The first draft of the Cluster Map is then implemented in the field to collect data. Finally, using completed component and variation data from the Cluster Map, an Innovation Configuration Map can be created (Hall & George, 2000; Heck et al., 1981).

Statement of the Problem

There is little disagreement that curriculum and pedagogy need to be updated to better meet the needs of our students. Some believe that the introduction of national standards and improved access to computers through one-to-one initiatives can address these concerns. Research on the impact of providing greater student access to technology has primarily been subjective in nature and focused on specific student outcomes such as
achievement. There exists a need to document student and teacher use of technology based on national standards.

This study seeks to develop a tool for examining student and teacher uses of computers in a one-to-one environment relative to the ISTE standards and specific student off-task behaviors. In addition, this study seeks to explore the relationship between configurations of use and student off-task behavior.

Questions Guiding the Study

This study will seek to answer the following research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?

2. What is the range of student off-task behavior during laptop computer based learning experiences?

3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

Significance of the Study

This research project will provide insights into the impact of different configurations of use of laptop computers on student engagement. Descriptions of the relationships between configurations of use and student engagement from this study may have value beyond this school setting as other schools and districts consider adopting similar initiatives.
Practical significance of this study centers on the development of the Innovation Configuration (IC) Map. The IC Map from this study could be used by schools and school districts to design professional development and to make decisions about future one-to-one programs. It could also be used as a tool for evaluation of laptop or one-to-one computing programs in this school, school district, and beyond.

The student off-task behavior component of the IC Map could be used to document student off-task behavior in any computer-based learning environment. Descriptions of student off-task behavior during computer-based learning activities could be used to determine the effectiveness of choosing this medium for instruction over other mediums. In addition, descriptions of student behavior during computer-based learning experiences could assist teachers in future classroom management decisions as well as in planning and implementing computer-based lessons.

Theoretical Framework

This study will be grounded in a theoretical framework of educational change, particularly the Concerns-Based Adoption Model of change (CBAM). The CBAM is unique because it considers change from the perspective of those implementing innovations within the context of the change itself (Heck et al., 1981). Change is perhaps the only constant in the field of education yet it is difficult to define it in a concise manner. One way to gain a better understanding of educational change is to consider the underlying principles associated with change: Change is a complex process rather than a one-time event; change is not readily accepted and often involves risk and uncertainty; individuals within a system must change alongside the changing system; change can be
considered to be movement from a state of disequilibria to one of equilibrium; and change comes in all shapes and sizes.

Hall and Hord (2001) proposed principles of change unique to the CBAM. In addition to the principles shared with other theories (change is a process; individuals and the system must change together; innovations can be of any size), the CBAM has the following identifying assumptions:

1. Development and implementation are two separate elements of change, of which the contributing proportions should be considered equal for the duration of the change process. Best practice would see equal effort, money, time, and personnel extended in the development and implementation phases of an innovation. Unfortunately what often happens is an unequal allocation, with more resources allocated to development and not enough to implementation for sustaining innovation adoption.

2. Interventions, the actions and events surrounding educational change, are key to the success of the innovation. Interventions can be workshops, casual conversations, and even decision-making events.

3. A balance between a top-down and bottom-up approach to educational change is more successful than a one-way initiative. Often those most affected by or those expected to implement change are voiceless in decision-making, leading to unnecessary resistance. Change initiated from the bottom-up often lacks the necessary support of the system within which it is a part.
4. Administrative leadership strongly influences the long-term success of a change initiative. Top-down and bottom-up initiatives are dependent on administrator's support and assistance in securing an infrastructure for change.

5. Mandates, although top-down, can lead to successful change if accompanied by support, training, and an understanding of the change process.

6. The school and the individuals within it are the primary unit of change. Although external factors can influence the change process, the onus is primarily on the school. If the school is part of a larger-scale initiative, it must move with and be supported by the larger system.

7. Change, although happening on many individual levels, is a group effort. All involved must contribute and be considered for change to be successful.

8. The state of disequilibria does not have to be painful if interventions of the change process are well understood and properly implemented. If facilitated effectively, the discomfort of being involved in the change process can be minimized.

9. The physical and personal features of the school can influence the change process: Physical features include structure and infrastructure, whereas personal features are the attitudes, beliefs and values of the individuals as well as the norms of the school (Hall & Hord, 2001, pp. 4-16).

Simply stated, we are living in a time of change. Not only is change relevant to education, changing conditions are frequently the focus of educational research. Wiersma (1991) suggested that "conditions under which research is conducted and data obtained within and across studies must be incorporated into a meaningful whole" (p. 19). As a theoretical framework, change is consistent with the research problem or phenomena and
will not just serve as a departure point for research, it will provide cohesion of research methodologies because it is an integral part of such methodologies. Using educational change theory as outlined in the CBAM as a perspective from which to conduct the current study, focuses the research on the key players in the change process – the teachers and students.

In the current study, the implementation of a one-to-one laptop initiative in a middle school will be examined from a change perspective. In particular, this study will examine the impact of a changing educational context on behaviors of students and teachers. Assumptions of educational change relevant to this study are evidenced in contextual conditions including: (a) The laptop initiative at the selected school is well supported by a GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs) grant, the school administration, and the school district; (b) teachers at the school are given opportunity for paid trainings; and (c) the physical and personal features of the school accommodate the innovation, in that the school has been physically prepared for adopting the innovation, integration of technology is a school goal, and the teachers elected to be involved in the one-to-one laptop initiative.
CHAPTER 2

REVIEW OF RELATED LITERATURE

This review considers the following research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?
2. What is the range of student off-task behavior during laptop computer based learning experiences?
3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

This review is divided into five sections. Section one will provide an overview of the literature search and selection procedures. Section two will review change theory and educational research using the Concerns-Based Adoption Model (CBAM) of change by providing an overview of change theories and then focusing more specifically on the Concerns-Based Adoption Model. In particular, the application of the CBAM in education and educational technology contexts will be examined. Section two will close with a review of literature supporting the use of this model as a theoretical framework for research. Section three will introduce research on one-to-one access to technology in the K-12 setting. The section will review findings of large-scale initiatives as well as more recent smaller studies involving one-to-one computing access. In particular, studies
related to student engagement and best practices will be reviewed. Section four, a literature review of student engagement in learning will introduce studies in which contextual influences impacted student engagement, or in which student engagement with educational technology was a focus. This chapter will conclude with a discussion of gaps in existing research.

Literature Review Procedures

A systematic search through three computerized databases - Education Resources Information Center (ERIC), the Association for the Advancement of Computing in Education’s (AACE) Digital Library, and Academic Search Premier via the Elton B. Stephens Company (EBSCO) interface was conducted. In addition a search was conducted with the Google Internet search engine. A search of the University of Nevada, Las Vegas (UNLV) library catalogue was performed. The following descriptors were used: CBAM, Concerns-Based Adoption Model, Innovation Configuration Maps, one-to-one computing, laptops, laptops in education, K-12 computing, laptops in the classroom, educational technology, educational technology K-12, palm pilots in education, handhelds in education, ACOT, anytime anywhere learning, Maine laptop program, MLTI, student engagement, student off-task behavior, and student engagement with technology. An ancestral search through the reference lists of the articles obtained in the computer search also was completed. In addition, UNLV faculty members recommended articles.

Selection criteria

Studies were included in the review of literature based upon their relevance to the purposes of the study: (a) to describe configurations of laptop computer use in the middle
school setting, (b) to describe student off-task behaviors during laptop computer based learning experiences in a K-12 setting, and (c) to investigate the relationships between the configurations of use of laptop computers and off-task behavior.

Educational Change

An examination of theories and models of change provides an excellent starting point to begin to understand problems, issues and change concepts. Many models and theories of change have been proposed. Though each is unique, there are basic principles or assumptions common to the proposed models or theories of change: Change is a process; change is often initially discomforting; and change is complex and dynamic, yet can be understood (Fullan, 2001; Hall & Hord, 2001; Persichitte, 1999; Rogers, 2003). This section will briefly outline the nature or assumptions that are common to many change theories and models, followed by a more detailed discussion of Rogers’ (2003) diffusion perspective and Hall and Hord’s (2001) CBAM model.

Figure 2. Fullan’s representation of the cyclical nature of change.

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Figure 2 (Fullan, 2001, fig.4.1, p. 51) shows the dynamic relationships between the key phases of change: initiation, implementation, and institutionalization. The ultimate goal of introducing an innovation, or initiating the change process is represented in the center of the circle in the form of student outcomes (such as improved achievement and attitudes) and organizational capacity (attitude change, shift toward problem solving, etc.). The change process begins when an individual or group initiates a change by promoting or perhaps even implementing a new program or innovation. An innovation may stay in the initiation stage for years, resulting in the progression to institutionalization taking 3-5 years and sometimes even more (Fullan, 2001; Hall & Hord, 2001; Rogers, 2003). As innovations are institutionalized, a new series of initiations and implementations begin, which may impact prior implementations and initiations, and the cycle continues. Even theories that perhaps appear more procedural, still address the dynamic nature of change. Rogers’ diffusion of innovation perspective is an example of this.

Rogers’ Diffusion of Innovation Perspective

To Rogers, diffusion is the process of innovation adoption among individuals within a larger system. It occurs with time and through communication and example setting by agents of change (Rogers, 2003). Additionally, innovation adoption is dependent on both internal and external factors and innovations must have meaning for the individuals who are expected to adopt them: “The characteristics of the innovation, as perceived by individuals, help to explain their different rates of adoption” (Rogers, 2003, p. 15).

Characteristics of an innovation, or internal factors can be understood by considering the questions an individual might ask oneself about the innovations’ impact on them as a
person. Rogers posed five perceived characteristics: (a) Is the innovation better than what is in existence? (relative advantage), (b) Is this innovation consistent with my values, experiences, and needs? (compatibility), (c) Is this innovation going to be hard for me to understand and use? (complexity), (d) Can I just use this innovation on a trial basis and then decide? (trialability), and (e) Will others even be able to tell that things have changed? (observability). Although relative to the individual, in order to find answers to these questions, one must look at factors internal to the innovation such as its specialized features, accessibility, and built-in support. Remembering that change is complex and multidimensional, factors external to the innovation must also be considered.

Rogers posed two primary external influences to innovation adoption: Adopter categories and innovation-decisions. Adopter categories are identified by the degree to which the individual adopts the innovation. Rogers put forward five adopter categories: laggard, late majority, early majority, early adopter, and innovator (Rogers, 2003). Where laggards would be those individuals who perhaps see limited relative advantage, compatibility, complexity, trialability, and observability of the innovation, early adopters and innovators would have a lot of yes answers to the questions about the internal factors of the innovation, and are excited and ready to implement it. Members within each category have much in common and like other theories of change, movement or progress is common but not always timely (Rogers, 2003). The element or variable of time in the diffusion process can be seen within the individual’s rate of adoption but also throughout the innovation-decision process.

To overcome the burden potentially created by the source of the innovation, Rogers integrated an innovation-decision process that can occur at the individual, unit, or
organizational level. There are five steps in the innovation-decision process: (a) knowledge, in which the individual has a basic awareness of the innovation and is just beginning to understand it; (b) persuasion, in which the individual is beginning to form an opinion of the innovation; (c) decision, in which through their actions the individual demonstrates a decision or choice to adopt or reject the innovation; (d) implementation, in which the individual actually begins to apply or use the innovation; and (e) confirmation, in which the individual begins to confirm or deny their prior decision by seeking reinforcement of such decision (Rogers, 2003). This process can eventually lead to adoption or rejection of an innovation. Innovation-decision can apply at the individual level, but it is well known that most sources of educational change are external to the teacher. The innovation-decision process is multidimensional, occurring on the individual level as well as at the level of the system in which that individual is a part.

In summary, Rogers’ diffusion of innovation perspective presents change as a communication process with many external and internal factors influencing ultimate innovation adoption. Internal factors are characteristics of the innovation as perceived by the individual. Such factors include the perceived benefit of the innovation in relation to the amount of effort and personal change required for successful adoption. For example in this study, internal factors may include whether the teacher perceives the use of laptop computers to be worth modifying instructional practices. Other characteristics include the malleability of the innovation or the flexibility of its potential use, as well as indication that change is actually underway. In this study, the development of the IC Map will address the malleability of the innovation, the introduction of laptop computers for students and teachers in the middle school. External factors include level of acceptance
and willingness to adopt an innovation as well as the source of the innovation-decision making. For this study, external factors could be considered to include the understanding that funds for the laptop program are externally controlled and support for teacher training and repair of laptop computers not guaranteed. External factors frequently outnumber the internal factors influencing change and are often out of the immediate control of the people most affected by the change. Thankfully, there exists particular models of change that attempt to overcome these factors. The next section will discuss the Concerns-Based Adoption Model, a model of educational change that focuses on those individuals who are personally involved in the change process.

*The Concerns-Based Adoption Model (CBAM)*

Hall, Wallace, and Dossett proposed the Concerns-Based Adoption Model in 1973 (Hall et al., 1999). This model is based on school practice and the understanding that “change facilitators need to understand the culture of the user system in which the change process is unfolding” (Hall et al., 1999, p. 3). Based on the work of Fuller (1969) who focused on concerns of teachers, the CBAM seeks to understand the effects of change on the individual within the school, as well as identifying and examining components of the innovation itself. Its primary focus is on collaboration between those actually using the innovation and those facilitating its use (Hall, Wallace, & Dossett, 1973).

The CBAM can be viewed as the foundation for a multi-stage decision process involving three systems - the resource system (change facilitators, consultants, and decision-makers), the user system (those adopting or expected to adopt the innovation), and the collaborative system (the combination or relationships between the other two systems) (Hall, Wallace, & Dossett, 1973). Initially, the resource system has strength
over the two systems, however as the user system strengthens, the power of the resource system fades. The collaborative system, a combination of the resource and user systems, “... is realized as both systems engage in an analysis of needs, an identification of concerns, and analysis of current use of the innovation” (Hall, Wallace, & Dossett, 1973, p. 25). For example, in this study, the resource system is the school district administration and grant-writers, and Apple Computers Inc., and the user system is the school and its teachers and students.

Collaboration between the resource and user system is bi-directional and continual. Through information and action channels, a change facilitator is able to collect data on abilities, concerns, and usage of the innovation. Analysis of such data can then be used to determine the user system’s level of readiness and need for resources for moving forward (Hall, Wallace, & Dossett, 1973). To better understand how the individual experiences change, Hall et al. (1999) identified three diagnostic dimensions: Stages of Concern, Levels of Use, and Innovation Configurations.

The Stages of Concern (SoC) dimension addresses feelings and perceptions. Three categories of concern have been identified: self, task, and impact. Building on Fuller’s model of student teachers’ concerns progressing through four levels (unrelated, self, task, and impact), Hall and his associates researched, identified, and confirmed seven specific Stages of Concern about an innovation (Hall & Hord, 2001). Though more specific than Fuller’s levels of concern, the CBAM Stages of Concern can be grouped according to levels. Self concerns has two stages: 1) Informational; and 2) Personal (Hall & Hord, 2001). Where the Awareness stage, labeled 0) has the individual not concerned at all about the innovation, the Informational and Personal stages indicate concerns of wanting
to know about the innovation and how it will affect the individual. The second level, *task* concerns, consists of one stage - 3) Management. In this stage the individual is concerned about the impact the innovation is having on their personal and professional time. The final level toward adoption of an innovation is the *impact* concerns level. This level can be broken into three stages - 4) Consequence, 5) Collaboration, and 6) Refocusing. Stage four concerns are when the individual has less concern about self and task, and more concern about how the use of the innovation is impacting clients. Stage five concerns reflect a desire to share with others, and when in stage six refocusing concerns, there is interest in modifying or replacing the innovation. There are three methods to assess concerns: one-legged interviews, open-ended concerns statements, and an SoC Questionnaire (SoCQ) (Hall & Hord, 2001). It is one thing to acknowledge the concerns of the individual users within the user system, but “a critical step in determining whether a new approach is making a difference is to determine first if the innovation is being used” (Hall & Hord, 2001, p. 81). The next section will discuss the Levels of Use (LoU) and Innovation Configuration (IC) Maps dimensions.

Where the SoC examined the personal impact of change, the Levels of Use dimension seeks to address the behavioral impact of change. The inclusion of an LoU dimension in this model acknowledges that change is a process and that there are different degrees of innovation use. Through interviews and observations one is able to identify three nonuse and five use levels (Hall & Hord, 2001). Nonusers (0 Nonuse, I Orientation, and II Preparation levels) range from those individuals who do not take any action in relation to the innovation to those who are just preparing for the first use. User levels
(III Mechanical, IV Routine, V Refinement, VI Integration, and VII Renewal) can range from using the innovation without reflection or consistency, through using it the same way each time, to using and modifying an innovation to enhance and explore new goals. The IC Maps also acknowledge that teachers will adapt the innovation to suit individual needs, yet by mapping these adaptations, factors inherent within the innovation can then be analyzed for training and support needs. Many studies have implemented the three dimensions of the CBAM to examine educational change. The feature of the CBAM most relevant to the questions posed in this study is the IC Map, in that it can provide a mechanism for describing how the innovation is being implemented in comparison to expected or ideal implementations.

*Research using the CBAM.*

This section will review examples of educational research using CBAM constructs. The CBAM has been used in educational research as an evaluation tool, a tool for examining innovation adoption, and as a theoretical framework for conducting educational research. The following studies illustrate the flexibility and adaptability of the CBAM for educational research. The first study was selected because it illustrates using all elements of the CBAM for educational research.

Hall et al. (1999) used the CBAM to facilitate and assess the implementation of a mathematics curriculum into Department of Defense Dependents’ Schools (DODDS). This study used the CBAM to answer a superintendent’s questions about how best to support teachers and to determine if an investment was financially worthwhile. Consistent with the CBAM operating as a collaborative system, information gleaned from this research was also used to guide facilitation of the change process – implementation
of a constructivist approach to teaching mathematics. Key change facilitators (superintendent, district office staff, and three master teachers) were trained in CBAM methodology (Hall et al., 1999). Stages of Concern (SoC) for district personnel involved in the change were regularly assessed. Levels of Use (LoU) was determined, and an IC Map was used to assess implementation of the constructivist perspective to teaching mathematics. Findings reported that teachers did become users and although not conclusive, anecdotal data from other districts suggested that the district being studied also exhibited more extensive use of the innovation (Hall et al., 1999). Analysis of Levels of Use indicated that over the three years of this study, many teachers in this school district had progressed beyond early LoU III Mechanical use, however Hall et al. (1999) added that with the complexity of the innovation it was not surprising that progression was not as rapid as the change facilitators had originally thought or hoped it might be.

Although not the primary emphasis in reports about this study, Hall et al. (1999) comprehensively illustrated the CBAM and the appropriateness of using its constructs and measures to assess the change process. Features of this study such as the slow rate of adoption serve as an excellent illustration of the assumptions of change: It is a process; it is complex and dynamic; it doesn’t happen overnight; but it can be understood and used to guide sustained efforts to improve education. Other studies reporting the use of the CBAM are less informative about the specifics of the model, but none-the-less confirm its application in educational research.

Newhouse (2001) applied all three dimensions of the CBAM to examine the implementation of a portable computing initiative at a private girls’ school in Australia. An Innovation Configuration Map developed by the researcher and associates was given
to senior staff members to respond to. The goal of the innovation configuration was to depict an image of satisfactory and unsatisfactory implementation of the technology in areas such as student access, teacher-student relationships, and technology literacy. In addition, the Stages of Concern Questionnaire (SoCQ) was administered in the final year of this three-year study to 73 staff members of which 51 responded. Results indicated that 20% of staff members were still in the self (informational 6%, personal 14%) and management (management 10%) stages, a surprising 52% of staff members were in an awareness stage, and 18% were in the impact stage (collaboration 8%, refocusing 10%) (Newhouse, 2001). Newhouse addressed the high proportion of those at an awareness stage by discussing that 10 of these people did report using the computer on a weekly basis and the reported lack of concerns could possibly be interpreted as satisfaction with the current implementation. Levels of use data did not support this recommendation as out of 23 teachers, 9 were reported as non-users, (nonusers 7, orientation 2) and 6 as mechanical users of the computers. In this study, the CBAM was used to develop an understanding of portable computing access in this private school and its effect on teachers. Data from the study was used to guide professional development. Newhouse promoted the use of the CBAM as a framework for conducting educational research and relevant to this study, confirmed that not all dimensions need to be used for a successful study.

Gershner and Snider (2001) used the CBAM LoU and SoC to examine the integration of the use of the Internet as an instructional tool in the middle and high school setting. Subjects included 49 teachers who were given electronic pre- and post-test versions of the SoCQ. A trained interviewer gathered LoU data at both the commencement and
conclusion of the study. Post-test SoCQ data were gathered on a select sample of 11 teachers out of the original 49, however all 49 teachers were interviewed for the post-test LoU. It was reported that the null hypotheses of no change in Stages of Concern or Levels of Use were both rejected. A reduction in teachers’ awareness concerns was the basis for rejecting the null hypothesis for concerns. In the Levels of Use analysis, a statistically significant difference between pre- and post-test data reflected a decrease in non-use level and an increase in routine and refinement levels of use. This is consistent with the assumption that change in behavior often precedes changes in attitude and beliefs. The researchers discussed that although this study was conducted in a four-month period, unsolicited anecdotal data suggested continued success with the change initiative.

A possible explanation offered for this was described as the balance between pressure and support at the school sites. Gershner and Snider (2001) used only two dimensions of the CBAM yet were able to report conclusive findings. One of the strengths of this model is its malleability to use all or part for educational research. Other studies have implemented only the SoC and were still able to report positive findings.

James, Lamb, Householder, and Bailey (2000) used only the SoCQ of the CBAM to examine the implementation of integrating science, math, and technology in a technology-rich middle school environment. The SoCQ was administered to teachers involved in the GTECH project. The GTECH project, funded by GTE foundation sought to improve understanding in content areas, problem-solving skills, and attitude toward science, math, and technology through an integrated approach. The first administration of the SoCQ occurred in spring of year one of the project, with a follow up in spring of year two. Year one teacher concerns were primarily in the informational, personal, and
management stages. The researchers interpreted this to indicate that teachers had not really begun the integrated approach because concerns theory suggests, "that if teachers had already begun use, their most intense concerns would be on managing GTECH implementation" (James et al., 2000, p. 30). Under this same premise, the second administration of the SoCQ was interpreted to reflect more involvement with the innovation because management concerns had intensified. Informational and personal concerns were still high as well. There was an increase in refocusing concerns from the initial to the follow-up SoCQ. The researchers suggested this resulted from teachers already thinking about ways to improve on the innovation. Relevant to this study, is that James et al. (2000) reflected upon the importance of involving teachers in the development of an innovation, and that results were used to guide professional development. The SoC dimension of the CBAM is often used to guide professional development. Other studies have implemented dimensions of the CBAM for evaluative purposes.

Mills and Tincher (2002) used the CBAM for evaluation of a technology professional development initiative in a small school district (2200 students, 147 teachers). In an effort to evaluate technology integration from a professional development model and standards perspective, this research implemented only the IC Map dimension of the CBAM. The IC Map was developed based on agreed upon technology standards and then administered to teachers as a checklist for data collection purposes. Data collection occurred at the beginning and end of the academic school year. Of importance to this study, is that the IC Map allowed the researchers to describe technology integration and to evaluate the effectiveness of an innovation, current professional development practices. Conclusions
drawn from the study included that teachers were progressing from technology operators to technology facilitators, however the focus of professional development needed to be expanded to include a greater integration emphasis. The use of the CBAM to describe or evaluate educational change is well documented. Other researchers have used CBAM as a perspective through which they examined educational change.

Slough and Chamblee (2000) applied the CBAM as a theoretical framework for one of their studies, but also used the questions from the SoCQ to guide their own ethnographic interviews to determine teacher perceptions of using manipulatives and calculators during mathematics instruction. Dass (2001) used the SoCQ for data analysis and the CBAM as the conceptual framework for examining the impact of professional development on the application of instructional innovations from a teacher concerns perspective. Pedron and Evans (1990) also applied the CBAM as a theoretical and practical framework for examining the impact of aligning professional development with teacher concerns.

Using the CBAM for educational research is common practice. This section has provided an overview of just a few of those applications. Studies selected for this section were chosen in an effort to illustrate the variety of modifications or partial implementations of the CBAM for educational research. The CBAM has been used in its entirety as a research model and tool for examining impact of an innovation, and partially as a theoretical framework, an evaluation tool, and to guide professional development. Literature using the CBAM in its entirety or partially for educational research is summarized in chronological order.
<table>
<thead>
<tr>
<th>Author/year</th>
<th>CBAM elements</th>
<th>Purpose of study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hall et al. (1999)</td>
<td>SoCQ</td>
<td>Facilitation and evaluation of mathematics curriculum and to guide training in constructivist math</td>
</tr>
<tr>
<td></td>
<td>LoU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC Map</td>
<td></td>
</tr>
<tr>
<td>James et al. (2000)</td>
<td>SoCQ</td>
<td>Examination of integrating science, math and technology, and to guide professional development</td>
</tr>
<tr>
<td>Slough and Chamblee (2000)</td>
<td>SOCQ</td>
<td>Determine how teachers implemented professional development manipulatives and calculators into teaching and factors influencing their decision</td>
</tr>
<tr>
<td>Gershner and Snider (2001)</td>
<td>SoCQ</td>
<td>Examine integration of Internet as an instructional tool</td>
</tr>
<tr>
<td></td>
<td>LoU</td>
<td></td>
</tr>
<tr>
<td>Newhouse (2001)</td>
<td>SoCQ</td>
<td>Develop an understanding of a portable computing initiative</td>
</tr>
<tr>
<td></td>
<td>LoU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC Map</td>
<td></td>
</tr>
<tr>
<td>Tincher and Mills (2002)</td>
<td>IC Map</td>
<td>Evaluation of technology integration initiative from a professional development perspective</td>
</tr>
</tbody>
</table>
The CBAM as a framework for conducting research.

The CBAM can be used for multiple purposes and in a multiplicity of forms. It can be used to evaluate, examine, guide and facilitate educational change. It measures “concern for people, organizational efficiency, and strategic sense” (Chamblee & Slough, 2004, p. 864). The CBAM has been expanded upon by others for development of professional development models, learning to teach and self-conception of teacher models (Richardson & Placier, 2001). There are many features of this model that make it relevant to research in education.

The CBAM is unique for educational research in that it examines change from the perspective of those implementing an innovation. The individual should be the primary focus of change because innovations are at risk of failure when concerns of implementers are intense (Gershner & Snider, 2001). Gershner and Snider applied all three dimensions of the CBAM to track progression of individuals implementing an innovation. Changed attitudes and behaviors toward the use of the Internet as an instructional tool indicated that teachers had progressed from thinking about technology to thinking with it. Use of the CBAM was logical for this study because it focused on the innovation implementers. Other studies using the CBAM for evaluative purposes add support to using this model for educational research.

One of the most powerful messages behind the CBAM is that change is a process experienced by individuals within a system. Mills and Tincher (2002) used IC Maps to evaluate technology integration practices of teachers before and after the introduction of an innovation. Justification for using the CBAM included that it promoted an understanding of educational change from the perspective of the persons most affected by
the innovation. The importance of teacher buy-in for successful educational change is well known, thus the CBAM is suited to educational research focusing on teachers. The premise of acknowledging the individual is offered as rationale for using the CBAM for theoretical framework purposes as well.

Slough and Chamblee (2000) used the CBAM as their theoretical framework for many of the same reasons other researchers use this model: The CBAM focuses on the individual and stresses the importance of addressing concerns in order for change to occur. Using the CBAM for a theoretical framework in educational research is rational because it not only stresses the importance of the individual in the change process, it promotes the concept that change can only happen one individual at a time (Slough & Chamblee, 2000). Further support for using the CBAM as a research agenda was presented by these same authors in their ten-year retrospective of CBAM implementation to assess changes in technology implementation.

Thus far, relevancy of using the CBAM for educational research has primarily been supported by researchers who touted the personal touch of the CBAM. Slough and Chamblee (2000) offered another layer of support: “One of CBAM’s strengths; and perhaps its justification for continued use, is its demonstrated flexibility . . . CBAM allow[s] a variety of researchers in a variety of settings to make sense of technological change” (p. 868). Perhaps the greatest support for using this model for educational research comes from the developers themselves: Hall, Wallace, and Dossett founded the CBAM on school practice (Persichitte, 1999). The CBAM evolved from educational research; it was tested in the educational setting, and represents a common way of thinking about change (Hall & Hord, 2001). Changing educational contexts continue to
serve as the inspiration for educational research. One element of education that is representative of a dynamic and changing context is in the area of educational technology, and more specifically access to educational technology.

One-to-One Computing in the Educational Setting

In the decade between 1987 and 1997, the ratio of students per computer decreased from 125 to 10 (Sandholtz, Ringstaff, & Dwyer, 1997). Corporate and government sponsored initiatives aimed at increasing student access to educational technology are providing students and teachers with one-to-one computing access across the United States and internationally. In many instances, the initiatives are small-scale often involving one or two classrooms or perhaps an entire school; others are on a larger scale. Two corporate-sponsored initiatives, Apple Classrooms of Tomorrow (ACOT) and Microsoft's Anytime Anywhere Learning (AAL), and one state-sponsored initiative, Maine Learning Technology Initiative (MLTI) have served as a foundation for continued research in one-to-one computing access. This section will begin with a review of the three large-scale initiatives, followed by an introduction to a selection of smaller scale initiatives focusing on student engagement and attitude toward learning.

Apple Classrooms of Tomorrow (ACOT)

The ACOT project was initiated through collaboration between Apple Computers Inc. and universities and public schools nationwide. What started in 1985 as a distribution of computers and related equipment to students and teachers in a handful of classrooms across America, ten years later was a large-scale study involving over 100 elementary and secondary classrooms nationwide (Apple, 1995). Reports and references to ACOT in
educational technology literature are numerous. Findings of the initiative extend far beyond what will be provided in this introduction to ACOT, however the major findings and implications will be discussed. More than 20 universities and research institutions were involved in ACOT research, but one study in particular continues to be representative of the important findings of this study: The report by Sandholtz, Rinsgstaff, and Dwyer, *Teaching with Technology: Creating Student-Centered Classrooms* (1997) will serve as a primary source for this discussion of ACOT's impact on teaching, learning and future studies in this area. In addition, Apple Computers Inc. provided a multitude of reports all available in the ACOT library (http://www.apple.com/education/k12/leadership/ACOT/library.html), the most relevant of which will be included this review.

Apple Computers Inc. began their longitudinal research of the ACOT project in 1987. Alongside the general data collection via audio-taped reflections and analysis for patterns, individual researchers representing Apple performed case study research on individual classrooms. Reports of the impact of one-to-one computing access on management, teacher beliefs, instructional change, student behaviors, writing, and mathematics problem-solving were published. Findings and recommendations of these reports included: Students maintained their performance levels on academic standards; initial indication that writing skills of students using computers improved; students were using the computers for higher level processing; the introduction of computers required many changes; assessment must have better alignment with the learning process; and teachers progress through changes in beliefs and practices with the introduction of computer technology into the teaching and learning environment (Apple, 1995). In
educational technology literature, perhaps the most well known finding of the ACOT study is the latter finding regarding the behaviors and beliefs and practices of teachers.

Based on the countless hours of observations and interviews, Sandholtz, Ringstaff, and Dwyer began to identify commonalities in teacher's experiences: Although the landscape and expectations changed dramatically with the introduction of ACOT equipment, change in factors such as roles and relationships of teachers and students was much slower and less obvious. Slow as it was, an almost predictable pattern of changes in teaching and learning emerged (Sandholtz, Ringstaff, & Dwyer, 1997). This predictable pattern was termed the instructional evolution model. It is perhaps the biggest research bi-product of the ACOT project and a most telling finding in light of the change literature reviewed above.

In the instructional evolution model, text-based curriculum delivered by traditional pedagogy is first enhanced and then gradually replaced by more student-centered approaches (Sandholtz, Ringstaff, & Dwyer, 1997). There are five stages to the instructional evolution model: (a) entry in which existing technology such as overhead projectors dominated instruction and the introduction of computers led to feelings of frustration and discomfort reminiscent of being a first-year teacher; (b) adoption at which stage the teachers spent less time being frustrated with the new technology and began to attempt to incorporate it into their direct instruction practices, (c) adaptation in which the technology became integrated into the classroom practices and teachers were using it as they would any other instructional tool, (d) appropriation at which time the individuals demonstrated an understanding of technology and its application in the educational setting and used it naturally and purposefully, and (e) invention at which stage the
teachers reflected on their teaching and wondered how they ever did it the old way (Sandholtz, Ringstaff, & Dwyer, 1997). It is at the invention stage that teachers’ instructional strategies and beliefs have evolved from traditional to constructivist: Teachers no longer see their role as the imparter of knowledge, but as an equal partner with their students in a quest for understanding and developing knowledge.

In summary, ACOT, a project that started off small-scale, grew to be the first large-scale implementation of one-to-one computing access and it generated foundational findings for future initiatives to build upon. The most well known report was about teacher change, and to this day, the instructional evolution model continues to be a resource for innovation adoption and to guide professional development. Other relevant findings included sustained or improved performance on standardized measures, increased problem-solving, greater engagement in learning, and increased motivation toward learning and school in general (Sandholtz, Ringstaff, & Dwyer, 1997).

Where the ACOT project provided participants with two desktop computers, more recent initiatives of one-to-one computing access have students and teachers using laptop computers at home and school. The Microsoft Anytime Anywhere Learning (AAL) initiative is a large-scale example of this type of one-to-one access.

Microsoft’s Anytime Anywhere Learning (AAL)

In 1996, through a collaborative effort between Microsoft Corporation and Toshiba America, 53 elementary, middle, and high schools at 26 sites across America became part of a large-scale one-to-one laptop program. Like Apple’s ACOT project, independent researchers were recruited to investigate the impact of one-to-one access on teaching and learning.
In efforts to document and investigate the impact of one-to-one computing access on teaching and learning, Rockman et al. (1997) interviewed, observed, and administered surveys to over 400 teachers involved in the project. Each year, the sample of teachers, students, and classrooms got more purposeful and a report of key findings was published. Relevant to this study, and one of the striking observations from the first year of AAL was the power of an existing technology infrastructure. Project schools were clearly identified as being in one of two groups: Group A consisted of schools with little if any pre-existing technology infrastructure and resources, and Group B comprised schools with well-developed technology programs and in many instances with computing access in the homes of students as well.

Observations of different implementations of the laptops in AAL schools led to the development of five implementation models (Table 2). Pertinent to this study is the reporting that schools implementing the laptops using a concentrated model reported the most satisfaction and the most time available for integrated curriculum uses of the laptops (Rockman et al., 1997). The other models reported positive outcomes including teacher attitude toward the laptops and evolving student and teacher use (Rockman et al., 1997). After just one year of implementation, teachers' self-reported teaching style changed dramatically. The use of project-based, interdisciplinary, or student-centered approaches became more prevalent while the use of traditional pedagogies decreased over 10% (Rockman et al., 1997). Student and teacher use of the laptops continued to be a research focus throughout the project.
Table 2. AAL Implementation models after year one

<table>
<thead>
<tr>
<th>Model ( % of schools)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated (46)</td>
<td>Students own a laptop and can take it home</td>
</tr>
<tr>
<td>Dispersed (12)</td>
<td>Laptop and non-laptop owning students are in the same classes</td>
</tr>
<tr>
<td>Class set (15)</td>
<td>Sets of laptops are available for checkout by teachers</td>
</tr>
<tr>
<td>Desktop (4)</td>
<td>School owned laptops distributed a few to each class</td>
</tr>
<tr>
<td>Mixed implementation (23)</td>
<td>Combination of at least two of the above</td>
</tr>
</tbody>
</table>

The second year study of AAL explored similar concepts to year one, but used a purposeful sample of 144 teachers and 450 students whose access to computers was in a concentrated model (Rockman et al., 1998). The primary focus was on when and how the computers were used. Surveys, interviews, and observations were used for data collection, however for comparative purposes, data was collected from non-laptop classrooms as well. Findings of the second year of relevance to this study included: students were using the computers more often and were making tool choices appropriate to the task; laptop students demonstrated more collaborative behaviors and project-based learning than non-laptop students; laptop students produced more and higher quality writing than non-laptop students; laptop teachers reported increased analysis, research, and critical thinking skills in their students; and traditional student and teacher roles were less apparent in laptop classrooms (Rockman et al., 1998). From an attitude and beliefs...
perspective, year two findings reflected continued enthusiasm for the project and positive progression of changing attitudes toward teaching with technology (Rockman et al., 1998). In summary, year two reported findings added strength to those of year one. For year three, the focus of the research shifted from observation of uses and applications to a more quantitative analysis of access, use, student achievement, and attitudes and beliefs.

Years one and two of AAL provided evidence of changing beliefs and practices as well as steadily increasing authentic uses of computers as learning and teaching tools. Year three “presents a more complex picture of the impact of a fully implemented school laptop program” (Rockman et al., 2000). Key findings of the year three report centered on: (a) access: All students reported increased access and use of computers at school and home, however laptop students had greater individual access; (b) impact on teaching: Laptop teachers showed significant movement toward constructivist pedagogies and learning; (c) impact on learning: Laptop students continued to outperform non-laptop students in core writing skills demonstrated on site-based tests, but analysis of standardized test scores was inconclusive; and (d) student and teacher beliefs about technology: Though both laptop and non-laptop students and teachers acknowledged benefits of computers, laptop students and teachers had more positive attitudes about the computers and their impact on student learning (Rockman et al., 2000).

In summary, like the ACOT project, Microsoft’s AAL initiative helped to establish a foundation and starting point for future one-to-one computing programs. Reported findings from three years of AAL research by an independent research team, (Rockman et al.) included greater enthusiasm for teaching with technology, a gradual shift toward constructivist pedagogies, improved writing skills, and especially significant to this
study, a progression of increasingly authentic and purposeful uses of technology, and improved student engagement and motivation for learning with technology. Rockman et al.’s reports on AAL have been used by Microsoft to compile a comprehensive guide for schools or districts wishing to begin their own AAL initiative. Additionally, Microsoft Corporation and the Gates Foundation continue to provide financial support in the way of grants to schools and districts considering AAL type initiatives. One such program that used funds from the Gates Foundation to get started is the Maine Laptop Program or Maine Learning Technology Initiative (MLTI).

**Maine Learning Technology Initiative (MLTI)**

In an effort to eliminate the digital divide, the state of Maine, at the vision of the former governor, proposed and implemented a laptop program in which all seventh and eighth grade students and teachers in the state would have one-to-one computing access. Following the recommendations of a task force who had thoroughly examined the feasibility of the governor’s proposal, the Maine Learning Technology Initiative (MLTI) began in Spring of 2002. Like the other major one-to-one computing programs, researchers and other institutions closely watched the MLTI.

After two years of research and analysis, the Task Force on Maine’s Learning Technology Endowment (2001) recommended that in order for technology to be an ally rather than an obstacle, all students will need access “when and where it can be most effectively incorporated into learning” (p. i). MLTI began their pilot laptop program at nine schools, one from each region, using funds from the Gates Foundation. Apple Computers was awarded a contract, and students and teachers in the seventh grade were provided laptops, extensive teacher training commenced, and a cadre of integration
mentors was formed. Fall 2002, the first full implementation of MLTI, saw over 17,000 seventh grade students and teachers in over 240 schools receive laptop computers (Silvernail & Lane, 2004). At the same time, a well-planned support system was implemented: Cadres of teacher leaders, technology coordinators, content mentors, and content leaders received extensive training and were given the responsibility to organize, establish, and maintain a professional development network. With a solid professional development system in place, in Fall 2003, eighth grade students and teachers were added to the program and the MLTI now consisted of over 34,000 students and 3,000 teachers (Silvernail & Lane, 2004).

Research on MLTI was guided by interviews with key personnel and developers of the project. Guiding questions fit into three broad categories: teachers and training, students and learning, and school and community (Silvernail & Lane, 2004). More specifically, examination of teacher behaviors and practices and the project’s impact on professional development, curriculum, student achievement, digital divide, school structure and culture, and family and community were core questions for the evaluation team. Evaluation was planned to be conducted in phases, with phase one looking at uses and impacts on students and teachers. Reported findings of phase one were published in February, 2004.

Surveys, site visits, observations, and analysis of documents (e.g. lesson plans and memos) were the primary data sources for phase one evaluation. The findings of phase one addressed three issues: “How are the laptops being used, what are the impacts of the laptops on teachers and students, and what obstacles, if any, have schools, teachers, and students encountered in implementing the laptop program?” (Silvernail & Lane, 2004, p. 43)
The findings of MLTI offer support to those of ACOT and AAL, but they also add to the overall research base on one-to-one access to computing in the K-12 setting.

Evidence collected for the evaluation of MLTI’s initial phase indicated successful implementation at the majority of schools (Silvernail & Lane, 2004). Of relevance to this study was the reporting that teachers and students used the laptops in a variety of ways: development of instructional materials, collaboration and communication, research, and organizing information. Teachers with more advanced technology skills and/or more professional development with technology used the computers 20-30% more than their colleagues (Silvernail & Lane, 2004). In contrast to ACOT findings, although language arts had the highest reported use (93%), use of laptops in science and social studies was also significant (91% and 88% respectively). Similar to AAL, it was reported that MLTI students who took their laptops home used computers more for academic uses than those students who left them at school. Naturally, amount and quality of use would impact students and teachers in different ways.

Over 75% of students reported that the laptops helped them to stay organized and to complete higher quality work, and teacher comments concurred (Silvernail & Lane, 2004). Enhanced student engagement was also reported: Students preferred to use laptops to other learning tools, and commented on learning being more fun and quicker when using the laptops. Many students attributed their school success to the laptops, however Silvernail and Lane warned that perceptions of innovations are often artificially high when the innovation is still a novelty. The students’ perceptions about the impact of the one-to-one access to computing is supported by teacher opinions with an added caveat germane to this study; students labeled at-risk show improved attendance and behavior
alongside their increased motivation, engagement, participation, and attitude toward learning (Silvennoinen & Lane, 2004). Similar positive findings were reported regarding the special needs student population. Administrators also reported that the laptop program had positively impacted attendance, behavior, and student motivation, however this is primarily anecdotal evidence and concrete data has not been adequately tracked or analyzed for reporting significant findings in this area.

Like the students, teachers participating in MLTI primarily reported positive impacts of the one-to-one computing access: Teachers felt the computers better helped them meet curricular goals and individual needs of students; they felt the laptops helped them to satisfy statewide learning standards, and their comments mirrored those of administrators with regard to attendance and behavior. Teachers were also those most impacted by obstacles associated with the one-to-one access. Obstacles reported by teachers were primarily about technical support, lack of time, and not enough professional development opportunities. The limited support was also considered an obstacle by technology coordinators and administration; some schools attempted to overcome this obstacle by training students to provide support. Other obstacles reported by teachers centered around the students: Approximately 40% of schools allowed students to take the computers home, yet over 70% of teachers preferred students be able to take the computers home. Similarly, teachers considered student misuse or lack of care about handling computers and associated consequences (e.g. taking the laptop away from the student) as an obstacle. Other obstacles were less personal and more financial: Although added expense was expected, from an administrative perspective, it was an obstacle that was difficult to overcome (Silvennoinen & Lane, 2004).
In summary, the MLTI is reported as being a successful implementation of one-to-one computing access. Although obstacles were present, the majority of schools reported positive impacts ranging from improved attendance, engagement, and behavior through to higher quality teaching and learning. Reported findings thus far have been primarily based on anecdotal evidence and it has been acknowledged that sustained analysis of the impact of MLTI will require additional measurements.

**Smaller-scale research on one-to-one computing in the K-12 setting**

Like the major initiatives, the majority of data reported in smaller scale studies on one-to-one computing access in K-12 education is subjective in nature. This section will review studies of one-to-one computing access with particular consideration to studies focusing on student engagement, student and teacher concerns and beliefs, and descriptions of patterns of computer use in a one-to-one setting.

Lowther, Ross, and Morrison (2003) examined the impact of one-to-one computing access on classroom activities, student use of technology, and writing and problem-solving skills. With the assumption that individual access to laptops would promote more active teaching and learning, Lowther et al., studied 21 classrooms (12 laptop and 9 control) across three grade levels (5th, 6th, 7th). Observations, surveys, interviews, and analyses of student writing and a specially designed problem-solving task served as the data sources.

Random observations of classrooms lasted for 15 minutes and were recorded descriptively. Observations were based on 24 target strategies in areas of instructional orientation, classroom organization, student activities, technology use, and assessment. A survey of computer use designed to focus on students rather than teachers was created for
the study using data from existing literature, administrative interviews, and existing instruments. For writing skill data, Lowther et al. reviewed prompted writing samples using a district scoring chart for evaluation. Problem-solving data was collected through administration of a task asking students how to solve a local recycling problem. Scoring of the problem-solving task was performed by trained reviewers at the university.

Lowther et al. concluded that laptop computers were used more as learning tools than as teaching tools in classrooms where access was one-to-one. Additionally, and of importance to this study, is that laptop classrooms were reported as being associated with more active learning. In particular, laptop students were more attentive and interested in learning than control students. Results of one-to-one laptop access improving student writing skills was considered a positive impact of the laptop initiative. Finally, enhanced student engagement was offered as a contributing factor to improved student problem-solving ability.

Weaknesses of this study lie within the anecdotal nature of the data and the personal differences between participants. At no time did the researchers acknowledge that one-to-one computing access could be considered a novelty, which could be interpreted as enhanced engagement or enthusiasm for learning. However, learning from their pilot study, the researchers were careful to ensure consistency of teacher training and analyzed pre-program achievement scores of students to minimize internal validity threats. The authors of this study conceded that their results can only be considered suggestive rather than conclusive about the benefits of a laptop program.

Hounshell, Hill and Swofford (2002) examined the impact of individual laptop computer access on performance of minority students. In collaboration between a
university and school system, minority students attended a technology rich integrated science and math experience. At the conclusion of the two-week experience, students were loaned the laptop computers and provided with Internet access and technical support for the following school year. 20 of 25 students who were given laptop computers completed and returned surveys at the end of the academic school year. 14 of the 20 students were interviewed to validate questionnaire data and to add to the general database.

Items on the questionnaire centered on student enjoyment and amount of use of the laptop computers throughout the school year. A high percentage (95) of students reported using the Internet, yet only 10% reported using the laptop computer at school. 80% of responses were positive for students considering the laptop helped improve grades, yet only 55% reported that the laptop contributed to greater enjoyment of school. The impact of the laptop on student attitude about school was reported as improving: a lot (15%); some (50%); and very little (35%). The authors interpreted these findings to indicate the success of the project.

This study has many limitations. Sample size is small and may not be representative of the general population as it included only one female. Questionnaire items were limited to yes/no answers and did not allow for explanation. No information about the format or analysis of interviews was provided. Overall, this study focused on whether students liked having laptop computers and did not provide any conclusive evidence of the impact of laptops on student performance or attitude about using laptops for educational purposes.
Figg, Ward, and Keller (2003) reported on the use of handheld and laptop computers for introduction of forestry concepts in the middle school setting. The subjects for the study were 16 sixth grade students who were invited to participate in this study. Following National Science Foundation standards, an inquiry-based lesson was developed and implemented by university education professors. The authors concluded that the integration of handheld computers promoted an engaging learning opportunity.

This study is limited in many ways. Like many studies on one-to-one computing access, it is an anecdotal report of activities and outcomes. Although contributing to the research base this study does not include any analysis of data that can lead to the conclusions drawn by the researchers. There are however anecdotal reports of one-to-one computing access that are more extensive and demonstrate benefits associated with such initiatives.

Anderson and Dexter (2003) reported on a technology initiative at Mantua Elementary School in Fairfax, Virginia. Mantua Elementary serves approximately 800 middle-class students in grades K-6. 5th and 6th grade students are provided laptop computers as part of a school-wide mission to integrate technology throughout instruction. In addition to the one-to-one laptop computing program, the school is technology rich in that the school also has classroom desktop computers, a computer lab, a distance learning lab, ability for television production, and one-to-one access to AlphaSmart portable word processors for students in lower grades.

Through observation and interviews, Anderson and Dexter reported on the school culture and professional community, technology infrastructure and support systems, and
improvements to teaching and learning including student and teacher practices and outcomes when a school is implementing a one-to-one laptop initiative.

Similar to this study and consistent with CBAM assumptions, the integration of technology at all levels including the one-to-one laptop computers was a result of a focused effort by teachers, administrators, and the community. The school made creating and supporting the technology initiative a long-term goal in which teachers demonstrated collegiality in helping each other and the administration demonstrated support by allocating necessary time and resources. Anderson and Dexter described continuity of curriculum, gradual transition toward teaching with technology including the Internet, the distance learning lab, and adaptation of lessons to better meet the needs and interests of students. Of importance to this study, it was reported that student practices and outcomes included use of a variety of applications such as word processing, creating graphs and multimedia presentations, and using the Internet for research. Students reflected on the impact of laptop computer access promoting life-long learning, changing attitude about schoolwork, and consistently high test scores.

The researchers and the school personnel are careful not to attribute outcomes solely to the introduction of the one-to-one laptop initiative, however the report includes suggestions of added value of the laptop program: Changing levels of comfort and skill of teachers when using technology, promotion of student proficiency at typing, expanding horizons via Internet based learning, and improved support of learning for students with disabilities are all listed as benefits of the technology initiative. The researchers are realistic and admit to challenges such as teacher turnover, sustained funding and concerns of newer staff members with the one-to-one program at Mantua Elementary School.
Table 3 summarizes in chronological order small-scale studies of one-to-one computing access focusing on student engagement and student use of laptops. Studies of the impact of one-to-one computing access in the K-12 setting are not limited to these. Studies focusing on teacher training and professional development (Atalib, 2002; Crystal, 2001; Mouza, 2000; Windschitl & Sahl, 2002; Yang, 2002) cited well-planned and well-implemented teacher training and professional development systems as crucial for successful one-to-one laptop programs. Other studies have focused on different amounts and levels of access (Peterson, 1999; Schaumburg, 2001). In a best practice environment, students and teachers have unlimited and uninterrupted access to laptop computers that they consider their own. One of the most commonly reported impacts of one-to-one computing access refers to pedagogy: Constructivist practice was discussed from a perspective of teachers moving toward this teaching style (Atalib, 2002; Crystal, 2001; Lowther et al., 2003; Peterson, 1999; Russell, Bebell, Cowan, & Corbelli, 2002) or as a key factor in successful one-to-one computing initiatives (Figg et al., 2003; Hartnell-Young, 2001; Mouza, 2000; Schaumburg, 2001; Windschitl & Sahl, 2002). Factors such as uninterrupted access, authentic integration, well developed and maintained technology infrastructure and teacher training/professional development programs, and constructivist pedagogies are all key to effective and sustained one-to-one computing initiatives. Although much research has been conducted on the impact of one-to-one computing access in the K-12 setting, many of the conclusions drawn in research in this area have thus far been based on anecdotal evidence. Similarly, many studies reported increased student engagement with learning, yet little attention is given to specific factors
Table 3. Summary of reported findings of small scale studies

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Reported findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hounshell, Hill, &amp; Swofford (2002)</td>
<td>Students using laptops for Internet access, 80% of students felt laptops contributed to better grades, 65% of students felt laptops contributed some or a lot to improved attitude about school</td>
</tr>
<tr>
<td>Anderson and Dexter (2003)</td>
<td>Creation and support of initiative from all involved, progression of teaching toward increased computer based, multiple uses of a variety of technologies, indicating thinking and teaching with technology, better meeting of students needs and interests, when teaching with technology, variety of student applications of computers, life-long learner attitude of students</td>
</tr>
<tr>
<td>Figg, Ward, &amp; Keller (2003)</td>
<td>One-to-one access to handheld computers promoted an engaging learning environment</td>
</tr>
</tbody>
</table>
indicating or impacting engagement. The next section of this review will examine student engagement by introducing studies in which contextual influences impacted student engagement, or in which student engagement with educational technology was a focus.

Student Engagement

Student engagement has been a focus of educational research for many years. Innovative curriculum, pedagogy, and classroom management strategies have all been examined in relation to student engagement. Studies of student engagement in which technology in the K-12 setting is a focus are less common and are primarily based on anecdotal data. This review of student engagement research focuses on studies of student engagement relative to the current study, in particular studies in which educational context impacted engagement with learning or in which engagement with technology was a focus of the study.

Yair (2000) investigated the relationship between student engagement with instruction and characteristics of instruction and students. Yair used descriptive statistics and regression analyses to estimate the effects of the independent variables (student demographics, instructional characteristics, and student mood) on the probability of student engagement and external preoccupation. Data for the study was collected in 1993 as part of the Sloan Study of Youth and Social Development, a study on how students think about their future. Using this data, Yair attempted to conceptualize student engagement in terms of a relationship between instructional variables such as subject matter and instructional strategies and methods, student background variables such as race, SES, gender, and age, and external factors including family life and work.
obligations. The study for which the data was collected used the Experience Sampling Method (ESM) in which the students wore a digital wristwatch that emitted signals eight times a day. At the sound of the beep, students were expected to fill in a questionnaire asking them such questions as *What were you doing,* and *what was on your mind.* For the purpose of Yair's study, a disjuncture between where the student was located (e.g. in a classroom during instructional time) and what was on their mind was considered to be disengagement from instruction.

Findings of Yair’s study include that external preoccupations or daydreaming encroached on students’ attention approximately 39% of the time. Additionally, student engagement was correlated with instructional characteristics, and more important and of particular relevance to the current study, race, at-risk status, and overall school success were correlated with student engagement. Hispanic and African American students were reported as having the highest degrees (50 and 51% respectively) of disengagement from the intended learning task, students with at-risk status were disengaged 5% more than their peers, and students who were low achievers were less engaged than their high achieving peers. The examination of the relationship between instructional practices and student engagement showed that in learning environments in which students are working in groups, working on individual projects or presentations, student engagement was higher than in environments in which students listened to a teacher lecture or watched a television or video presentation.

Yair’s study appears to examine student engagement and environmental factors quite comprehensively, however there are limitations to this study. Limitations of the study include the fact that the data used for analysis and conclusions was collected for an
entirely different purpose and as Yair discussed had limitations within itself. First, the
data collection tool relied on student self-reporting of location and thoughts.
Additionally, students responded on average 34 out of 56 times they were beeped, and
Yair did not have access to information about contextual features relative to the missed
beeps. In some instances, students did not complete the questionnaire in its entirety and
once again information pertaining to this was unavailable to Yair. Other studies have
collected original data and found similar results.

Anderson and Scott (1978) looked at the relationship between teacher methods,
student characteristics, and student involvement in learning. The specific questions of the
study focused on whether there was a relationship between particular types of teaching
methods and involvement in learning of different types of learners, and are there specific
teaching methods that maximize or minimize differences in involvement among different
types of learners. The sample for the study drew from heterogeneously grouped ninth
through twelfth grade students at a suburban high school. Student involvement in
learning was defined as the amount of time a student was engaged in task-relevant or on-
task behavior such as eyes-on, writing, or working with other students. Data was
collected by two trained observers using a time interval scan method.

Independent variables for this study were the type of teaching method, scholastic
aptitude, and academic self-concept. Teaching methods included lecture, classroom
discourse, seatwork, groupwork, and audiovisual method in which students watched
filmstrips or slide shows. Scholastic aptitude was determined by scores on the Lorge-
Thorndike Intelligence test, and self-concept was measured using the Scott Academic
Self-Concept scale. Observations were conducted in seven classes for 9 days. Results
indicated that students with high aptitude and academic self-concept were most engaged
during audiovisual teaching practices and least engaged during group work, but more
important for this study, is that students of low achievement and low academic self
concept seem to be most affected by variations in teaching method.

This study provided insights into how learning environments impact student
engagement, and especially relevant, this study acknowledged that context of learning
impacts student engagement. The study does however have limitations. First and
foremost, though not a limitation of the study but more of the study’s relevance to the
current study is the age of the study. This study was conducted in 1978. Findings of this
study led the researchers to recommend teachers implement classroom discourse and
seatwork methods with students of low aptitude and low self-concept. Although
classroom discourse in which the teacher uses student responses to teacher questions to
guide mini-lessons is still considered an effective strategy, since this study was
completed, further research has made contrary recommendations about individual
seatwork, particularly with the current emphasis upon collaboration and problem-solving
skills. In addition, the scholastic aptitude test that was administered focused on verbal
aptitude, which reflects only part of a student’s scholastic aptitude and doesn’t allow for
exceptional students in other areas to be as easily identified. Finally, and related to verbal
aptitude, this study provided little information about content of observed lessons, so few
conclusions can be drawn if student disengagement was related to lack of interest in
content. Other studies however have addressed student engagement and learning context
by examining engagement across subject areas.
Filby (1978) examined the impact of instructional practices of teachers on student engagement during reading and math lessons. Participants were 122 5th and 139 2nd grade students. Data collection was through classroom observation on a one day a week basis for the duration of an academic school year. Focus of observations was based on rotating sample procedure in which target students were observed approximately once every four minutes. Observations were coded dependent on content, setting, student engagement, and teacher instructional behavior. Teacher behaviors for the study were described as interactive, and included presentation, monitoring, and providing feedback. Student behaviors were coded to be either self-paced, in which students worked independently on seatwork or individual pursuits upon early completion of a whole group assignment. Other paced settings were considered those in which small group instruction occurred, or the pace of instruction was beyond the control of the student.

Results of this study of import to the current study include findings of the relationships between feedback and student engagement, student-teacher interactions and student engagement, and instructional strategy and student engagement. Filby reported that students who receive more academic feedback, particularly in reading, have higher levels of engagement in the learning activity. Additionally, students who receive individualized direction from the teacher during mathematics have higher engagement with learning. Filby reported that the strongest effect of student-teacher interaction is at the general level; broadly speaking, more interaction is associated with more student engagement. This is relevant in that many educators and researchers believe that the use of technology allows for students to receive more immediate feedback and for teachers to better individualize instruction. Filby also reported that student engagement is higher in a
group work environment rather than an environment that promotes independent seatwork, as reported in both mathematics and reading across both grade levels. Filby concluded that this study indicates that student engagement is higher when students receive timely feedback, individualized instruction in mathematics, interact more with the teacher, and spend less time on independent seat work. This study has relevance to the current study in that it examined student engagement in different learning contexts, and although it did not use technology as a focus, many of the recommendations for improving engagement are features inherent in educational technology applications.

Baker et al., (2004) examined off-task behavior of students during computer based tutoring sessions. Many advocates of computer based tutoring systems tout the benefit of these applications to be the immediacy and relevancy of individual feedback. Baker et al. studied five middle school classrooms in two schools. The population sample included students ranging from 12 to 14 years of age. The goal of the study was to examine the impact of different types of off-task behaviors on student achievement while using a cognitive tutoring system. Students were given a pretest and posttest and students were observed during the computer based tutoring session. Of particular relevance to this study is that the observations of off-task behavior were coded by category: on-task, on-task conversation, off-task conversation, off-task solitary behavior, inactivity, or gaming the system. Gaming the system is described as using the feedback element of the system for purposes other than intended.

Results of the study included that the most frequent off-task behavior was conversation followed by gaming the system. Frequency of off-task behavior in general was concluded to be a good predictor of student performance on the posttest, however
gaming the system was the only behavior that significantly correlated with the posttest. The researchers did acknowledge that gaming the system may be an indicator of not knowing the content enough to begin with because follow up tests indicated that these students were generally of lower academic achievement and demonstrated less prior knowledge in the pretest. Students with the same characteristics who did not game the system achieved higher scores on the posttest. Conclusions of this study were that some, but not all, off-task behavior is associated with less learning. Limitations of this study primarily stem from the data collection. Students were observed in a specific sequence that could have resulted in student off-task behaviors not being identified. Additionally this study was designed to address concerns relative to designing appropriate computer based tutoring systems and not to address student engagement issues per se. Other studies of student engagement and technology have been designed to simply describe relationships between student engagement in technology rich contexts.

Sandholtz, Ringstaff, and Dwyer (1994) addressed student engagement in technology rich classrooms as part of their longitudinal study of the ACOT classrooms. Using anecdotal notes and reflections of ACOT teachers, the authors defined student engagement with technology as including variables such as initiative, self-motivation, independent experimentation, spontaneous collaboration and peer coaching, and enthusiasm or frustration. Data from 32 teachers and classrooms was collected in the form of bimonthly audiotapes, weekly reports sent via email, and correspondences between sites. 1,707 episodes relating to student engagement were retrieved from transcribed and coded communications. Results of this study were reported descriptively as changes in student attitude, time usage, on-task behaviors, student initiative, and

59

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student experimentation and risk-taking. Examples of teacher reports of increased engagement included students choosing to work with computers rather than other mediums, students being highly engaged in the assignments and working at an individual pace, and students being greater risk-takers and showing greater initiative to expand their own learning.

Sandholtz, Ringstaff, and Dwyer concluded that technology had a positive impact on student engagement but only under certain conditions, and only with the use of certain applications of the technology. Relevant to this study is that using technology for lower-level activities such as drill and practice does not result in students showing greater engagement and that the role of the teacher makes an impact on student engagement levels. In environments where teachers used technology to meet the individual needs of the students yet still be part of the overall curricular goals, engagement was higher than where teachers simply used computers for unrelated assignments. Student engagement has been shown to be impacted by many different contextual components. Table 4 summarizes studies reviewed and the findings relevant to this study.

Gaps in Existing Research

It is apparent that there is an extensive database of studies on student engagement and one-to-one computing access, however there exist few studies that combine these two concepts. Many studies of student engagement focus on general pedagogy and classroom management issues in the K-12 setting, but do not focus on contextual issues pertaining
Table 4. Summary of findings of student engagement studies related to current study

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Relevant findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filby (1978)</td>
<td>Student engagement is higher when students receive regular feedback, have authentic interaction with the teacher, and receive individualized instruction.</td>
</tr>
<tr>
<td>Sandholtz, Ringstaff, &amp; Dwyer (1994)</td>
<td>Student engagement during computer-based learning is dependent on level of cognitive skill required for activity, and the role of the teacher as viewed by the teacher. Engagement with learning is higher when the context is authentic and part of the overall curricular goal.</td>
</tr>
<tr>
<td>Yair (2000)</td>
<td>African American, Hispanic and at-risk students have high levels of disengagement. Students show greater engagement during cooperative activities or relevant individual activities.</td>
</tr>
<tr>
<td>Baker et al. (2004)</td>
<td>Off-task behavior can be categorized into different behaviors. Not all behaviors have the same impact.</td>
</tr>
</tbody>
</table>

Off-task behavior can be categorized into different behaviors. Not all behaviors have the same impact to different levels of engagement. Studies focusing on student engagement and technology specifically tend to focus on higher education and do not have the focus that the current study proposes. With the expansion of technology in the K-12 educational
setting, there is a need for studies that examine the relationships between student engagement and different educational contexts as impacted by the use of technology for teaching and learning.

Summary

Much of the existing research on one-to-one computing access in the K-12 setting focused on constructivist pedagogies and outlined specific utilizations of computers. Additionally, studies discussed teacher issues such as classroom management and classroom arrangement (Peterson, 1999; Windschitl & Sahl, 2002; Yang, 2002). Teacher perspectives and behaviors were consistently reported by sharing teacher comments and recommendations, however inclusion of a measure of evaluation for such behaviors as part of the study was rare. Creation and/or implementation of a standardized evaluation tool would strengthen this area of research, as it would add validity to any reported findings. Use of a valid and reliable measure of evaluation is just one gap in the research in this area that this study hopes to address.

A large percentage of studies included in this review followed a similar research protocol, making this an area of one-to-one computing research that could be explored further. The research focus of many of the small-scale and larger initiatives included in this review was broadly expressed as a desire to determine the impact of one-to-one computing access in the K-12 setting. Observations, interviews, and anecdotal records commenced at approximately the same time the participants received their computers and conclusions were often drawn from teacher reflection. Only one study actually observed the classroom setting prior to one-to-one access. Russell et al. (2002) observed frequency of student use of AlphaSmarts when access was at approximately a 3:1 ratio and then
again following the addition of more AlphaSmarts resulting in a ratio of 1:1. This study also used an evaluation tool consisting of a checklist of behaviors and events for the ‘blind’ observer to use. As a result, Russell et al. were able to provide solid evidence to support their conclusions. There is a need for more studies to implement a research protocol that follows this model: observation/pretest, intervention, observation/posttest. Like the use of a standard measure, this type of research model would provide tangible evidence of shifting pedagogies, behaviors, and beliefs when given one-to-one computing access.

Some of the best uses of reported findings of studies are back within the context in which the study was conducted. Many studies of student engagement and one-to-one computing highlight benefits and strategies for general enhancement of these concepts, however there have been few studies that create a product that can be used to guide staff development and decision making. This study seeks to provide a practical tool for these important characteristics of K-12 education while adding to the understanding of student engagement and one-to-one laptop computing, and the relationship between the two.
CHAPTER 3

METHODOLOGY

Methods and procedures used in this study will be detailed in this chapter. This chapter is organized into five sections: (a) research design, (b) setting, (c) participants, (d) instrumentation and procedures, and (e) treatment of data. Human subject protocol procedures were reviewed and approved by the university and school district under which the study was conducted.

Research Design

This study employed quantitative and qualitative methods and consisted of two phases. The first phase drew from ethnographic and grounded theory procedures to conceptualize or present a visual model of the range of conditions and consequences (Creswell, 1998) of one-to-one computing access in the middle school setting. More specifically, in the first phase of the study, observations and interviews were employed for data collection. Data collected was used in conjunction with the ISTE NETS to identify configurations of teacher and student use of laptop computers and student off-task behavior during computer-based learning experiences in the middle school setting. Data from phase one of the study was used to develop an Innovation Configuration (IC) Map for addressing research questions: (a) What are the configurations of technology use
by teachers and students in a one-to-one computing environment, and (b) What is the range of student off-task behavior during laptop computer based learning experiences.

The second phase of this study addressed research question (3) What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting. The IC Map developed in phase one was used to quantify relationships between student off-task behavior and configurations of laptop use.

Setting

This study was conducted in 7th grade classrooms at a middle school in the southwestern United States. The middle school at which the study was conducted has a student population of approximately 1,300 students, with the total district population being approximately 270,000. Eighty-four percent of the students at the middle school are eligible for free or reduced lunch, however, the school administration considers 95% - 100% to be a more accurate representation (personal communication, April 3, 2005). A large percentage (55%) of the students are English Language Learners. School attendance rates at the selected middle school are reported as being slightly lower than the district, but still being over 90%, and transience rates are approximately 35%. Class sizes are in alignment with the overall school district with between 25 and 28 students in each class. The school has enhanced technology integration and preparing students for 21st Century as one of its school goals. All classrooms within the school have Internet access, each classroom has at least one desktop computer, and every teacher has a laptop computer.
The school site for this study was selected by a university-affiliated program for inclusion in a GEAR UP grant. This federal grant was designed to increase the number of college bound students from low-income families. Access to one-to-one computing is one element of the GEAR UP program at the middle school. Funds for teacher training and professional development opportunities are provided as part of the grant, as well as sponsored parent events and school-community relationships. Integral to the GEAR UP program and the selection of the school for housing an International Baccalaureate program, the school administration chose to make technology, specifically a one-to-one laptop initiative a school focus. Along with the laptop program, the school was redesigned to be a technology rich school with several computer teaching labs, wireless Internet throughout the school, and opportunities for paid technology professional development for teachers.

Participants

Participants for this study were drawn from 7th grade classes at the selected middle school. All participants who consented to be observed by the researcher are considered participants for this study. A total of 10 teachers agreed to be participants for this study. Participants were identified in three ways. First, the researcher who had been provided a list of teachers and classrooms approached classroom teachers via a school based email system and asked permission to observe in his/her classroom during laptop-based learning experiences. Second, the researcher approached teachers in person while on the school campus and asked to observe in his/her classroom. Third, the researcher approached teachers either via email or in person and requested permission to visit
classrooms, but added that the assistant principal recommended the teacher and the classroom be considered a participant in the study. All core subjects (English, history, math, reading, and science) were represented, however the primary participants were reading, history, and science teachers. Teachers were asked to sign the consent form (APPENDIX A) on the first day of observation and prior to class beginning.

Instrumentation and Procedures

This study utilized a variety of data collection tools including observations, interviews, lesson artifacts, and a researcher-developed tool. The primary purpose of the first phase was to collect information that could be used to construct an Innovation Configuration (IC) Map of (a) all the ways laptops are being used by teachers and students, and (b) student off-task behavior during laptop-based learning experiences. In the second phase of the study the IC Map was used to identify and analyze through descriptive statistics, the relationships between the configurations of use of the laptop computers and student off-task behavior. This section will begin with an overview of the process of developing an IC Map. Second, a description of research instrumentation and the procedures contributing to the development of the IC Map for this study will be described.

Development of an Innovation Configuration (IC) Map

The purpose of developing an IC Map is to present clear descriptions of all the ways an innovation is being used (Hall & George, 2000). The IC Map for this study was used to describe all the ways laptop computers were being used by teachers and students and the range of student off-task behavior during laptop-based learning experiences.
Developing an IC Map is a multi-step and dynamic process (Hall & Hord, 2003). Figure 3 shows the steps and features for developing an IC Map. Components identifying unique aspects of an innovation are the basic units of the IC Map (Hall & George, 2000). Development of the map centers on identifying components and variations that are grouped together in clusters. Clusters represent major themes or functions of an innovation (Hall & George, 2000).

![Figure 3. Innovation Configuration mapping (Hall & Hord, 2003, p. 49)](image)

The steps for developing the IC Map are distinct yet relative to each other. After deciding which features of innovation adoption will be the focus of the IC Map, the first step is to create a Cluster Map. Sorting key documents and data collected through observations and interviews, as shown in the top portion of Figure 3, creates a Cluster Map.
Map. For this study, the IC Map focused on clusters of teachers and students. The individual components of the Cluster Map in this study were based on preliminary observation and interview data and the ISTE NETS. Variations and dimensions of the components were informed by preliminary classroom observations, informal interviews with classroom teachers, and formal interviews with two individuals employed as technology integration trainers or specialists.

The second step in this dynamic process is to field test the first draft of the IC Map. For this study, the researcher conducted focused observations in participating classes and focused interviews with participating teachers. Arrangement of times for focused observations and interviews followed the same procedure for that of informal interviews and observations, and was primarily through researcher-initiated email using the school district internal email system. During focused observations, drafts of the IC Map were used as data collection guides during the observation period. Drafts of the IC Map were used during focused interviews for the purpose of collecting additional information about components and variations that may have occurred during classroom periods, but outside observation periods. Descriptions of observations and interviews follows this section.

*Observations*

The role of the researcher in this study was as direct observer (Yin, 2003). For this study, descriptive observations during the first phase were conducted to support the development of the first draft of the IC Map. Observations focused on: (a) the physical setting, which for this study would include furniture arrangement and materials in classrooms; (b) participants, which were students and teachers; (c) activities and interactions between participants; (d) conversations, in particular content and roles of
participants in such conversations; and (e) subtle factors such as non-verbal communications and impromptu activities (Merriam, 1998).

Following the creation of the first draft of the IC Map, focused observations were conducted for the purpose of verifying and refining the initial and subsequent IC Map drafts. Heck et al. (1981) suggested that observations for collecting data using the first draft of the IC Map is particularly beneficial when an innovation is being implemented by more than one user and includes interactions between students and teachers. IC Map drafts served as the tool for recording data collected during focused observations.

Interviews

Two interview formats were used for this study. Informal interviews with teachers were conducted in relation to descriptive observations. The purpose of the informal interviews was to gather data for developing the initial components and variations of laptop use.

A second more formal interview format was used in this study. Formal interviews usually occur at specific times and at the request of the interviewer (Spradley, 1980). Although Hall and Hord (2001) recommended that when constructing an IC Map, the innovation developers or experts are interviewed, for this study, formal interviews were conducted with teacher participants, the teacher trainer, and the school district instructional technology facilitator. Heck et al. (1981) proposed a personal interview as the primary means for data collection using drafts of the IC Map. The IC Map drafts are used as both the tool to focus the interview and to record data during the interview. As a tool for guiding the interview, the IC Map draft provides a systematic way of asking
questions yet also allows the researcher to make distinctions and confirm how the innovation is being used or modified (Heck et al., 1981).

Procedure

The first phase of this study addressed two main research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?
2. What is the range of student off-task behavior during laptop computer based learning experiences?

Descriptive observations for phase one were conducted as time permitted in the participating 7th grade classrooms. Arrangement for observation was made prior to classroom visits using an internal email system. No contact was made with students or teachers during descriptive observations, and descriptive observation data was recorded on the researcher’s personal laptop computer using a word processing program.

Descriptive observations lasted an entire period even if only part of the period was laptop-computer based. Days of observations depended on researcher, participant, and school schedule. The researcher sat at the back of the room at a student desk, and as was necessary, moved around the room to have a clearer view of students’ laptop screens. Following the creation of the drafts of the IC Map, focused observations were conducted in participating classrooms. During focused observations, IC Map drafts were used to focus the observation, and data was recorded on the researcher’s personal laptop computer.

Informal interviews were conducted on an impromptu basis following or preceding descriptive observations. Additionally, informal interviews were conducted on the
university campus at which the researcher works as a visiting faculty member and at which several of the teachers attend classes for Masters degrees. Recording of informal interview data was completed in a timely manner (within hours) as anecdotal notes/addendums to descriptive observation data or as a journal. Formal interviews were conducted at a mutually agreed upon time. The first series of formal interviews was conducted with the experts, prior to development of IC Map drafts. The second series of interviews was conducted with participating teachers. The IC Map drafts served as the focus for the teacher interviews. The researcher provided participating teachers with IC Map drafts to guide the discussion and allow for the teacher to clarify and share additional information.

Treatment of Data

The research questions of phase one:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?

2. What is the range of student off-task behavior during laptop computer based learning experiences?

were conceptualized through two types of analyses. Analysis of descriptive observation and informal interview data drew from ethnographic methodology and was reported descriptively as an integral part of the IC Map. Data recorded on or with the IC Map drafts was analyzed following the guidelines of *Measuring Innovation Configurations: Procedures and Applications* (Heck et al., 1981).
Using the ISTE NETS as a foundation, descriptive observation and informal interview data was used to develop the initial and subsequent drafts of the IC Map. The first and subsequent drafts of the IC Map sought to be descriptions of “what would I see in the classroom when the innovation is in use” (G.E. Hall, personal communication, March 3, 2005). Domain analyses focusing on strict inclusions (X is a kind of Y), means-end (X is a way to Y), and rationale (X is a reason for Y) relationships were conducted (Spradley, 1980). This data contributed specifically to the conceptualization of components, including dimensions and variations as well as for addition of unique components within IC Map clusters.

Data from the completion of the IC Map, including student off-task behavior components for each participating classroom and classroom teacher was analyzed to address questions one and two. The IC Map was analyzed on an individual participant/classroom and group level. First, variation in components were assigned a number and individual classroom data was converted to a number sequence based on variation in component assignments. For example, variations in the component of student actions at start of laptop-based lesson was assigned a number from 1 - 4. All of the number sequences were analyzed by looking for clusters and patterns. To describe how all participating classrooms are using the laptops for teaching and learning, all raw scores were tallied and converted to percentages and a group profile was created. The group profile was reported in the form of the final IC Map for all the ways laptop computers are being used for teaching and learning and the range of student off-task behavior during laptop-based learning experiences.
The research question of phase two:

3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

was addressed in two steps. First, configurations of laptop use was identified from the IC Map. Second, raw scores for variations of student off-task behavior from the IC Map were isolated and compared across different configurations of laptop use. Comparisons focused on overall relationships between the configurations of use and the student off-task behavior. Table 5 summarizes the data analysis for this study.

**Trustworthiness**

"Because a research design is supposed to represent a logical set of statements, you can also judge the quality of any given design according to certain logical tests" (Yin, 2003, p. 33). Wiersma (1991) suggested that no matter what form research takes, it should possess validity and reliability. Validity can be considered in terms of internal and external concepts.

Internal validity refers to the degree with which the research findings match reality (Merriam, 1998). There are several strategies that can be applied through data collection and analysis phases of a study to address internal validity. In this study, internal validity was verified by (a) triangulation - use of interviews and observations for data collection; (b) member checks – returning summary statements of interviews to interviewee for verification and requesting teachers review data collected using the IC Map drafts; (c) long-term observation – the researcher conducted multiple observations in each classroom to ensure that data collected and reported is truly reflective of classroom environment and practices; and (d) clarification of researcher biases (Merriam, 1998).
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data Analysis</th>
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<tbody>
<tr>
<td>1. What are the patterns of technology use by teachers and students in a one-to-one computing environment?</td>
<td>Descriptive observations and informal interview data was analyzed using domain analyses (strict-inclusion, rationale, and means-end). Data collected in focused observations and formal interviews using IC Map drafts was converted to number sequences that in turn was analyzed by looking for clusters and patterns. Patterns and clusters are reported descriptively.</td>
</tr>
<tr>
<td>2. What is the range of student off-task behavior during laptop computer based learning experiences?</td>
<td>Configurations of laptop use was identified from IC Map. Raw scores and percentages of student off-task behavior component were isolated from IC Map and compared within and across configurations.</td>
</tr>
<tr>
<td>3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?</td>
<td></td>
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External validity refers to the degree with which a study’s findings extend beyond the immediate setting of the study (Yin, 2003). Several alternate terms to external validity have been suggested including working hypotheses, reader generalizability, and case-to-case transfer, however the underlying assumptions of external validity in qualitative research is that the reader is able to make comparisons and analogies between the study and their unique situation (Merriam, 1998). Strategies suggested by Merriam for addressing external validity under this assumption are rich, thick description and inclusion of discussion of how typical the program being studied is when compared to other situations. For this study, information about the school, and district population is provided. Readers could use this information to relate the context of this study to their unique situation. The IC Map concept is in itself a rich thick description of the ways laptop computers are being used and student off-task behavior. Readers will be able to access drafts of IC Maps in addition to the final IC Map for comparing the situation at this school site to their unique situation.

Reliability refers to the extent with which an alternate researcher could follow the same procedure and discover the same findings (Yin, 2003). “The goal of reliability is to minimize the errors and biases in a study” (Yin, 2003, p. 37). Strategies for addressing reliability include conducting the study in as operational way as possible (Yin, 2003), making clear the position of the researcher, and triangulating data collection and analysis (Merriam, 1998). This study closely followed the methodologies outlined in this chapter, with all observations being conducted by the same researcher in order to ensure consistency of observations and recording of data. In addition, this study includes descriptions of the role of the researcher and the extent to which communication between
the researcher and participants occur. Throughout the study, the researcher continually verified analysis of observations and interview data with participants.
CHAPTER 4

RESULTS

This study examined the impact of one-to-one computing access in the middle school environment. Research was conducted in two phases. Phase one was development of an Innovation Configuration (IC) Map of all the ways laptop computers were being used by teachers and students, and the range of student off-task behavior during laptop-based learning experiences. Phase two examined the relationship between configurations of laptop use and student off-task behavior. The presentation of results is divided into three sections: (a) development of Innovation Configuration (IC) Map, (b) identification of configurations of laptop use and range of student off-task behavior, and (c) exploration of relationships between variations in student off-task behavior and configurations of laptop computer use.

Development of Innovation Configuration (IC) Map

An Innovation Configuration (IC) Map is created in phases (Hall & George, 2000). The first phase is to review printed materials, conduct interviews, and observe the innovation being implemented in a range of settings to identify components and clusters of components (Hall & George, 2000). The second phase, which is cyclical in nature is to construct an initial draft of an IC Map complete with dimensions and variations for each
component. The development of the initial draft of the Innovation Configuration Map complete with dimensions and variations for each component is then field tested and revised until sufficient data is collected to develop a complete verbal picture of all the "ways components of an innovation can be made operational" (Hall & George, 2000, p. 3). The final Innovation Configuration is a representation of the group profile created by documenting variation frequencies collected through focused observations and interviews.

*Identification of Clusters, Components and Dimensions*

A review of the ISTE NETS (2000) for teachers and students revealed distinct expectations for technology integration in the K-12 setting. These expectations were considered for development of clusters and components for the first draft of the IC Map. There are six technology standards for teachers: (a) technology operations and concepts, (b) planning and designing learning environments and experiences, (c) teaching, learning and the curriculum, (d) assessment and evaluation, (e) productivity and professional practice, and (f) social, ethical, legal, and human issues. Each standard comprises distinct identifiers for general preparation, professional preparation, student teaching/internship, and first-year teaching. For this study, identifiers for first-year teaching contributed to the development of components for the first draft of the IC Map. Additionally ISTE NETS technology standards for students were evaluated for applicability in this study.

Technology standards for students are broken into essential conditions and standards for students. Essential conditions relevant to this study include teacher-centered approaches to learning, access to contemporary technologies, and educators skilled in the use of technology for learning (ISTE, 2000). Standards for students are broken into six
standards: (a) basic operations and concepts, (b) social, ethical, and human issues, (c) technology productivity tools, (d) technology communication tools, (e) technology research tools, and (f) technology problem-solving and decision-making tools (ISTE, 2000). Like the teacher standards, each student standard includes distinct identifiers that were considered during development of the initial draft of the IC Map for this study. For more specific examples and grade level appropriate standards, the profiles for technology literate students (ISTE, 2000) was examined and the profile for grades 6-8 was considered during IC Map draft development. Three clusters, teachers, laptops, and students emerged from an examination of the ISTE standards for teachers and students, essential conditions for students, and the student profiles.

The preliminary draft of the IC Map (APPENDIX B) was created using the ISTE data for components and descriptive observation and informal teacher interview data for variations. A total of 11 classroom observations had been made in nine classes for history, math, English, and reading. Although descriptive observation and informal interview data were reviewed and considered during the creation of the draft, the primary consideration for this draft was the ISTE standards. For example using Standard II-D specifying that teachers “plan for management of technology resources within the context of learning” (ISTE, 2000), the following teacher component was created:

Teachers include consideration of management of resources and student learning with technology:

a. All the time, included in plan book, and apparent in observation
b. All the time, but mentally. Apparent in observation
c. Some of the time but not consistently
d. Only as the situation/need arises
e. Not at all
The preliminary draft lacked depth and rich description of what an observer would see if they saw the laptop computers being used in the classroom (G.E. Hall, personal communication, March 3, 2005). It is apparent from the above example taken from the preliminary draft of the IC Map that it would be very difficult to conceive a visual representation of what it might look like when laptop computers are being used for teaching and learning. Using Heck et al.'s 1981 definitions for IC Map elements, this draft did not include dimensions (identifying aspects of each component), but only included variations (the different ways the components can be made operational).

A reevaluation of the original clusters identified that the cluster of laptop was essentially how teachers and students used the laptops, therefore for subsequent phases, IC Map development focused on two clusters, teachers and students. Using the clusters of teachers and students, the first step toward making the Innovation Configuration for this study a richer description of the ways laptop computers were being used was to create a list of components and possible dimensions (APPENDIX C). The list was developed using concepts from the preliminary draft, examples of other Innovation Configurations in which dimensions were clearly identifiable (Hall & Hord, 2001; Hall & George, 2000), and researcher expertise and understanding of effective technology integration in the K-12 environment. Several components and related dimensions (e.g. component of lesson opening with dimensions of checking for prior knowledge, confirmation of understanding, introduction of technology requirements and skills) were extracted from a hypothetical description of a classroom in which technology integration was working perfectly (G.E. Hall, personal communication, March 3, 2005).
Figure 4 is an illustration of how components and dimensions evolved during IC Map development in this study. This example begins with the preliminary draft (APPENDIX B) and is the initial component drawn directly from the ISTE standards for teachers; specifically standard II-D: “Plan for the management of technology resources within the context of learning activities” (ISTE, 2000, p.12). After determining through review and revision of the preliminary draft that this component was uni-dimensional, this component was expanded upon and included in the list of possible components and dimensions (APPENDIX C, and represented by the rectangular icons in Figure 4).

Between development of the list of possible components and dimensions and development of Draft 1 of the IC Map, descriptive observations and interviews with teachers were conducted. Analysis of observation and interview data identified that the component of Instructional and management strategies would best be broken into four distinct components in Draft 1 (represented by hexagons in Figure 4). Between Drafts 1 and 2, focused observations were conducted. Through ongoing analysis of observation data and review of Draft 1, components were modified, expanded upon, and/or condensed as they evolved into components for Draft 2 (represented by circles in Figure 4).

The links between the icons are an example of how some dimensions of the initial component skipped Draft 1 yet were included in Draft 2 of the IC Map (dashed lines in Figure), where others were included in Draft 1 and then again in a slightly different form in Draft 2 (solid lines).
Figure 4. Example of evolution of components and dimensions during IC Map development

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Dimensions for the 5 components at the bottom of Figure 4 draw from previous drafts as well as from data collected in ongoing observations.

When discussing the evolution of components and dimensions, in reality it is difficult to separate this process from the evolution of variations for each component. This example is representative of the evolution of components and dimensions in this study, in that all components began in the preliminary draft (APPENDIX B) or list of possible components and dimensions (APPENDIX C). Together with data from interviews and observations components were expanded upon for the drafts of the IC Map so that variations developed for each component would be rich descriptions of innovation implementation. Effort was made to have dimensions guide the variations so that variations would be adequately descriptive, but not repetitive or having so many dimensions that it would be difficult isolate unique implementations.

Identification of Variations

The second step in development of an Innovation Configuration for this study was to begin to create the rich paragraphs describing the different variations for each component. This was accomplished through analysis of observation and interview data. Two experts in the field of technology integration (the teacher trainer from Apple Computers and a school district instructional technology facilitator) were interviewed. The first guiding question was "please describe for me what you would see if you were observing a classroom in which laptop computers were being used most effectively, for example a best-case scenario". Phrases such as "transparent technology", "facilitating teacher", "informed students", and "harvesting Internet skills" were used to describe effective technology integration. Descriptions of lesson formats including phrases such
as “lesson is guided by an essential question”, “technology is used for creation, collaboration, communication, and assessment”, “lesson is tied into multiple subject areas”, and “teachable moments” contributed to the development of variations for laptop use in the IC Map.

The second question of the interview asked the expert to describe a worst-case scenario. Phrases including “lack of awareness”, “lack of goals”, “uninformed students”, “structured chaos”, and “technology is an obstruction” were used to describe the overall environment of a worst-case scenario of laptop use in the classroom. Lesson specifics drawn from the interviews included descriptions such as “teacher starts lesson with a menial, low-level cognitive task”, “a lesson on X when it was introduced as being on Y”, “inclusion of a hands-on component, but using a skill introduced in a different context a long time ago”, and “lack of cooperative learning, communication, and collaboration”.

The interview context was informal with the interview lasting approximately half an hour. The interviewer took notes on a notepad and asked interviewees to stop at particular intervals for note taking. At the conclusion of the interview, notes were read back to interviewee and the researcher summarized current understanding of interviews.

Building on identified components and dimensions, domain analyses of expert interview data and observation data from 17 visits in 10 different classes (history, math, reading, science, and English) were conducted (APPENDIX D). Spradley (1980) suggested distinct types of domain analyses depending on the types of relationships being examined: Strict inclusion (X is a kind of Y) relationships (Spradley, 1980) were identified for kinds of teacher actions, student actions, teacher/student interactions,
<table>
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<th>Included Terms</th>
<th>Cover Term</th>
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<td>Teacher questioning</td>
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<tr>
<td>Troubleshooting with laptops</td>
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<tr>
<td>Sharing websites</td>
<td>student/teacher</td>
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<tr>
<td>Student questioning</td>
<td>Is a kind of</td>
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<tr>
<td>Emailing/I-chatting</td>
<td>interaction</td>
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<td>Casual conversation</td>
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<td>Disciplining students</td>
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<td>Reminding of copyright</td>
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<td>Advising on presentations</td>
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<td>Complimenting</td>
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<td>Reminding students to save work</td>
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<td>Demonstrating a concept</td>
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<tr>
<td>Completing an assignment</td>
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<tr>
<td>With a partner</td>
<td>Is a way to</td>
</tr>
<tr>
<td>On a lap/knee</td>
<td>use a laptop</td>
</tr>
<tr>
<td>By oneself/individually</td>
<td></td>
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<tr>
<td>At a desk</td>
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student/student interactions, and student off-task behaviors. Means-end (X is a way to Y) relationships (Spradley, 1980) for ways to use a laptop computer and rationale (X is a reason for Y) relationships of reasons for using a laptop computer were examined. Table 6 represents examples of domain analyses conducted in this study. A complete list of analyses is provided in APPENDIX D. Additionally a list of laptop applications was created from analysis of observation data.

Step three, the development of paragraphs of variations for each component drew directly from the domain analyses and list of laptop applications. In an effort to thoroughly describe different variations for each component, dimensions were used to order and structure the format of the variations. For example, for the component of student control of laptop during learning experience with dimensions of control, position and decision-making, the following variations were developed:

1. Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.
2. Laptops are centrally positioned yet it is apparent that one student is sharing with the others. Control of laptop is generally by one person but consultation on navigation and aesthetics of content is evident.
3. Laptops are positioned in front of one individual but turned for others to see. Control is by one person, and others are observers.
4. No sharing of laptops. Students who do not have laptops use alternative learning tools.

Although most components of Draft 1 of the IC Map (APPENDIX E) provided rich descriptions of laptop computer use or student off-task behavior, some components were too descriptive and needed to be broken into two or three separate components (G.E.Hall,
personal communication, March 30, 2005). For example, the component of \textit{laptop-based lesson format} with dimensions of \textit{opening, middle, closing} had as one variation:

1. Students enter the room and take out laptops, open them and wait for further direction. Some students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students stop what they are doing and wait for direction for the lesson. Students are directed to assigned application and work on it as directed. At the end of the lesson, students put laptops back in backpack without being reminded and follow school routine of sitting silently at desk until dismissed by teacher.

It was identified in this variation, that the dimensions of \textit{opening, middle, closing}, should be components in and of themselves, with a recommended additional component of \textit{student actions with laptops at beginning of laptop-based lesson}. The resulting draft of the IC Map Draft 2 (APPENDIX F) was field tested in three classrooms and one teacher interview.

Figure 5 illustrates the evolution of two variations for one student off-task behavior component of the Innovation Configuration developed during this study. Variations are the rich paragraphs describing the possible ways an innovation is being made operational (Hall & George, 2000). The variations from Draft 2 of the IC Map in this example are represented in the large diamond icons at the bottom of the figure. These are not the only variations for this component but were chosen because they are representative of the way the variations evolved in this study. Development of variations is not mutually exclusive to development of components and dimensions.

At the top of Figure 5 is the originating component (cloud) taken directly from the list of possible components and dimensions (APPENDIX C). This component was identified to have three possible dimensions: number of students, time, and teacher awareness of
Figure 5. Example of evolution of variations during IC Map development

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(represented by circles in Figure 5). After review of observation and interview data, it became apparent that these dimensions should be for two separate components. The originating component and three dimensions evolved into two components each with unique dimensions that would allow for rich variation paragraphs to be developed. The rectangular icons in Figure 5 represent components (dimensions) with variations for each as developed in Draft 1 of the IC Map.

Further analysis of observation data resulted in these two components merging back into one component for Draft 2 (represented by the upper diamond shapes). Through this, it was decided that the most descriptive paragraphs about this component could be created, two of which are represented by the lower diamond icons in Figure 5. This example is representative of the evolution of the different variations identified in this study, in that most of the variations from this study originated from the list of components and dimensions and were broken apart and put back together into various components, dimensions and variations throughout the IC Map development. The term evolution of components, dimensions and variations is especially appropriate when describing the development of and Innovation Configuration because similar to evolution of an individual in an ecosystem, the evolution of the components and dimensions was dependent on the concurrent evolution of variations.

Field testing of the IC Map

Draft 2 of the IC Map was deemed suitable for data collection for phase two of this study as during field testing, no components and/or variations needed to be expanded upon, divided into multiple components, or modified in order to sufficiently describe all the configurations of laptop computer use and student off-task behavior. The teacher
who participated in the interview was able to clearly identify which variation best described them. A final Innovation Configuration, (APPENDIX H) was developed following data collection and based on recommendation of G.E. Hall. The primary differences between the draft used for data collection and recording of results and the final Innovation Configuration of this study is that final draft is more true to the IC construct in its layout and organization.

When developing an Innovation Configuration, variations of components are intended to represent a continuum and not discrete units. The use of vertical lines in an Innovation Configuration are intended to represent fidelity lines, in that all variations to the right side of a line have been judged to be unacceptable (Hall & Hord, 2001). In the development of the IC Map drafts for this study, lines were used not to represent anything at all, but to help the researcher maintain focus during data collection and analysis. Additionally, an Innovation Configuration is traditionally presented using a landscape paper orientation, however for the purpose of navigability during data collection and analysis during this study, portrait orientation was used until the final draft (APPENDIX H).

Summary of Development of IC Map

The development of an IC Map of configurations of laptop computer use for teaching and learning and the range of student off-task behavior in the middle school setting for this study was a multi-step process. Table 7 shows the phases and process of developing the IC Map in this study. The development of the IC Map for this study took approximately one month with 3 drafts including the preliminary one being created.

Following the development and review of the preliminary draft, interim and partial drafts were reviewed, and subsequent drafts developed with consideration of feedback.
from review. Classroom observations and data collection were ongoing through the duration of developing the drafts, and data was included in modification of components, dimensions, and variations even though it was not specifically added to the domain analyses.

Table 7. Summary of IC Map Development

<table>
<thead>
<tr>
<th>Phase</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Identified components and clusters. Primary consideration was analysis of ISTE NETS for teachers and students (2000). Additionally observation and interview data were considered.</td>
</tr>
<tr>
<td>Two</td>
<td>A list of possible components and dimensions was created building upon phase one data. Data from expert interviews, classroom observations, and teacher informal interviews was analyzed using domain analyses. Paragraphs describing variations were created from domain analyses using dimensions as an organizational guide. The IC Map draft was field-tested in three classrooms and one teacher interview.</td>
</tr>
</tbody>
</table>
Challenges Faced During IC Map Development

There were several challenges faced during the development of the IC Map for this study, most of which centered on scheduling of classroom observations. First, classroom observations relied upon teacher willingness to be considered a participant for the study. Informal interviews with participants and non-participants revealed that many teachers do not plan as many laptop-based lessons as they would like due to student apathy about bringing laptops to class, and therefore several teachers were hesitant to identify themselves as participants for this study. Second, scheduling of classroom observations was dependent on participants notifying the researcher in advance of suitable times for observations. Third, both laptop-based lessons and subsequent scheduling of classroom observations was in many ways dictated by the district, state, and national testing calendar.

Identification of Configurations of Laptop Use and Student Off-Task Behavior

This section specifically addresses research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?

2. What is the range of student off-task behavior during laptop computer based learning experiences?

Where the first part of this chapter described the development of the IC Map of all the ways laptop computers were being used and student off-task behavior, this section will specifically draw from the completed IC Map (APPENDIX G) and report profiles of
computer use for teachers and students. Clusters of uses and student and teacher behaviors identified in observations and interviews will be examined and addressed as configurations of laptop computer uses in the middle school setting. Finally, the range of student off-task behavior during laptop-based learning experiences will be addressed.

Profiles of Computer Use

To profile computer use the data collected using the final draft of the IC Map was analyzed. Focused interviews with eight teachers and focused observations in 10 participating classrooms were conducted. Math teachers did not participate in focused interviews, and only one math teacher consented to participate in a focused observation. After 18 focused observations predictable patterns of teacher and student use emerged and further observations although conducted were not included in the data analysis. Results of the focused interviews and observations are reported as teacher and student profiles. APPENDIX G can be referred to for all recorded variations and percentages.

Teachers.

Teachers are using the computers in a variety of ways for a variety of learning goals, with specific uses often being dependent on desired learning outcomes. Teachers are planning lessons that demonstrate many qualities of constructivist pedagogy including allowing students choices, asking open-ended questions, and promoting a comfortable and non-intimidating learning environment. They are addressing required technology skills for meeting learning outcomes as an integral part of the lesson format, and using technology as the primary instructional material for many lessons. Figure 6, taken directly from the IC Map (APPENDIX G) shows the percentage of teacher instructional
<table>
<thead>
<tr>
<th>Component (dimensions) and variations</th>
<th>% inter view</th>
<th>% obser rv.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher instructional strategies at start of lesson (Prior knowledge, Technology skills, discussion of LO(learning objective), Checking for understanding, Modifications for laptop/non-laptops)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Lesson follows specific format (eg Madeline Hunter, Learning cycle,...). Expectations and LO articulated as per lesson format. Students’ prior knowledge is addressed through questioning of students. If necessary, technology and required skills for lessons are addressed in a mini-lesson or reminder of associated task. Lesson introduction includes modifications and/or considerations for students who do not have laptops.</td>
<td>50</td>
<td>78</td>
</tr>
<tr>
<td>b. Lesson generally follows effective lesson format with LO written on board, and briefly discussed. Student prior knowledge is addressed as a reminder of what they learned in the past or through brief questioning. If necessary, technology skills are introduced as a reminder with some direction or clarification. Modifications for students who do not have laptops are addressed but not integral to lesson directions.</td>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>c. Lesson begins with students copying LO from board, but no discussion of it. Technology skills are addressed informally. Prior knowledge is not addressed or is addressed very informally. Modifications for students who do not have laptops are addressed informally.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Teacher instructional actions (Use of technology, Use of whiteboard, Use of instructional materials)** |              |             |
| a. Teacher uses laptop and projector to demonstrate laptop-based activity, and leaves projector on for duration of assignment. Teacher uses whiteboard/blackboard/overhead projector for reminders, and technology for demonstration/mini-lessons. Technology is the primary instructional material for the lesson. | 50           | 17          |
| b. Teacher starts lesson by using laptop and projector but turns it off once students are set up. Whiteboard/blackboard/overhead projector is used for demonstration, mini-lesson, and reminders. Technology is supplemental material. | 50           | 11          |
| c. Teacher uses laptop and projector for starting lesson and leaves it on during lesson but does not use it for further demonstration. Intermittent instruction does not occur or teacher gives more specific directions on a one-on-one basis using student’s laptops. |               | 11          |
| d. Teacher does not use laptop and projector to start lesson because application is routine to students and/or demonstration is not necessary. |               | 50          |
| e. Teacher does not use laptop or projector to start lesson or for any part of the lesson. |               | 13          |

Figure 6. Percentages of variations in teacher actions and instructional uses of technology as recorded in interviews and observations
strategies and use of technology for instructional purposes as reported in interviews and observations. Teachers are considering student learning through laptops in that 50% of them report addressing technology skills during lesson introductions. Interviews revealed that teachers sometimes felt they did not address prior content knowledge as much as they possibly could, thus considered variation b to be more representative of themselves.

Observations contradicted this, which may be an indication that addressing prior content knowledge is something teachers do automatically. Observations also revealed that teachers frequently address technology skills, often as a reminder of which application to use, and modifications for students without laptops were specifically addressed. Observations revealed that modifications for non-laptop students were addressed more frequently than modifications for laptop students. Interviews revealed that although teachers predominantly use the laptop computers and projection devices for introductory lessons, they turn them off because they want to conserve the bulbs in the projectors. In addition, the interview question was worded such that teachers selected the ‘most representative’ variation, and many added that later in the year, students need little instruction on how to use the technology. This could help explain the high percentage of teachers observed not using the laptop at the start of the lesson despite their reporting that they do.

Teachers are using computers for planning, communication, and record keeping in addition to instructional uses. Figure 7, taken from the IC Map (APPENDIX G) shows the results of uses of technology as reported by teachers during focused interviews. Results may add to more or less than 100 due to rounding to nearest whole number. One hundred percent of teachers interviewed and observed indicated that they always use
computers for attendance, record keeping, and personal email using the school district email system. Similarly, 100% of teachers use computers for taking attendance because it is a requirement, whereas for record keeping and personal email, 87% considered it to be a requirement, and 13% considered it to be from choice.

<table>
<thead>
<tr>
<th>Teacher uses of laptop computer</th>
<th>Not at all</th>
<th>Always out of choice</th>
<th>Always because required</th>
<th>Sometimes based on choice</th>
<th>Variable based on content and goals</th>
<th>Occasional just getting used to it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>50</td>
</tr>
<tr>
<td>Attendance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring student activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>87</td>
</tr>
<tr>
<td>Personal email/Interact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Researching lesson ideas or content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Demonstration/examples</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>Own web page/creating web-based assignments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63</td>
<td>37</td>
</tr>
<tr>
<td>Student communication, dissemination of lesson content</td>
<td>26</td>
<td>50</td>
<td>12</td>
<td>12</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Figure 7. Percentages of teacher uses of laptops reported in focused interviews

Additionally, 100% of teachers reported in the interviews that they choose to use the Internet for researching lesson ideas and lesson content. One teacher discussed in the interview, "I make a point of checking for lesson ideas on a weekly basis. I look at the National Science Foundation website every week." The science teachers reported 97
creating web-based lessons *always out of choice*, whereas the other content areas were
evenly divided across *sometimes out of choice, variable based on content and goals and
25% reported occasional/just getting used to it*. This was confirmed in observations in
which 100% of observations in the two science teachers’ classrooms, students were
completing web-based assignments such as scavenger hunts. In the history, English, and
reading classes, a variety of uses including web-based assignments, word processing
assignments, and presentations were observed.

Fifty percent of teachers reported using laptops for student communication and
dissemination of lesson content. This was not observed in 50% of classrooms, however
teachers did share during the interviews, that when they do disseminate materials or have
students use the dropbox for submitting assignments, they always do so out of choice
rather than requirement or based on content. Several teachers disseminated and collected
assignments electronically at each observation. Teachers made statements such as, “I am
definitely *always* on this one. I email the students their assignments and they are always
emailing me about stuff”. Another teacher commented that “I always make the
assignments available on Edline (school district grade reporting program) so the parents
know what is going on and students who miss know what they missed”.

As an instructional tool, 100% of teachers reported using the laptops *out of choice* for
demonstrations or examples, however only 50% reported *always* doing so. During the
interview, one teacher shared that this was more frequent at the beginning of the year, but
now it is routine to the students so it isn’t as necessary. The science teachers in particular
were observed using their laptops and projectors for sharing examples of searching
strategies and mini-clips of scientific phenomena.
In summary, teacher uses of laptop computers extend into planning, instruction, and record keeping. Teachers plan lessons expecting student laptop access, and if necessary will direct students to work with partners to ensure laptop access during the lesson (75% reported in interviews). Teachers have a willingness to use the laptops for instructional purposes with only two teacher uses of laptops having not at all responses. Teachers are addressing technology skills and requirements as integral parts of lesson formats without even being aware of it. Observation revealed and interviews confirmed that teachers are planning instructional activities for students that require student laptop use. The next section will report on student laptop uses as found in focused observations and recorded in focused interviews.

*Students.*

Like teachers, students are regular users of the laptop computers for both academic and personal purposes. Academic purposes include completing assignments, communicating with the teacher, taking notes in class, and creating and sharing presentations. Personal purposes include Internet-based activities such as email and Internet surfing as well as non-Internet based games. Off-task uses of laptop computers by students will be specifically addressed in the reporting of off-task behavior.

Students are using computers as an integral part of their school experience. They are taking their laptops out as part of class readiness and are showing responsibility for positioning themselves near charging stations. Students share laptops in ways that it is difficult to identify whose laptop it is. Figures 8 and 9 taken directly from the IC Map (APPENDIX G) show percentages of variations in student behavior and actions during laptop-based lessons.
<table>
<thead>
<tr>
<th>Component (dimensions) and variations</th>
<th>% interviews</th>
<th>% observ.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student laptop behavior at commencement of Laptop-based Lesson (use of laptop, readiness for start of lesson)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Many students take out laptops with other required learning tools (binders, pens, texts...). Laptops are opened and students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students close laptops or minimize window.</td>
<td>63</td>
<td>50</td>
</tr>
<tr>
<td>b Some students take out laptops with other learning tools, open them and play games or other non-educational/personal activity. When the teacher starts class, students with open laptops keep them open until directed to close. Other students sit at desks and laptops do not appear until the teacher starts class and requests they take them out.</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>c Only one or two students take out laptops as an integral part of preparing for class. Laptops sit on desk but are not opened. Once teacher starts class and requests laptops, more students retrieve laptops from backpacks.</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>d Students prepare for class but do not take laptops out of backpacks unless requested by teacher.</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td><strong>Student actions at start of lesson (Noise, seat selection, Movement around class)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a Noise level is appropriate for students entering a class that has not begun. Students sit at any seat and are not directed to move by the teacher. Student movement around room is self-initiated and based on laptop charging or sharing laptops, retrieval of materials for instructional purposes.</td>
<td>25</td>
<td>67</td>
</tr>
<tr>
<td>b Noise level is appropriate for students entering a class. Students have assigned seats. Movement around class (teacher directed and self initiated) is appropriate for activity in that students move on an as needed basis for charging, retrieval of materials etc.</td>
<td>63</td>
<td>28</td>
</tr>
<tr>
<td>c Noise level is either too loud or no talking at all as students enter room. Students sit at any desk yet teacher moves student at commencement of class. Teacher moving student is based on management rather than instruction. Only student initiated movement is to a charging station or for off-task purposes.</td>
<td>13</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 8. Percentages of variations of student behavior and actions at commencement of lesson as identified in interviews and observations
### Component (dimensions) and variations

<table>
<thead>
<tr>
<th></th>
<th>Student/student laptop interactions before start of lesson (content, number of students, use of laptop)</th>
<th>% interviews</th>
<th>% observ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Some students with laptops are looking at course content related material on one or more laptops. Students are discussing work completed for current class or an alternate class. Students are in groups of two or three with at least one computer.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b</td>
<td>Some students with laptops are viewing and discussing either course related material or laptop ‘logistics’ such as changing wallpaper, using the laptops etc. Each student has own laptop and students are in groups of two or three.</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>c</td>
<td>Some students are using laptops for personal goals such as email, l-chat or looking up personal information with other students. Predominantly one laptop per group of two or three students.</td>
<td>50</td>
<td>39</td>
</tr>
<tr>
<td>d</td>
<td>Little or no interaction centering on laptops prior to start of class</td>
<td>25</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Student control of laptops during learning experiences (control, position, decision-making)</th>
<th>% interview</th>
<th>% observ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.</td>
<td>50</td>
<td>28</td>
</tr>
<tr>
<td>b</td>
<td>Laptops are centrally positioned yet it is apparent that one student is sharing with the others. Control of laptop is generally by one person but consultation on navigation and aesthetics of content is evident.</td>
<td>25</td>
<td>39</td>
</tr>
<tr>
<td>c</td>
<td>Laptops are positioned in front of one individual but turned for others to see. Control is by one person, and others are observers</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>d</td>
<td>No sharing of laptops. Students who do not have laptops use alternative learning tools</td>
<td>0</td>
<td>33</td>
</tr>
</tbody>
</table>

Figure 9. Percentage of variations of student laptop behaviors before and during learning experiences as reported in interviews and observations

In approximately ¼ of focused observations and interviews, students are taking laptop computers out of backpacks as they prepare for class. Examples in which laptops did not come out of backpacks integral to getting ready for class, the teacher shared in the interview that this is because the class starts with silent reading, or the teacher has...
requested that students wait until they are asked to retrieve laptops before doing so. Students are comfortable with using laptops, and seamlessly position themselves near charging stations and openly share their laptops with other students. During several interviews, teachers volunteered that students are so open with their laptops that often they do not know whose laptop it is until they see the backpack it is returned to. This was confirmed in observations however in cases where sharing was more than 2:1, it was more evident of whose laptop was being used. Sharing of laptops was highly dependent on proportions of access. Classes in which no sharing was observed were classrooms where only a few students did not have their laptops with them. In these scenarios, the teacher often loaned the student the teacher laptop or the student routinely used alternative tools. Alternatively sharing of laptops did not occur in classrooms in which sharing would have resulted in a greater than 2 or 3:1 ratio.

Students are using laptop computers for personal use. Both observations and interviews revealed that students are using laptop computers for email, I-chat and playing games. The most common observed use of laptop computers prior to class starting was playing games, in particular Mario Brothers. All students using laptops for playing games prior to commencement of class were observed playing the same version of the game. Other uses of laptops for personal goals included email and less often I-chat. Students informally shared that I-chat wasn’t as good as email because other students can butt in on your conversations. Teachers reported that I-chat used to be a problem but is less of a novelty now, so students don’t do it as much.

Interviews with teachers about student uses of laptops during learning experiences were recorded on the IC Map. Figure 10, taken from the IC Map (APPENDIX G)
illustrates student uses of technology for learning experiences as reported in focused
teacher interviews. Totals may add to more than 100 due to rounding to nearest whole
number. Students are using the laptops for a variety of purposes: submitting and
retrieving assignments, completing presentations, word processing, Internet-based
activities, and completing group projects.

The most frequent reported student uses of laptops were basic functions such as word
processing, Internet-based research, and completing group or individual assignments. Use
of laptops for learning experiences that lasted more than one class period were reported
as weekly even though the students may have in fact been using the laptops two to three
times a week to complete the assignment. Teachers reported and observations confirmed
that the most common use of the laptops by students was for basic functions in particular
word processing. School routine is for students to complete an activity called Primetime,
a warm up type of activity in which students answer three to five questions relative to
course content. Each subject area has Primetime, and it was observed that laptop students
always used their laptops for this activity. It should be noted that in some classes on
variable days, Primetime was completed verbally with no student use of laptops or any
other form of learning tool. Basic functions was the only laptop use that all teachers
reported using at least some of the time.

Laptops were reported as being used for Internet-based research in many classrooms:
75% for guided research and 63% for open-ended research. Students consistently used
the laptops for guided research in science, with this being the predominant use observed
in these classes. Students completed both open-ended and guided Internet research in
reading, English, and history, however the only time students used their laptops for
<table>
<thead>
<tr>
<th>Student uses of laptops in learning experiences</th>
<th>not at all</th>
<th>at least 2X/week</th>
<th>weekly</th>
<th>requirement of laptop students</th>
<th>student choice</th>
<th>dependent on content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic functions (word processing, calculator, dictionary/spellchecker)</td>
<td>50</td>
<td>13</td>
<td>25</td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Communication with teacher or professionals/experts</td>
<td>75</td>
<td>13</td>
<td></td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Open Internet research (eg Google, Yahoo,...)</td>
<td>13</td>
<td>63</td>
<td></td>
<td></td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Multimedia based research (CD ROMs)</td>
<td>63</td>
<td></td>
<td>13</td>
<td>25</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Guided research (eg scavenger hunts)</td>
<td>13</td>
<td>25</td>
<td>50</td>
<td>13</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Webquest</td>
<td>63</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group assignment/presentation</td>
<td>38</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free time</td>
<td>50</td>
<td>13</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual assignment/presentation</td>
<td>13</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Multi-disciplinary assignment</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Mini-clip/online movie for assignment content</td>
<td>63</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test or quiz</td>
<td>88</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspiration software</td>
<td>38</td>
<td>13</td>
<td>38</td>
<td></td>
<td>13</td>
<td></td>
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<tr>
<td>Submitting assignment</td>
<td>38</td>
<td>38</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrieving assignment</td>
<td>63</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Record keeping</td>
<td>63</td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal management/planner</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Instructional Games/puzzles</td>
<td>63</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
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<td>Homework expectation</td>
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<td>13</td>
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<tr>
<td>Virtual field trips</td>
<td>88</td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplemental CDs, not research based</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

Figure 10. Student uses of laptops during learning experiences as reported in focused interviews

104

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completing WebQuests was in history classes. In some classes, the students did not use the laptops for anything other than word processing or creating presentations.

Teachers reported group or individual presentations as a weekly student use of laptops: 50% for group assignments and 63% for individual assignments. Use of laptops for this purpose was primarily reported by history teachers and reading teachers, with history teachers making it more of a requirement and reading teachers making this a student choice for assignments such as book reports and responses or final projects. It was apparent in observations that students were proficient at the use of presentation tools including I-movie and Appleworks Presentation.

Multidisciplinary assignments were a use of laptop computers that was reported as either being dependent on content or not used at all. Interviews revealed that as part of the International Baccalaureate (IB) Program, students are required to complete at least one interdisciplinary assignment per semester. Not all students or teachers who were considered participants for this study are involved in the IB program and the only teachers reporting interdisciplinary uses of laptops were IB teachers.

The predominant use of the Internet was for research, with only 25% of teachers reporting student use of Internet-based instructional games. When reporting the use of laptop computers for research, teachers did not promote and students were never observed using supplemental or textbook CD ROMs. The only research done by students using computers was Internet-based. Similarly, the only observed use of educational software was the concept mapping software Inspiration.

Finally, the use of laptop computers for retrieving and submitting assignments at a frequency of at least twice weekly was reported by 38% of teachers interviewed.
Teachers shared in interviews that this is something they would do more of, but because there is no simple or easy way to grade, make comments, and return assignments to students they tended to not have students use this feature. Of the teachers who did, one had arranged for students to have personal email addresses within the school district email system and another used different features such as the school assignment dropbox system or the school district Edline system.

In summary, students are using the laptop computers for a variety of educational purposes both out of choice and as requirement for completing both routine and content-based assignments. The most common reported use of laptop computers by students was word processing. Teachers rarely reported that students used laptops for communication with either the teacher or experts in the field, and despite the school owning licenses for students to take online quizzes, only one teacher reported this as a frequent student use of the laptops. Only two uses (basic functions and guided research) were required and only in a small percentage of classes. The next section will examine clusters of student and teacher use of the laptop computers.

Configurations of Laptop Use in the Middle School Setting

Several clearly recognizable configurations of laptop use were identified through analysis of data collected using the IC Map. For the purpose of this study, different configurations have been labeled (G.E. Hall, personal communication, April 19, 2005). Three unique configurations were identified: (a) The Jetsons (b) Star Trek, and (c) Lost in Space. The configurations are unique in that they are not relative to each other; nor are they representative of frequency of each configuration, but true to the Innovation
Configuration construct, the configurations are descriptions of the different ways the innovation is being implemented.

The Jetsons.

This configuration is labeled The Jetsons because it represents the use of laptop computers for teaching and learning, as one would expect in the 21st century. There was a pattern in The Jetsons configuration to use the laptops as the primary tool during the lesson. Students enter the classroom, take out their laptops, and use them for personal goals while the class settles in. Conversation prior to the start of class is casual and when the bell rings, students responsibly either leave laptops open on the desk with no windows open, or close laptops but leave them on the desk. All but perhaps two or three students come to class with their personal laptop and exceptions are due to laptops being repaired or recalled. In The Jetsons configuration, students sit at any desk and move seamlessly to charging stations as necessary. Teachers begin lessons by using their laptop and a projection device to introduce concepts and confirm that students either have the required technology skills or specifically address them as part of the lesson introduction. There is little need for sharing of laptops in this configuration.

During instructional time in The Jetsons configuration, students retrieve their assignments from the school dropbox system or check their school district email for the required documents. Teachers incorporate project-based learning and students are given choices on how to complete assignments. Students use laptop computers for a variety of instructional purposes: basic functions, Internet-based research (mostly guided), communication with teachers, individual and group presentations, retrieving and submitting assignments and homework. Teachers rarely collect papers from students and
the only time students print is for purposes of displaying work. Teachers make a conscious effort to allow students freedom to explore technology and content. When questions arise about technology use, both teachers and students offer suggestions. Assessment is often technology based in the form of online tests and quizzes or student presentations (I-movies and slideshows). Finally, it is evident in this configuration of use, that teachers make a conscious effort to keep up to date on resources and effective uses of technology in the curriculum by routinely checking specific websites for updates or by setting aside times for Internet-based instructional research.

*Star Trek.*

Like Star Trek the television series, Star Trek the configuration of laptop use by teachers and students in the middle school setting is variations on the same theme. This configuration was labeled Star Trek because classroom dynamics and laptop use by teachers and students varied dependent on learning goal and degree of one-to-one student laptop access. This configuration describes one in which not all students bring laptops to class for various reasons - parents did not give consent, batteries are dead, laptop is being repaired or recalled, or they decided to leave it at home today. In this configuration, students come to class and some students take out their laptops, others wait to be asked to do so. Those who do take out laptops use them for personal goals and when class starts mostly leave laptops open and in some cases continue playing games. Students only move to charging stations at the last minute and sit in their assigned seats or with a group as directed by the teacher.

In the Star Trek configuration, the teacher begins class with the use of their laptop and a projector but at the later stage of the academic year, technology use is routine and
demonstration or reference to technology skills is not required. The teacher addresses requirements for technology use as an integral part of the lesson, and modifications for non-laptop students are addressed. Students are grouped based on laptop access. Depending on the learning goal of the lesson, there are times when students do not share laptops at all; when students do share laptops it is difficult to determine whose laptop is being used.

During instructional times in the Star Trek configuration, students retrieve assignments electronically on occasion, but dissemination of handouts and worksheets is principally manual. Submitting of assignments is manual because students predominantly complete a handout and return it to the teacher. There is no electronic communication between teachers and students in this configuration. Students are limited in their uses of technology to basic functions such as word processing and Internet-based research, both guided and open-ended, and occasional use of presentation tools. There is no homework expectation involving technology, and assessment is paper and pencil based. Assignments last either a single period or two periods at the most, and perhaps once a semester students complete a project-based assignment. Project-based assignments usually involve students researching an assigned topic and completing a slide show presentation or other presentation such as poster, mini-book, or completion of an assignment template.

In the Star Trek configuration, interactions between teachers and students center on content rather than technology and when technology questions arise, teachers are the primary responder, only referring the question to the class in extreme cases such as “Did everybody just lose Internet?” The teacher uses technology for record keeping and
required attendance, but use of technology for researching lesson ideas and content is limited to researching websites for students to access during scavenger hunts.

*Lost in Space.*

Like the television series, the Lost in Space configuration of laptop uses by teachers and students in the middle school setting is somewhat antiquated, but it is named more for the fact that the atmosphere in these classrooms is one of despair but doing the best one can under the circumstances. In the Lost in Space configuration, teachers and students do not use laptops very much because not all students bring their laptops to class on a regular basis. Prior to class commencing, conversation between students and teachers is casual and perhaps two or three students take out their laptop as they prepare for class, using the laptops for personal goals, mostly playing games. Laptops are closed or put away at the request of the teacher once class begins. On a few occasions, the laptop and projector are used by the teacher for the lesson introduction, but the laptops are not the primary teaching and learning tool in the Lost in Space configuration. Several students do not take laptops out when the teacher requests and have to be asked why not. In some instances, students take laptops out of backpacks but use the textbook to complete the assigned task. Students sit at assigned seats and there is little movement for charging purposes or any purpose other than classroom management/discipline. Teacher introduction of lessons is equally directed to students with and without laptops, and any student grouping is based on peer relations rather than laptop access or teacher direction.

In the Lost in Space configuration, students use the text as the primary instructional tool and either answer questions from the book or complete a teacher made handout. There is no electronic dissemination or collection of assignments, nor is there electronic
communication between teachers and students. Students use the laptop computers for word processing and little else. Occasionally students may complete Internet-based research. There is little student-teacher or student-student interaction regarding laptop use in the Lost in Space configuration, and students who are using laptops do not ask many technology related questions of the teacher. Technology-based assessment does not occur, and teachers use technology for required purposes such as attendance and recording of grades. Other teacher uses of technology are for lecture/presentation purposes and researching of content but not Internet-based activities.

Range of Student Off-Task Behavior

The range of student off-task behavior can be addressed in an examination of data collected using the IC Map. Figures 11 and 12 are select student components of the IC Map representing student off-task behavior. In general, off-task behavior is not distracting to others and interviews revealed that teachers are in fact aware of off-task behavior even if the researcher didn’t observe it. One teacher commented during the interview that she knows students are off-task, but she also knows that they will complete the assigned task, so she doesn’t pay as much attention to it as perhaps she should. Additionally, observations did not spread across all periods of the day, so teacher reporting of off-task behavior would be more representative of an overall profile. Students are involved in both laptop and non-laptop types of off-task behavior.

Student laptop related off-task behavior was predominantly not disruptive to other students (87% from interviews and 89% in observations). Teachers also reported that students engaged in laptop related off-task behavior were quieter than non-laptop off-task students, and observations confirmed this. Students who were engaged in laptop related
### Component (dimensions) and variations

<table>
<thead>
<tr>
<th>15</th>
<th>Student off-task behavior (Activity, Individual or with peers, Discussion, Use of technology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Majority of students who are off-task are involved in non-laptop related off-task behavior. Off-task behavior is more on an individual basis and is not necessarily distracting to others (applying make-up, completing other work, drawing, listening to cds with headset/walkman, fidgeting in backpack, or not doing anything at all). Discussion is minimal.</td>
</tr>
<tr>
<td>b</td>
<td>Students who are off-task are predominantly involved in non-laptop related activities. Off-task behavior is distracting to others or involves more than one student per activity. Examples include talking, passing notes, looking at cds together, sharing food/gum. Discussion is irrelevant to content of lesson or technology.</td>
</tr>
<tr>
<td>c</td>
<td>Students who are off-task are involved in both laptop and/or non-laptop behavior. Majority of students who are off-task are doing their own thing and not distracting others. Discussion is minimal.</td>
</tr>
<tr>
<td>d</td>
<td>Students who are off-task are involved in both laptop and/or non-laptop behavior which is distracting to others. Laptop-related behaviors are relatively quiet compared to non-laptop off-task students. Laptop behavior is centered on one laptop.</td>
</tr>
<tr>
<td>e</td>
<td>Students are predominantly involved in laptop related off-task behavior but aren’t distracting other students. Off-task behavior includes changing fonts and wallpaper of laptop, listening to music, email/I-chat, Internet surfing or playing games on laptop.</td>
</tr>
<tr>
<td>f</td>
<td>Students are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17</th>
<th>Student off-task behavior (Frequency, Number of students, Computer-based or not, type, Teacher awareness/management of)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Some students are off-task for part of the class. Off-task behavior is predominantly from non-laptop students. Teacher uses verbal effort to whole group to redirect (eg “too much noise”)</td>
</tr>
<tr>
<td>b</td>
<td>Some students are off-task for a small percentage of the class, mainly during the ‘settling down’ time. Off-task behavior is both laptop and non-laptop related. Teacher monitors behavior using proximity control</td>
</tr>
<tr>
<td>c</td>
<td>Minimal off-task behavior or off-task behavior is transitional (settling in, waiting for bell,…)</td>
</tr>
</tbody>
</table>

---

Figure 11. Percentages of variations of student off-task behavior as reported in interviews and observations

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### Component (dimensions) and variations

<table>
<thead>
<tr>
<th></th>
<th>Student technology based off-task behavior (degree of disruption to others, hiding of, educational value)</th>
<th>% interviews</th>
<th>% observ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Off-task behavior is individual and not disruptive to others. Off-task behavior is relative to education such as changing font, working on another assignment, checking dropbox/grades. Student does not minimize or stop unless directed by teacher specifically.</td>
<td>13</td>
<td>33</td>
</tr>
<tr>
<td>b</td>
<td>Off-task behavior is not individual and is not disruptive to others. Off-task behavior may have educational value (learning how to use technology, relative to another assignment, ...). Students do not minimize or stop unless directed by teacher.</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>c</td>
<td>Off-task behavior is not individual but is not disruptive to others. Off-task behavior is predominantly non-educational such as looking at websites, photos, ... Windows are minimized when teacher approaches</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>d</td>
<td>Off-task behavior is individual and not disruptive to others. Off-task behavior has little educational value (changing wallpaper of desktop, looking at non-educational websites, emailing, ...) Student minimizes window when teacher approaches</td>
<td>50</td>
<td>56</td>
</tr>
<tr>
<td>e</td>
<td>Off-task behavior is not individual and is disruptive to others. Off-task behavior is non-educational (email, web surfing, ...).</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>

Figure 12. Percentages of variations of student technology-based off-task behavior as reported in interviews and observations

Off-task behavior with peers rather than individually, tended to be leaning in closely to one laptop and whispering about the activity. Non-laptop off-task behavior was less physically obvious, but mostly involved talking to neighbors or even to students several seats away. It was also observed that laptop related off-task behavior tended to last longer (if not stopped by the teacher) than non-laptop off-task behavior. Technology specific off-task behavior was reported by teachers as being mostly individual (63%). Observations confirmed this (89%), with specific behavior observed being the playing of the Mario game and occasional emailing. In many observations (56%), students were observed minimizing the screen or otherwise disguising the fact that they were off-task.

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The only times when students did not hide their off-task laptop-based behavior was when it was educational but not necessarily related to the assigned work. For example, a student who was supposed to be completing an assignment on the continents was observed being fully engaged in reading a website about Egyptian mythology. Other students were observed looking at or completing assignments for other classes.

Table 8 shows the results from observations and interviews of students engaged in different categories of off-task behavior. From this table, it is apparent that the predominant off-task behavior is conversation based, which when paired with findings of laptop or non-laptop off-task behavior, would indicate that students are more engaged in non-laptop related off-task behavior. There was a large percentage (56 observed and 50 interview) of students who are using learning tools for purposes other than intended on at least an occasional frequency.

In summary, student off-task behavior during laptop-based learning experiences was both laptop and non-laptop related, however non-laptop behavior was more identifiable by noise level. Laptop related off-task behavior was predominantly playing of games or using the Internet for personal communication or interest. Students were often seen hiding or disguising off-task behavior when it is laptop based. Teachers were often aware of laptop off-task behavior, however in a majority of the scenarios, off-task behavior was not disruptive to others. Non-laptop off-task behavior was typically conversation and was more often addressed by the teacher.
Table 8. Percentage of students engaged in specific off-task behavior

<table>
<thead>
<tr>
<th>Off task behavior indicator</th>
<th>Frequent/ Many students</th>
<th>Occasional Some students</th>
<th>Minimal students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Involvement in an entirely different task to the one assigned</td>
<td>0 0</td>
<td>28 38</td>
<td>72 62</td>
</tr>
<tr>
<td>Discussing topics that are not relevant to the assigned task</td>
<td>28 25</td>
<td>50 62</td>
<td>22 13</td>
</tr>
<tr>
<td>Not completing any task at all</td>
<td>0 0</td>
<td>28 0</td>
<td>72 100</td>
</tr>
<tr>
<td>Use of learning tools for purposes other than intended or specified for the learning</td>
<td>28 25 28 25 44 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>activity (eg surfing the Internet, email, ichat)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Exploration of Relationships Between Variations in Student Off-Task Behavior and Configurations of Laptop Computer Use

Off-task behavior observed and reported in teacher interviews of this study covers a broad range. Linennbrink and Pintrich (2003) identified specific categories of student-off-task behavior: (a) involvement in an entirely different task to the one assigned, (b) discussing topics that are not relevant to the assigned task, or (c) not completing any task at all, and (d) use of learning tools for purposes other than intended or specified for the learning activity (such as surfing the Internet for movie information or using a computer to email friends during class time) all of which were observed or reported by teachers as representative of students in this study. Specific off-task behavior can also be categorized as being laptop related or non-laptop related. Laptop related off-task behavior observed and reported in teacher interviews included playing the Mario game, emailing other people, and looking at unrelated websites. Non-laptop off-task behavior was characterized by discussion or talking with occasional instances of students not doing anything at all.

Three configurations of computer use were identified in this study: The Jetsons, Star Trek, and Lost in Space. The Jetsons configuration is representative of a scenario in which use of technology is invisible and the norm rather than the exception. In this configuration teachers and students show signs of thinking with technology, and student uses of laptops for learning are varied, with assessment aligned with learning experiences. Students bring their laptops to school daily and expect to use it in class. In the Star Trek configuration, students are less conscientious about bringing laptops to school, and often times bring it to class but don’t use it. In this configuration, students use
laptops for basic functions such as word processing and a reasonable amount of Internet-based research. They do not routinely retrieve or submit assignments electronically and there is little or no homework expectation for using the laptops. The third configuration of laptop computer use identified in this study is the Lost in Space configuration. In this configuration, teachers and students are not routine users of laptops for teaching or learning. Between 10 and 20% of students bring their laptop and take it out as they ready for class. Laptops in this configuration are largely used for basic functions such as word processing and spell checking. Students may choose to use the laptops for research, however supplemental materials are available and many students choose these over the laptops.

The IC Map developed in this study was used to address question 1 about configurations of laptop use and question 2 regarding student off-task behavior. Descriptions of laptop use and off-task behavior will now be used to address research question:

3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

Table 9 shows the relationships between the configurations of use and off-task behavior by category. This table was created by isolating off-task behavior indicators and categories from the IC Map and comparing them across the configurations of use. As the table was being created, it became apparent that the relationships between off-task behavior and unique configurations of use were not exclusive, in that individual off-task behavior categories could not be related to just one of the configurations of use. In order
Table 9. Summary of relationships between categories of off-task behavior and configurations of laptop use

<table>
<thead>
<tr>
<th>Off task behavior indicator</th>
<th>Frequent/Many students</th>
<th>Occasional/Some students</th>
<th>Minimal/Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement in an entirely different task to the one assigned</td>
<td>Lost in Space</td>
<td>Star Trek</td>
<td>Star Trek</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jetsons</td>
</tr>
<tr>
<td>Discussing topics that are not relevant to the assigned task</td>
<td>Jetsons</td>
<td>Lost in Space</td>
<td>Star Trek</td>
</tr>
<tr>
<td></td>
<td>Star Trek</td>
<td>Star Trek</td>
<td>Star Trek</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jetsons</td>
</tr>
<tr>
<td>Not completing any task at all</td>
<td>Lost in Space</td>
<td>Lost in Space</td>
<td>Star Trek</td>
</tr>
<tr>
<td></td>
<td>Star Trek</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of learning tools for purposes other than intended or specified for the learning activity (e.g. surfing the Internet, email, I-chat)</td>
<td>Star Trek</td>
<td>Star Trek</td>
<td>Lost in Space</td>
</tr>
<tr>
<td></td>
<td>Jetsons</td>
<td></td>
<td>Jetsons</td>
</tr>
</tbody>
</table>
to provide the richest description of the relationships between variations of off-task behavior and configurations of use, it was deemed necessary to illustrate the entire range within and across each configuration. Similarly, exact percentages or raw scores are not included in Table 9 for three reasons: (a) This study is an exploration of the relationships between the variations of off-task behavior and the configurations of use, and is not intended for making definitive statements regarding the different configurations. Inclusion of percentages may be misinterpreted as indicating one configuration is better than another; (b) Although three configurations of laptop use were identified in this study, each configuration is not equally represented; and (c) It is important to focus on the range of off-task behavior rather than exact frequencies as the results of this study were based on a finite number of observations and interviews and may not be fully representative. This section will explore the range of off-task behavior relative to the individual configurations of laptop use by teachers and students in the middle school setting: The Jetsons, Star Trek, and Lost in Space.

The Jetsons

The Jetsons configuration is typified by all but one or two students using laptops for completing classroom assignments on a regular basis and always taking laptops out of backpacks for class readiness. The range of off-task behavior in this configuration spanned both laptop related and non-laptop related behavior and at most could be categorized as occasional under two of the off-task behavior indicator categories.

The relationship between The Jetsons configuration and the off-task behavior category of not completing any task at all was on a minimal student level. The Jetsons configuration could be described as a hive of activity with students interacting with each
other and the teacher, or appearing to be diligently working on their laptops. The relationship between The Jetsons configuration and off-task behavior category of involvement in an entirely different task to the one assigned was also on a minimal level. The primary relationship between The Jetsons configuration and the range of student off-task behavior categories was with discussing topics that are not relevant to the assigned task. This was observed and reported in interviews as occasional/some students in 100% classrooms representative of The Jetsons configuration. There was also a relationship between The Jetsons configuration and use of learning tools for purposes other than intended or specified category. This was reported and observed to be both minimal and occasional. Off-task behaviors in The Jetsons configuration were both laptop and non-laptop related.

The Jetsons configuration is representative of regular and routine use of laptop computers. Prior to class starting, students engage in both laptop and non-laptop activities and all students have laptops on desks. Laptop related off-task behavior during class is individual and not disruptive to others. Laptop off-task behavior has little educational value or is not related to the assigned task. Specifically, laptop related off-task behavior in The Jetsons configuration centers on using the laptop computers for playing games or email. The relationship between non-laptop off-task behavior and The Jetsons configuration centered on talking more than any other type of non-laptop off-task behavior. In summary, off-task behavior in The Jetsons configuration ranged from discussion of irrelevant topics to playing computer games on laptops on an occasional or minimal frequency.
Star Trek

Star Trek configuration of use could be summarized as middle level users whose use of laptops is not associated with over-enthusiasm and expectation of regular use. In this configuration, a lot but not all students bring laptops to class and most of them take the laptops out as they prepare for class; some need a little more coaxing. Laptop based learning experiences centers upon basic functions or Internet-based research. The range of off-task behavior in Star Trek configuration spans both laptop related and non-laptop related behavior and could be categorized as occasionally or frequently under three of the off-task behavior indicator categories.

The relationship between Star Trek configuration and the off-task behavior category of not completing any task at all was observed and reported on a minimal and occasional student level. The other three categories of off-task behavior were observed and reported in interviews as being relative to this configuration on an occasional, frequent, or minimal basis. The primary relationship between Star Trek configuration and the range of student off-task behavior categories was use of laptops for purposes other than intended. This was observed on a frequent and occasional basis as playing of games with less use of email. There was a relationship between patterns of use in this configuration and the off-task category of discussing topics that are not relevant to the assigned task. This was observed and reported in interviews as occurring on a frequent, occasional, and minimal basis. The final off-task behavior indicator of involvement in an entirely different task to the one assigned was observed and reported in interviews as occurring predominantly on an occasional basis with a few examples of minimal. An example of this type of off-task behavior was observed when a student was reading a fiction novel during a laptop-based
science lesson on volcanoes. Students engaged in both laptop and non-laptop off-task behavior.

Star Trek configuration describes students who use and do not use laptops for learning experiences. Off-task behavior in this configuration was not exclusive to either group or either type of off-task behavior. Laptop students and non-laptop students were engaged in both laptop and non-laptop off-task behavior. Students freely shared laptops allowing for non-laptop students to be engaged in laptop off-task behavior such as playing games. Talking tended to be more frequent with non-laptop students. Teachers used verbal efforts such as “too much talking” or “quiet down” to redirect off-task students. In summary, off-task behavior in Star Trek configuration covered a broad range. Off-task behavior centered on using learning tools for purposes other than intended. Off-task behavior such as talking was often addressed by the teacher. Students who brought their laptops shared freely with non-laptop students allowing for both groups of students to engage in laptop off-task behavior.

Lost in Space

Lost in Space configuration is characterized by minimal laptop use and small percentages of students bringing laptops to class on a regular basis. In the Lost in Space configuration, teachers do not plan extensive laptop-based lessons and the text is the primary instructional tool for lessons. The range of off-task behavior in this configuration spanned both laptop related and non-laptop related behavior and could be categorized under all four of the off-task behavior indicator categories.

All four off-task behaviors were present in the Lost in Space configuration, but never on a frequent level. Students were observed and reported in teacher interviews as being
involved in an entirely different task to the one assigned on a minimal basis. Similarly, students were observed and reported in teacher interviews as minimally discussing topics unrelated to assigned task. Students were however observed and reported in interviews as occasionally and minimally not completing any task at all. Finally, the Lost in Space configuration had a relationship with students using learning tools for purposes other than intended on only a minimal level. Students are involved in both laptop and non-laptop off-task behavior.

In the Lost in Space configuration students use laptops for basic functions such as word processing and rarely shared laptops. Off-task behavior occurred mostly as students settled into class. Laptop related off-task behavior was observed and reported as being individual and not disruptive to others. Laptop related off-task behavior is non-educational and consists of playing games or changing screen images. Non-laptop off-task behavior is individual and in groups, and ranges from talking to putting on make-up. These behaviors were observed more than laptop related off-task behavior. In summary, the Lost in Space configuration exhibits a range of student off-task behavior but at a minimal student level.

Summary

This study examined three research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?
2. What is the range of student off-task behavior during laptop computer based learning experiences?
3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

In order to address the first two questions, an Innovation Configuration was created. Three unique configurations of laptop use emerged from this study: The Jetsons, Star Trek, and Lost in Space. Each configuration can be identified by the description of laptop-based teaching and learning as well as by the degree with which access to laptops is one-to-one. A range of off-task behavior such as involvement in an entirely different activity to the one assigned, not completing any task at all, use of learning tools for purposes other than intended, and discussing topics not relevant to assigned task were identified and examined. As a population, students are involved in a range of off-task behavior both laptop related and not.

To address question 3, relationships between the configurations of use and the range of student off-task behavior were explored. The Jetsons configuration of use spanned less of the range of off-task behavior than the other configurations. The Star Trek configuration spanned the range of off-task behavior and had more students off-task more regularly than the other configurations. Although the Lost in Space configuration extended the complete range of off-task behavior it was more on a minimal student level. In all three configurations, students were involved in laptop and non-laptop related off-task behavior, with the greatest range being in the Star Trek configuration.
CHAPTER 5

DISCUSSION

This chapter is divided into five sections: (a) summary, (b) discussion of research findings, (c) limitations of current study, (d) implications of current study, and (e) recommendations for further study.

Summary of Study

This study was guided by three research questions:

1. What are the configurations of technology use by teachers and students in a one-to-one computing environment?
2. What is the range of student off-task behavior during laptop computer based learning experiences?
3. What is the relationship between variations in student off-task behavior and configurations of laptop computer use in the middle school setting?

Existing literature on one-to-one computing access in the K-12 setting is predominantly anecdotal in nature and focuses on constructivist pedagogies and specific student uses of laptop computers. Other studies focus on the impact of technology on outcomes such as achievement and student attitude toward learning. Hall and George (2000) suggested that too often educational research is focused on outcomes with little attention given to
exactly how innovations are being implemented in classrooms. Rather than addressing impact of one-to-one access to computing in the middle school, the current study sought to provide rich descriptions of all the ways laptop computers are being used in the middle school setting. Additionally, this study sought to explore student off-task behavior and whether relationships existed between the configurations of use and the student off-task behavior.

Students and teachers in 7th grade at a school in a large southwestern school district were selected as participants for this study. Participation in the study was voluntary. The 7th grade students and teachers at the middle school were given individual access to laptop computers as part of a GEAR UP grant. Seventh grade teachers at the school elected to be part of the program and received some training prior to the academic school year. Observations were conducted between October 2004 and April 2005.

This study employed qualitative and quantitative procedures and was conducted in phases. First, an Innovation Configuration (IC) Map was developed. ISTE NETS for teachers and students were examined and observations and interviews were analyzed to create drafts of an IC Map. One preliminary and two complete drafts were created. The final draft was field tested in classrooms and verification was sought through teacher interview. Second, the IC Map was used to collect data on all the ways laptop computers were being used by teachers and students, and the range of off-task behavior in the middle school setting. Eighteen focused observations were conducted in 10 participating classrooms and eight participating teachers were interviewed using the IC Map as the focus. Third, data collected using the IC Map was recorded and analyzed, and percentages of typical usage identified. Teacher and student profiles of use and the range
of off-task behavior were explored. Configurations of laptop use were identified by examining clusters of use across teacher and student profiles. Finally, relationships between the range of student off-task behavior and the configurations of use were explored.

Three configurations of use were identified in this study: The Jetsons, Star Trek, and Lost in Space. The Jetsons configuration is representative of digital teaching and learning in the 21st century. Students and teachers seamlessly integrate laptop computers into the lessons. Students and teachers use the laptops for a variety of educational and personal goals and a project-based approach to learning and assessment is implemented. Electronic communication and use of laptops in class is an expectation of students and teachers. In the Star Trek configuration of use, laptop computers are less invisible and a conscious effort is made to get students to be digital learners. Many but not all students bring laptops and students are often grouped based on access. Predominant uses of laptops in Star Trek configuration are basic functions such as word processing and spell checking and Internet-based research. Electronic communication between teachers and students is minimal and assessment is primarily through traditional avenues. The third configuration is the Lost in Space configuration. In this configuration, minimal student involvement with laptops is a result of minimal students bringing laptops to class. Students use laptops for word processing and occasional Internet-based research. Electronic communication is rare and assessment is traditional.

The second research question explored the range of student off-task behavior during laptop based learning experiences. Off-task behavior in this study was identified using two criteria. First, using off-task behavior indicators identified in existing literature: (a)
involvement in an entirely different task to the one assigned, (b) discussing topics that are not relevant to the assigned task, or (c) not completing any task at all (Linnenbrink and Pintrich, 2003), and (d) use of learning tools for purposes other than intended or specified for the learning activity (such as surfing the Internet for movie information or using a computer to email friends during class time). Second, off-task behavior was determined to be either laptop related or non-laptop related.

Question three sought to explore relationships between the variations in off-task behavior and the configurations of laptop use identified in questions one and two. Findings of this study indicate that for this population, relationships between configurations of use and the range of student off-task behavior exist. In The Jetsons configuration, students exhibited a limited range of off-task behavior on an occasional basis. The most frequent off-task behavior relative to The Jetsons configuration was talking and playing computer games. In Star Trek configuration off-task behavior covered a broader range and on a more frequent basis. In the Star Trek configuration, students were frequently engaged in off-task behavior categorized by using learning tools for purposes other than intended, and were occasionally involved in off-task behavior categorized as involvement in an entirely different task to the one assigned. In the Lost in Space configuration the relationship with the variations of off-task behavior covered a broad range; in fact a relationship with all categories of off-task behavior was identified, but predominantly on a minimal level.

This study was conducted within a framework of educational change, specifically the Concerns-Based Adoption Model (CBAM). Assumptions of educational change relevant to this study include the understanding that change is a complex and multi-dimensional
process; change must occur on the individual and group levels, and that in order for change initiatives to be sustained, they must be supported on all levels. The CBAM theory and methodology were chosen to guide this study because CBAM focuses on the individuals most affected by change initiatives – teachers and students.

Discussion of Research Findings

Research findings of this study will be discussed in two sections. First the configurations of laptop computer use will be discussed. This will be followed by a discussion of the range of off-task behavior and the relationship between such behavior and the configurations of use.

Research Question 1

The first research question of this study sought to understand all the ways laptop computers were being used by teachers and students in a middle school setting in which access was on a one-to-one basis. In order to adequately describe configurations of use, the IC Map was created, student and teacher profiles discussed, and then patterns or clusters of use identified. Three configurations were identified: The Jetsons, Star Trek, and Lost in Space.

The three configurations of use identified in this study are distinct from each other in not just the degree of laptop integration into teaching and learning, but also in the amount of access. Although this study was designed to explore configurations of use in a one-to-one computing environment, the reality was that even though students had opportunity for one-to-one access, they did not always take advantage of it. What occurred in this school was a scenario that should have followed Microsoft and Toshiba’s Anytime
Anywhere Learning’s (AAL) concentrated model, in which access to laptops reflected ownership, but was more of a mixed implementation model of concentrated and dispersed implementations (Rockman et al., 1997). All 7th grade students in this study were offered a laptop computer by the school. Data provided by the school administration indicates that in the 2004-2005 school year, the school has had a total 7th grade student population of over 700, however only 500 at one time. Of the 500 students, approximately 80% had laptops assigned to them. The primary reason students did not receive a laptop was because parents did not want to or had not given consent. Necessary repairs were another factor contributing to students not having one-to-one access as intended. This included all of the laptops being returned to Apple for a recall, and between 30-40 student laptops being repaired by the site computing strategist at any one time. Additionally, pure student access was impacted by the fact that some students simply chose to not bring their laptop to school: “These kids are simply too cool to carry a backpack so they just don’t bring their laptops to school” (school administrator, personal communication, January 20, 2005). Lack of pure one-to-one access was a critical factor in determining configurations of use because it impacted student grouping, relevance of completing Internet-based assignments, using the laptops for submitting and retrieving assignment, communicating with the teacher, and using laptops for homework. In many ways, one might consider degree of pure on-to-one access the dictator of pedagogy in this laptop initiative.

The Jetsons configuration was representative of a concentrated model of implementation in which all but one or two students brought a laptop to class. When students did not have one-to-one access, the teacher loaned the student the teacher laptop
or had the student work at one of the classroom desktop computers. Pedagogy in this
configuration of use was most representative of a constructivist philosophy with students
being given choices on project-based learning activities, and teacher acting as facilitator.
In the Jetsons configuration, teachers rarely lectured, often gave students choices in seat
selection and completion of projects, and encouraged learning from peers. In relation to
Sandholtz, Ringstaff, and Dwyer’s (1997) instructional evolution model, The Jetsons
configuration was clearly on the invention level, in which teachers wondered how they
ever did it the old way. Teachers are already expressing concerns about how they will
teach next year when the incoming 7th graders do not have laptop access. When
considering The Jetsons configuration of use and educational change, The Jetsons is
representative of the innovators or early adopters in Rogers’ diffusion of innovation
theory: they have a willingness to take risks, they see the advantage both personally and
for the students of using laptops for teaching and learning, and the use of laptops in their
classrooms is natural perhaps indicating it is in alignment with the teacher’s educational
philosophy.

The second configuration of use identified in this study was termed Star Trek. In this
study, the Star Trek configuration represents a dispersed model of implementation, in
which student access to laptops is not on a pure one-to-one basis and classrooms have
students both with and without laptops. Teachers could be considered to be at the
adoption level of use on the instructional evolution model (Sandholtz, Ringstaff, &
Dwyer, 1997) in that they are beginning to incorporate the laptops into teaching and
learning. Many of the teachers would have been adaptors, using the technology as they
would any other tool if student access were more consistent. In the Star Trek
configuration teachers make conscious efforts to have students share laptops for completing assignments, however due to unequal access it is not a requirement that students retrieve, submit or complete homework assignments using the laptops.

In the Star Trek configuration, many teachers could be considered early adopters according to Rogers’ (2003) adopter categories in that their use of laptops for teaching and learning was inspirational and motivating to other adopters. Other teachers could be considered early majority in that they followed the early adopters but weren’t necessarily resistant to using the laptops. The teachers who were early adopters would possibly have been innovators given more consistent student access. Consistent with educational change theory, Star Trek was the most prominent configuration of use, confirming both Rogers’ diffusion of innovation theory and educational change theory assumptions that change is slow, a process, and innovation adoption may stay in the initiation phase for an extended period of time (Fullan, 2001; Hall & Hord, 2001; Rogers, 2003).

The third configuration of use identified in this study was Lost in Space. This term was chosen for several reasons. On the continuum of innovation adoption and the instructional evolution model, Lost in Space configuration teachers are stuck in traditional pedagogies and are attempting to make the innovation fit into their existing teaching patterns. This configuration was most affected by student access, in fact it is almost inappropriate to consider Lost in Space as part of a one-to-one computing initiative, however, as Hall and Loucks (1977) suggested, it is critical to examine all configurations of innovation adoption.
Configurations of use and the ISTE NETS.

Configurations of technology use in this study can be examined in relation to the ISTE NETS for students and teachers. NETS for students and teachers are divided into categories. NETS for students are: (a) basic operations and concepts, (b) social, ethical, and human issues, (c) technology productivity tools, (d) technology communication tools, (e) technology research tools, and (f) technology problem-solving and decision-making tools (ISTE, 2000). All three configurations of use met standard (a) basic operations and concepts. Students in all configurations demonstrated an understanding of technology for both personal and educational purposes and proficiency in technology use. Student standard (b) social, ethical, and human issues was more evident in The Jetsons configuration than the other configurations, primarily because this standard addresses student attitude toward technology use. The Jetsons configuration also satisfied student standards (c) technology productivity tools, (d) technology communication tools, and (f) technology problem-solving and decision-making tools (ISTE, 2000) on a consistent level. The Star Trek and Lost in Space configurations rarely met these standards. Similarly student standard (e) technology research tools, was partially met by in the Star Trek and Lost in Space configurations, but more extensively in The Jetsons configuration. In The Jetsons configuration, students were given opportunities to make choices regarding the most appropriate tools for collecting and reporting data, whereas in the Star Trek configuration students had access but limited choices. In the Lost in Space configuration students were inconsistent in their use of technology for research, often electing to use more traditional resources. In summary, ISTE NETS for students can be met in a meaningful and natural way when student access is one-to-one and teachers are
promoting constructivist pedagogies. Less access appears to equate to less consistent meeting of technology standards for students, however for teachers, student access is less of a factor in meeting several of the ISTE NETS.

NETS for teachers are also categorized: a) technology operations and concepts, (b) planning and designing learning environments and experiences, (c) teaching, learning, and the curriculum, (d) assessment and evaluation, (e) productivity and professional practice, and (f) social, ethical, legal, and human issues (ISTE, 2000). All three configurations were observed to meet the first standard, technology operations and concepts. Teachers demonstrated proficiency in technology operations, although not all teachers consistently demonstrated growth in this area. One teacher shared informally that she was pursuing greater knowledge in technology operations because even if the students weren’t using laptops as much as she wanted, she was excited at the opportunity to learn more for herself. Other teachers showed less enthusiasm for pursuing enhanced knowledge of computer applications and integration.

Teacher technology standard (b) planning and designing learning environments and experiences, was consistently met by all configurations but perhaps had the strongest relationship with the Star Trek configuration where teachers consistently had to consider management of student learning in a technology enhanced environment. On the surface, it would appear that all configurations also met teacher standard (c) teaching, learning, and the curriculum, but deeper consideration shows otherwise. This standard stresses student-centered approaches, the use of technology to develop higher-order thinking skills, and facilitating of student learning. Under this description of the standard, it was most consistently met in The Jetson configuration. This pattern is replicated in an examination
of teacher standard (d) assessment and evaluation. All configurations represented the use of technology to collect and analyze data in the form of using the school district grading software, however only The Jetsons configurations met the other two criteria of this standard; technology for assessment of student learning, and multiple methods of evaluating students' use of technology. Standard (e) productivity and professional practice would also appear to be met by all configurations, however closer examination of criteria for meeting this standard indicates that it is barely being met by any of them. This standard has four criteria: using technology for professional development, evaluating and reflecting on professional practice regarding the use of technology, applying technology to increase productivity, and using technology to communicate with peers, student, and the community to nurture student learning. In none of the configurations was technology used for professional development or for reflecting on professional practice; all configurations to some degree involved the use of the laptops to increase productivity; and only The Jetsons configuration met the criteria regarding communication.

The final teacher standard, (f) social, ethical, legal, and human issues was partially met within the different configurations. The one-to-one initiative at this school was in many ways implemented to address several criteria of this standard: to empower learners from diverse backgrounds, to promote safe and healthy uses of technology, and to facilitate equitable access, although they were met in different degrees and in different ways by the configurations. The other criteria for this standard, modeling of appropriate uses of technology was evident in all configurations, however more in The Jetsons and Star Trek configurations. In summary, relationships between NETS for teachers and the
configurations of use were only to a certain degree dependent on students having pure one-to-one access to laptop computers: The Jetsons configuration demonstrated more comprehensive meeting of technology standards for teachers than Star Trek or Lost in Space configurations, but what is interesting is that the Star Trek configuration in many cases forced teachers to meet standard criteria such as ensuring equitable access and planning for management of technology during learning experiences.

Advocates of more student computing access (CEO Forum, ISTE, Partnership for 21st Century Skills) consider consistent and meaningful computing access to be crucial for future success in society. The introduction of the ISTE NETS for teachers and students was one way educational organizations attempted to better prepare students for their future. Relating the identified configurations of laptop use to national standards and finding that the configuration most representative of best practice (The Jetsons) also met the most student and teacher standards for technology use could be used to support the push for greater access to technology in the K-12 learning environment.

*Configurations of use, existing research, and educational change.*

Educational change theory, and in particular the CBAM assumes that individuals within the system must change alongside the changing system (Fullan, 2001; Hall & Hord, 2001; Rogers, 2003). This is especially true with the Lost in Space configuration. If we were to consider the Lost in Space configuration as a system itself, we will not see any movement toward a more consistent one-to-one environment unless the students change and start to consistently bring and use their laptops for learning. If we consider the Lost in Space configuration as part of the larger school system, we will not see
sustained change at the school level until this configuration changes and/or no longer exists.

The configurations of use identified in this study support and unfortunately confirm existing research. Becker (2001) suggested that in at-risk populations the use of technology is predominantly in word processing or drill and practice applications. Although no drill and practice applications were observed, perhaps because it is a middle school, the predominant use of laptops at this school across two of the configurations (Star Trek and Lost in Space) was for word processing. In confirmation of Rockman et al’s (1997; 1998) findings, a concentrated model of implementation is the most effective. It was evident from the configurations of use identified in this study, that the concentrated model represented by The Jetsons, embodied pedagogy considered to be best practice for technology integration at the K-12 level: Constructivist practices such as higher-level questioning, facilitative teacher role, alternative assessments that more appropriately align with learning experiences, and project-based learning were consistently reported as integral to The Jetsons configuration.

The identification of three configurations of use in this study confirms Hall and Louck’s (1977) justification for including the Innovation Configuration construct in the CBAM change model. The distinct features of The Jetsons, Star Trek, and Lost in Space configurations indicate that the one-to-one laptop initiative at the selected school has been implemented in a variety of ways. “The idea that an innovation might be altered during implementation would seem to be common sense” (Hall & George, 2000, p.2) was a concept embraced by innovation adopters at this school. Consistent with the IC construct being analogous to a road map in which some configurations may better fit a
particular setting (Hall & George, 2000), the configurations of laptop use identified in this study centered around the setting, yet still provide a description of all the ways the laptop computers are being made operational.

Research Questions 2 and 3

When considering a discussion of the range of student off-task behavior in this study, it is difficult to separate the behavior from the context. Research question 2 sought to describe the range of student off-task behavior during laptop-based learning experiences in a one-to-one computing environment, whereas research question 3 sought to explore this range in light of different contexts, specifically configurations of laptop use in the middle school setting. Data collected using the IC Map were used to address these questions. IC Map components of off-task behavior were based on preliminary observations and existing literature definitions of off-task behavior, in particular criteria identified by Linnenbrink and Pintrich (2003): (a) involvement in an entirely different task to the one assigned, (b) discussing topics that are not relevant to the assigned task, or (c) not completing any task at all, and (d) use of learning tools for purposes other than intended or specified for the learning activity. Additionally, off-task behavior was categorized to be either laptop or non-laptop related with the goal of providing a richer description of the off-task behaviors.

Increase in student engagement is often reported as a benefit of providing students with one-to-one computing access. What is traditionally missing from the literature touting this benefit is a description of what student engagement with technology looks like in the classroom setting. Using the definition of student engagement by Slavin (1997), in which students are considered engaged if they are cognitively and physically...
engaged with the assigned task, one could prematurely assume that this study supports the notion that increased access to technology leads to increased student engagement; the students were focusing on the technology, discussing the technology, and using the technology during learning experiences. What this study does however is look more closely at indicators of student engagement by specifically focusing on off-task behavior. It was observed and reported in this study, that students are meeting the above assumed criteria for engagement: They are very focused on the technology, they use it throughout the learning experiences and they are discussing technology use. However, and in support of Goffman's (1967) proposal regarding apparent engagement, the findings of this study indicate that many of these behaviors may appear to be representative of student engagement, but in fact represent a range of student off-task behavior.

Results of this study indicate that during laptop-based learning experiences a range of student off-task behavior exists. Question 2 sought to describe this range. Students in this study were most frequently observed and reported by teachers as using the laptops for purposes other than intended and discussing topics unrelated to lesson content. Claiming students are off-task while engaged in laptop-based learning experiences is not to say that all students are not engaged, however the range of off-task behavior identified in this study, and in particular the extent of technology based off-task behavior is contradictory to popular opinion and studies expressing increased access leading to increased engagement. This can be seen in a comparison of the relationships between off-task behavior and configurations of laptop use within the context of this study.

When considering the relationship between pedagogy and student engagement, this study is consistent with many others: Learning environments in which students are
assigned large amounts of seatwork on topics they consider uninteresting or irrelevant is not conducive to high proportions of student engagement, particularly with lower achieving students (Becker, 2001; Doyle, 1986; Jones, 1996). In relation to technology, Sandholtz, Ringstaff, and Dwyer (1994) concluded that uses of technology have a positive impact on student engagement but only under certain conditions, and not those in which the use of technology is on a lower cognitive level. The findings of this study, in which the Lost in Space configuration, whose primary use of laptops was for word processing, spanned the range of off-task behavior is an example of this scenario. The relationships with the range of off-task behavior and the Lost in Space configuration were not necessarily stronger than those with The Jetsons or Star Trek configurations, but the range of off-task behavior was more extensive. Off-task behavior in the Lost in Space configuration was less technology-based which may contribute to the fact that teachers recognized and addressed the off-task behavior more consistently. Consistent with educational change theory, change in practice often precedes change in beliefs, so teachers may not yet be at a stage of change in which they are ready to acknowledge or feel the need to address technology-based off-task behavior.

The relationship between off-task behavior and The Jetsons configuration can be discussed in light of existing literature on student engagement as well. The Jetsons configuration of use should support Sandholtz, Ringstaff and Dwyer’s (1994) proposal that in classrooms where the integration of technology is authentic and integral to meeting student needs and learning goals, the impact of technology on engagement is most positive. What is interesting about the relationship between the findings of the current study and Sandholtz, Ringstaff, and Dwyer’s proposal is that the Jetsons

140

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configuration had a range of off-task behavior on a relatively occasional level. Initially this would seem contradictory to Sandholtz, Ringstaff, and Dwyer’s findings, yet is perhaps best addressed by quoting a teacher: “Off-task behavior isn’t as bad in this class because these students all do their homework and I know they will finish the project”.

This comment was offered during an informal interview immediately following a lesson in which students were working on a project that spanned several weeks. In using the word bad, the teacher clarified she was implying not having as bad an impact. This finding also supports Baker et al.’s (2004) proposal that different types of off-task behavior have different impacts on student achievement.

In The Jetsons configuration, off-task behavior was predominantly playing the Mario game on an individual level or discussing topics not related to the assigned task, which is not unlike off-task behavior in Star Trek and Lost in Space configurations. What is important about the findings of this study in relation to Baker et al.’s finding is that in the current study, the configurations of laptop use were to some extent based on learning context, thus perhaps indicating that the impact of off-task behavior on student achievement is varied, but at the same time dependent on desired learning outcomes: In configurations such as Star Trek where students were completing Internet-based research and were required to submit their assignment at the conclusion of the class period, playing the Mario game has more of an impact than it does in The Jetsons configuration in which students are working on a long-term project.

The relationship between the Star Trek configuration and student off-task behavior is perhaps the most complex result of this study to discuss. Off-task behavior in the Star Trek configuration spanned laptop and non-laptop related behavior. In many ways this
could be expected considering the Star Trek configuration represents a dispersed model of implementation. The Star Trek configuration of use was reported as having the most frequent occurrence of both the off-task behaviors of talking a lot and using laptops for purposes other than intended. In the Star Trek configuration observations included extensive playing of games and a lot of off-topic discussion.

Like the Lost in Space configuration in which teachers addressed the off-task behavior of talking using traditional management techniques such as verbal redirection or proximity control, it was perhaps more difficult in the Star Trek configuration for teachers to at the same time acknowledge and address the inappropriate use of laptops. An example of this could be seen in which a student appeared to be diligently working away at his laptop-based assignment and was not disturbing anyone or talking to other students. The teacher was busy addressing other classroom management issues such as too much talking and students not doing anything at all, and was probably relieved that this student was engaged in his laptop-based assignment. In reality, this student remained off-task by being fully engaged in a non-educational website to the extent that he did not complete the assigned word processing task. This observation supports studies suggesting student engagement is relative to the degree of cognitive skill required to complete the assigned task and to Goffman’s (1967) proposal that students may appear to be fully engaged but are not. In addition, this example can be used to confirm Sandholtz, Ringstaff, and Dwyer’s (1997) ACOT problem that led to the development of the instructional evolution model: Although the landscape and expectations changed dramatically with the introduction of ACOT equipment, change in factors such as roles and relationships of teachers and students was much slower and less obvious.
In summary, the identification of the range of student off-task behavior and the existence of relationships with configurations of laptop use identified in this study at best should be considered controversial. In the Lost in Space configuration of use, the range of student off-task behavior was extensive but on a minimal level, and often was immediately addressed through classroom management strategies. If one considers the definition of student engagement to be the level of cognitive and physical engagement, to the untrained eye the results of this study could be interpreted as supporting the notion that increased technology access results in increased student engagement: The degree of off-task behavior appeared to be consistent with the degree of computing access. However, when one considers student engagement to be relative to the assigned task, this study contradicts the notion that increased access to technology leads to increased student engagement: In The Jetsons and Star Trek configurations, students were both cognitively and physically engaged – in activities unrelated to the assigned task.

If one were to consider the three configurations of use identified in this study to represent different levels of computing access, the results of this study can not be considered to support the view that increased access leads to increased student engagement. The relationship between off-task behavior and the Lost in Space configuration was broad but not necessarily deep and off-task behavior was fairly representative of normal off-task behavior. To compare this relationship to that between the range of off-task behavior and The Jetsons configuration, one may assume that the increased access led to increased engagement because The Jetsons configuration off-task behavior was a narrower range. Figure 13 illustrates the relationships between the degree of off-task behavior and the degree of student access to laptop computers.
When the relationships between off-task behavior and Lost in Space and The Jetsons configurations are compared to the Star Trek configuration, it appears that increased access does not necessarily equate to increased engagement: Access in Star Trek was definitely greater than in the Lost in Space configuration and access in The Jetsons was considerably more than in Star Trek, yet the degree of off-task behavior was greater in Star Trek than the other two configurations.

Additionally, we could consider the Lost in Space configuration in which students had equal opportunity to one-to-one access as all other 7th graders at the school, but chose to not bring them or use them for learning experiences, to not be decreasing the digital divide but perpetuating it. A dangerous cycle can be extracted from the Lost in Space configuration: Teachers did not plan or implement as many laptop-based lessons because students did not bring or chose to use their laptops, and students did not bring their laptops because teachers did not always require their use.
The results of the current study do not support the notion that increased access to technology leads to increased engagement in the K-12 setting. In fact, the results of this study contradict this suggestion. Students in The Jetsons configuration in which access was as close to pure one-to-one as possible exhibited a range of off-task behavior that although not as extensive or frequent as configurations with less proportionate computing access still cannot be interpreted as increased engagement. It was only through examination of specific configurations of use and the range of off-task behavior that this study could be considered contradictory to existing research. If the current study had focused solely on configurations of use, it would indeed have added to the existing literature because students at the selected middle school are using laptop computers for a variety of purposes, both educational and personal, and for all intensive purposes appear to be highly engaged and motivated to learn with their laptops. Focusing observations on students and teachers following CBAM methodology allowed this study to closely examine and identify specific uses of the laptop computers that led to the discovery of the range of student off-task behavior. We can definitely say that oftentimes access to technology increases motivation to use the technology, however results of this study could be interpreted to say that use of technology does not equate to uses for academic purposes.

Limitations of Current Study

All studies have limitations, and this study is no exception. Limitations of this study can be discussed in sections: development of IC Map, participants and setting, research findings, and researcher bias.
Development of IC Map

The development of the IC Map for this study was a complex process and chapter four addressed some of the challenges. The development of the IC Map for this study was impacted by several factors including school district testing policy, teacher frustration with student apathy about laptop computers, and scheduling conflicts. Although over 30 observations (descriptive and focused) contributed to the development of the IC Map for this study, these observations did not span the range of teachers in the 7th grade at the select school, and some of the classrooms observed for development of the IC Map were not the same classes that were observed during the data collection phase. Consequently, the IC Map developed in this study may not be as representative of all configurations of laptop use.

Second, although the researcher was fortunate to have access to one of the developers of the CBAM, this was the researcher's first attempt at developing an IC Map. The IC Map resulting from this study is a work in progress and if used in alternate settings may need to be modified.

Participants and Setting

There are many limitations of this study centering on participants and setting. First, the setting of this study is unique in that this study was conducted at a middle school in an extremely large school district, but more importantly, the selected school site was included in a GEAR UP grant initiative to prepare students from low-income families for college. The setting of this study could be described by change theorists, and in particular the CBAM theory to be in many ways a worst-case scenario. Hall and Hord (2001) suggest that for change initiatives to be sustained, a proportionate amount of resources
needs to be invested in both development and implementation of innovation adoption.

This was not the case at the selected school.

The setting of this study provided increased access to technology and endless amounts of initial support, however there was minimal consideration given to implementation in the form of on-going teacher training, incentives for students to bring and use laptops, or consequences for not doing so, and the support system for repairing of broken laptops during implementation was limited to external sources or the one computing strategist, whose role changed from strategist to repairperson with the adoption of this innovation.

Second, the student population at this school was unique in that students in the seventh grade were perhaps not as motivated about school in general as other 7th grade students may be. The administrator's comment about students being too cool to bring laptops to school was verbalized by numerous teachers, both participants and not: They didn't bother to plan innovative lessons because students simply didn't care. The general consensus of many teachers was that the students strived to work at menial employment because even that was a step up from their parents' employment status.

Third, as was discussed in the configurations of use, although this study should have been conducted in a one-to-one environment, the reality was that it was not. In only a limited number of classrooms was student access to technology on a pure one-to-one basis.

Fourth, participation in this study was on a voluntary basis and there were several teachers at the grade level whom, although using computers for teaching and learning on various levels, did not consent to participate. A total of 10 teachers participated in
focused observations and eight in focused interviews, however a total of 17 teachers
teach the core subjects at the grade level. Only two math teachers consented to
participate, one during descriptive observations and a different one for a focused
observation. The math teacher who did consent to participate and was observed during
the preliminary observation period did not agree to be observed for focused observations.
It should be noted that several math teachers replied when asked to be participants, that
they do not use the laptops. Other content area teachers offered similar justifications for
not having observations conducted in their classroom. Teacher non-use of laptops was
confirmed by students who said they do not use laptops with particular teachers.

Research Findings

Research findings of this study are limited by several factors already discussed as
limitations. The number of participants in this study was not extensive and as a result
findings may not be transferable to larger populations. Additionally research findings of
this study may not extend to other populations as they were based on an IC Map
developed from the same population. Research findings of this study may be interpreted
as contradictory to existing research and require additional study. Additionally,
implementation of this innovation at the school being studied is in its first complete year
and findings could change with a different student population or as the laptops become
more of a natural consideration for students and teachers. Finally, research findings of
this study are exploratory and are not necessarily conclusive, which should be considered
when contemplating these results and findings.
Researcher Bias

It is extremely difficult to remove the teacher from the person. The researcher conducting this study is an experienced and licensed teacher and a doctoral student in curriculum and instruction with an emphasis on educational technology. The researcher pursued a degree in educational technology, and in particular this study, because effective technology integration is an area in which she is passionate about. Although all observations were descriptive, interactions with teachers both informally and during focused interviews may have impacted the interpretation of them. Additionally, because the researcher was not affiliated with the school prior to commencement of the study, and was introduced by higher-level administrators from the school district, teachers may have initially viewed the researcher as an outsider. It should be noted however that as this study developed over the course of the year, the researcher began to be greeted as a change facilitator and was invited by school personnel to contribute to decisions regarding the laptop initiative being studied.

Implications of Current Study

This study had three purposes: First, this study sought to describe configurations of laptop computer use in the middle school setting. Second, this study sought to describe student off-task behavior during laptop computer based-learning experiences. Third, this study sought to explore the relationship between student off-task behavior and configurations of laptop computer use. The findings of this study have implications within and beyond the school setting in which the study was conducted.
Implications of this study within the context of the school setting have already been considered by school personnel. Findings of configurations of use have already contributed to decisions regarding continuation of the laptop initiative. Additionally, results of this study will contribute to future professional development topics at the request of the school administration.

On a broader scale, implications of this study will extend beyond the immediate school setting and will contribute to the existing literature on on-to-one computing access in the K-12 setting. More specifically, because this study sought to describe configurations of use rather than make judgments about the impact of one-to-one access, it may be incentive to other researchers and change facilitators to consider configurations of use prior to making decisions about impact.

Perhaps the biggest implication of this study lies in its findings. This study did not glorify the use of laptop computers for teaching and learning but simply reported on configurations of use. The results of this study support many existing studies in its findings that innovation adoption is a slow process and has many different forms, however the results of this study regarding student off-task behavior may be interpreted as being contradictory to existing beliefs on the relationships between computer access and student motivation and engagement. Unlike previous studies, this study explored specific indicators of student behavior rather than more common methodology of interval scanning for general indicators of on-task behavior, the implications of which may extend into other areas of educational research.

Many things were learned from this study that can be used by others as they consider implementing a one-to-one computing initiative. First, it is important to know the student
population and consider learning goals, needs, and school and home environment when implementing an initiative that extends beyond the school walls. With nothing but the best intentions, the one-to-one computing initiative at this school was implemented to broaden the horizons of the students and to strengthen the goals of the GEAR UP grant. Unfortunately, many of the students at the school although aspiring to have better careers than their parents, sought to pursue careers in landscaping, hairdressing, and working in clothing stores; careers at which the students did not consider they would need computer skills and which made the standard 7th grade curriculum irrelevant and uninteresting. Additionally, as was witnessed particularly in the Star Trek and Lost in Space configurations, using laptops for homework was not an expectation because students did not have Internet access at the home, and/or did not consider homework as an enhancement to the learning experience. Informal conversations with teachers at this school shared that often the homework expectation was in fact to make sure the students had written the learning objectives for the daily lesson in their planner, and no assignment was actually completed as homework. Factors such as this may impact the sustainability of a one-to-one computing initiative and should be considered during the planning stages.

Second, the fact that this school site, which should have been as close to pure one-to-one laptop access was more of a mixed model of implementation (Rockman et al., 1997) needs to be considered when planning a one-to-one computing initiative. The distinct configurations of use identified in this study were for a large part based on the degree of one-to-one access, in that pedagogy and management decisions were grounded in how many students actually had access to a laptop. As was evidenced in Star Trek and Lost in
Space configurations there was a dangerous circle of teachers not planning laptop-based lessons because students didn’t have access, and students not considering laptops for learning because they only used them on a minimal level. In order for the laptop initiative at this school site to move forward and The Jetsons configuration to be more prevalent, a plan for motivating or providing incentive for students to choose laptops for learning and perhaps having consequences for not bringing laptops to class may need to be implemented. Others considering a one-to-one initiative will hopefully address this in the planning phase.

Third, professional development is a crucial consideration for implementing change initiatives in the school setting and in particular for those considering a one-to-one computing initiative. Teachers at this school had access to extensive professional development at the commencement of the laptop initiative, however the content of the trainings was more on how to use the computers than how to use them for teaching and learning. Similarly, opportunities for continued training were impacted by budgetary concerns. Effective professional development that was ongoing, relevant and met the needs of the participants (Birman, Desimone, Porter, & Garet; 2000) could have impacted a change toward greater prevalence of The Jetsons configurations at this school. Relying on teachers to find time to seek their own professional development was not sufficient for sustaining the change efforts of this laptop initiative.
Recommendations for Further Study

This study was exploratory and findings of this study may not be considered conclusive. The results of this study indicate that further research in this area is needed to confirm and extend the findings of this study.

An area for further study in this area includes replicating the methodology of this study with a larger participant base and in a more pure one-to-one environment. This study found that students are engaged with technology but not necessarily for educational purposes. Studies of educational technology in the K-12 setting focus predominantly on impact or use of specific applications, and few studies exist that look closely at specific student behaviors during technology-based lessons. There exists a need to focus specifically on what individual students are doing with the technology during technology-based learning experiences.

The results of this study were impacted by the lack of pure student one-to-one access to laptops. Possible reasons for this lack of pure access included that parents did not give consent for students to have a laptop computer and students lacking motivation to not only bring laptops to school, but to choose them as a tool for learning. An area related to one-to-one computing access in the K-12 setting that is largely unexplored is an examination of why students are not motivated to even bring the laptops to class. No studies included in the review of literature for the current study discussed issues of student motivation to bring laptops to class. One cannot imagine that it is novel to only this study therefore student motivation to choose laptops for learning is indeed an area for further research. Replicating this study with student populations at different levels may
provide insight into more specific motivational features of technology for teaching and learning and/or whether the motivation is simply an age-related issue.

This study identified three distinct configurations of laptop computer use in the middle school setting. Each configuration described student and teacher behaviors as well as overall classroom climate. What is interesting about the results of this study that could be an area for further research on patterns of use of laptop computer for teaching and learning is that it is impossible to extract a particular teacher or group of students from a configuration. If forced to identify teachers as belonging exclusively to a particular configuration, it would be impossible. Further research to examine the impact of different student populations and changing classroom dynamics on the patterns of technology use by one teacher could extend the findings of this study and add to the literature on one-to-one computing.

As technology access in classrooms is increased, there is a need to continue to document its use, prior to or integral to examining its impact. The tool for documenting the use of laptop computers developed in this study is a start, however more tools need to be developed and implemented in educational technology research.

Additionally, continued research examining the relationship between student computing access ratios and the ISTE NETS for students and teachers is needed. The results of this study found a positive relationship between increased access and meeting technology standards, however more extensive research in this area, particularly in the light of NCLB is needed.

This study found that a relationship between degree of computing access and degree of off-task behavior existed. It was only by looking for specific criteria of off-task
behavior using the IC Map, that this relationship was identified. Existing studies of student engagement in classrooms tend to focus on management and pedagogical strategies for enhancing or promoting student engagement, and studies describing specific student behaviors are limited. Conducting studies of student off-task behavior focusing on specific and identifiable criteria using alternate quantitative and qualitative methodologies could extend the research findings of this study and add to the literature on both the impact of technology on student engagement and student engagement in general. As greater technology access and use are promoted, it will be crucial for educational researchers of student engagement and classroom management to include consideration of technology in their future studies.
APPENDIX A

INFORMED CONSENT FORM
TEACHERS AND STAFF

We are interested in learning more about the effectiveness of providing students and teachers with laptop computers, and I would like to invite you to participate in a research study. The purpose of this study is to examine the effectiveness of the laptop program at your school, Roy Martin Middle School. Your personal effectiveness is not the goal of the research, but rather to see how access to laptop computers changes both the students’ and your beliefs and practices. You are being asked to participate in the study because you are directly involved with the laptops, and your input will be valuable for the purpose of the study. If you agree to participate in this study:

☐ You may be asked to allow one of the researchers to observe (not evaluate) the way you and your students are using the laptops in the educational setting.

☐ You may also be asked to be part of a group of fellow teachers from your school to participate in ongoing discussions (<10) about your involvement in the laptop program.

There may be no direct benefits to you as a participant in this study, however, we hope to learn from your experiences so we can contribute to decisions about the best way to continue with the laptops at both your school and district wide. There are risks involved in all research studies. This study may include only minimal risks. You may be uncomfortable being observed by the researcher. If you are part of the small discussion group, you will be asked to meet during lunchtime. You will not be compensated for your time.

Confidentiality: All of the information collected will be kept strictly confidential. Information and quotations may be reported in professional journals and/or at professional meeting; however, the information will be presented in such a way that individuals cannot be identified. All data collected will be stored in locked files at an undisclosed location at UNLV for at least three years after completion of the study. At the end of the three-year period, all data will be destroyed.

Consent: Your participation in this research is strictly voluntary. Non-participation will not result in any penalty or loss of benefits to which you are otherwise entitled. Every attempt to minimize your identity will be made and no identifying information will be recorded in the data. Your signature certifies that you have read the information presented. You may ask any questions concerning the research before agreeing to participate or during the study. You also may withdraw from the project at any time without penalty if you do not wish to complete the interview process. If you have questions about your rights as a research participant that have not been addressed by the investigator, you may contact the UNLV Office for the Protection of Research Subjects, telephone (702) 895-2794. If you have any questions or concerns about the study, you may contact the research team at any time.

Signature of Research participant ____________________________
Name (please print) ____________________________ Date ____________________________

Thank you for your assistance and time.

Donovan@unlv.nevada.edu                      khartley@unlv.nevada.edu
APPENDIX B
PRELIMINARY DRAFT OF IC MAP

Teacher/subject  class period  date

<table>
<thead>
<tr>
<th>Cluster and components</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers</strong></td>
<td></td>
</tr>
<tr>
<td>1. Teacher has:</td>
<td></td>
</tr>
<tr>
<td>a. Awareness of NETS and consideration of NETS when planning student learning experiences</td>
<td></td>
</tr>
<tr>
<td>b. Awareness and consideration of NETS in planning some of the time</td>
<td></td>
</tr>
<tr>
<td>c. Awareness of NETS</td>
<td></td>
</tr>
<tr>
<td>d. No awareness of NETS</td>
<td></td>
</tr>
<tr>
<td>2. Teacher pursues opportunities to stay abreast of current and emerging technologies</td>
<td></td>
</tr>
<tr>
<td>a. Pursuing higher ed. and/or spending personal time exploring and seeking current information</td>
<td></td>
</tr>
<tr>
<td>b. Pursuing higher ed credential</td>
<td></td>
</tr>
<tr>
<td>c. Explore and pursue current info on own time (out of interest)</td>
<td></td>
</tr>
<tr>
<td>d. Attend staff development willingly and make a concerted effort to use what was learned</td>
<td></td>
</tr>
<tr>
<td>e. Attend staff development only because it is required</td>
<td></td>
</tr>
<tr>
<td>3. Teacher designs developmentally appropriate learning opportunities that integrate technology</td>
<td></td>
</tr>
<tr>
<td>a. As often as possible (&gt; 3X per week)</td>
<td></td>
</tr>
<tr>
<td>b. As often as possible but dependent on content</td>
<td></td>
</tr>
<tr>
<td>c. Inconsistently (btw 1-3 times a week) depending on content</td>
<td></td>
</tr>
<tr>
<td>d. Inconsistently and usually if others have recommended lessons</td>
<td></td>
</tr>
<tr>
<td>4. Teachers include consideration of management of resources and student learning with technology</td>
<td></td>
</tr>
<tr>
<td>a. All the time, included in plan book and apparent in observation</td>
<td></td>
</tr>
<tr>
<td>b. All the time, but mentally. Apparent in</td>
<td></td>
</tr>
</tbody>
</table>
observation  
c. Some of the time but not consistently  
d. Only as the situation/need arises  
e. Not at all  

5. Teacher assesses student learning using technology  
   a. Uses multiple assessments including online quizzes, technology-based final projects as often as possible  
   b. Occasional use of online quizzes or alternative assessments using technology  
   c. Have used technology to assess student learning, but don’t use it regularly  
   d. Have never used technology for assessment  

6. Teacher applies technology to increase productivity: (gradebook, assignment dropbox, computer-based lesson plans, rubric wizards, test generators, ppt/slideshow, projection devices, dissemination of materials/assignments). Teacher uses:  
   a. All of above on a regular basis  
   b. Many of above on a regular basis  
   c. Some of above on a regular basis  
   d. Some of above on an as needed basis  
   e. Some of above but would like to learn how to use more  
   f. Only the tools required by administration  

7. Teacher uses technology for professional communication  
   a. Interact daily at the school and district level and uses electronic communication with students  
   b. Interact at school level and communicates with students as necessary  
   c. Interact at school level 3-4 days a week and rarely if at all with students  
   d. Interact at school level 1-3 times a week and not with students  

8. Teacher applies an understanding of social, ethical, and legal issues when teaching with or integrating technology into student learning experiences  
   a. Consistent reference to and implementation of resources that respect and acknowledge issues  
   b. Some/occasional references to and/or implementation  
   c. Little of no reference to issues  
   d. Little of no understanding of issues
<table>
<thead>
<tr>
<th>Laptops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Laptops are used to address content standards</td>
</tr>
<tr>
<td>a. Integrated to some degree into every learning experience</td>
</tr>
<tr>
<td>b. Integrated to some degree into many learning experiences based on teacher judgment of appropriateness</td>
</tr>
<tr>
<td>c. Integrated into learning experiences based on content</td>
</tr>
<tr>
<td>d. Laptops used for practice or reinforcement of content only</td>
</tr>
<tr>
<td>2. Learning experiences use laptops to:</td>
</tr>
<tr>
<td>a. Word processing/basic functions</td>
</tr>
<tr>
<td>b. Internet searching using a search engine</td>
</tr>
<tr>
<td>c. Internet searching -teacher directed (eg WQ)</td>
</tr>
<tr>
<td>d. Communicating with experts</td>
</tr>
<tr>
<td>e. Productivity/presentation (eg l-movie, ppt, slideshow)</td>
</tr>
<tr>
<td>f. Virtual field trips</td>
</tr>
<tr>
<td>g. Organizing information</td>
</tr>
<tr>
<td>h. Graphics</td>
</tr>
<tr>
<td>i. Collecting data/record keeping/probeware,…</td>
</tr>
<tr>
<td>j. Communicating with teacher</td>
</tr>
<tr>
<td>k. Time filler when finished with work (teacher permitted)</td>
</tr>
<tr>
<td>3. Laptop based lessons promote higher order thinking skills and creativity as evidenced by type of activity in component two:</td>
</tr>
<tr>
<td>a. All the time</td>
</tr>
<tr>
<td>b. Most of the time</td>
</tr>
<tr>
<td>c. Some of the time</td>
</tr>
<tr>
<td>d. Rarely or never</td>
</tr>
<tr>
<td>4. Laptop based lessons promote 21st century skills including problem-solving, collaboration, and communication</td>
</tr>
<tr>
<td>a. All the time</td>
</tr>
<tr>
<td>b. Most of the time</td>
</tr>
<tr>
<td>c. Some of the time</td>
</tr>
<tr>
<td>d. Rarely or never</td>
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<tr>
<td></td>
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<tr>
<td>---</td>
</tr>
<tr>
<td><strong>1. Students demonstrate proficiency in use of and understanding of technology</strong></td>
</tr>
<tr>
<td>a. 90-100% of students</td>
</tr>
<tr>
<td>b. 70-90% of students</td>
</tr>
<tr>
<td>c. approx 50% of students</td>
</tr>
<tr>
<td>d. &lt;50% of students</td>
</tr>
<tr>
<td><strong>2. Students demonstrate an understanding of social, ethical, and cultural issues of technology</strong></td>
</tr>
<tr>
<td>a. All students all the time</td>
</tr>
<tr>
<td>b. All students some of the time</td>
</tr>
<tr>
<td>c. Some students all the time</td>
</tr>
<tr>
<td>d. Some students some of the time</td>
</tr>
<tr>
<td>e. Inconsistently</td>
</tr>
<tr>
<td><strong>3. Students demonstrate responsible use of laptops</strong></td>
</tr>
<tr>
<td>a. All students all the time</td>
</tr>
<tr>
<td>b. All students some of the time</td>
</tr>
<tr>
<td>c. Some students all the time</td>
</tr>
<tr>
<td>d. Some students some of the time</td>
</tr>
<tr>
<td>e. Inconsistently</td>
</tr>
<tr>
<td><strong>4. Students use laptops for assigned task</strong></td>
</tr>
<tr>
<td>a. All students all the time</td>
</tr>
<tr>
<td>b. All students some of the time</td>
</tr>
<tr>
<td>c. Some students all the time</td>
</tr>
<tr>
<td>d. Some students some of the time</td>
</tr>
<tr>
<td>e. Inconsistently</td>
</tr>
<tr>
<td><strong>5. Students use laptop computers for purposes other than the assigned task</strong></td>
</tr>
<tr>
<td>a. All students all the time</td>
</tr>
<tr>
<td>b. All students some of the time</td>
</tr>
<tr>
<td>c. Some students all the time</td>
</tr>
<tr>
<td>d. Some students some of the time</td>
</tr>
<tr>
<td>e. Inconsistently</td>
</tr>
<tr>
<td><strong>6. Students use laptop computers for assigned task but are discussing unrelated topics</strong></td>
</tr>
<tr>
<td>a. All students all the time</td>
</tr>
<tr>
<td>b. All students some of the time</td>
</tr>
<tr>
<td>c. Some students all the time</td>
</tr>
<tr>
<td>d. Some students some of the time</td>
</tr>
<tr>
<td>e. Inconsistently</td>
</tr>
</tbody>
</table>
7. **Student demonstrate off-task behavior by involvement in an entirely different and non laptop related activity to the one assigned**
   - a. All students all the time
   - b. All students some of the time
   - c. Some students all the time
   - d. Some students some of the time
   - e. Inconsistently

8. **Students demonstrate off-task behavior by not showing engagement in any activity**
   - a. All students all the time
   - b. All students some of the time
   - c. Some students all the time
   - d. Some students some of the time
   - e. Inconsistently
APPENDIX C

COMPONENTS AND DIMENSIONS

☐ Laptop-based Lesson Format
  o Beginning
  o Middle
  o End

☐ Instructional and management strategies
  o Grouping
  o Teacher or student centered
  o Focusing attention of students
  o Classroom/desk arrangement
  o Dissemination of materials
  o Collection of materials

☐ Teacher actions
  o Movement around class
  o Discussion with students
  o Use of technology
  o Use of whiteboard
  o Use of instructional materials

☐ Teacher actions at start of lesson
  o Checking prior knowledge
  o Confirmation of understanding
  o Introduction of technology requirement and skills

☐ Student/Teacher interactions
  o Questioning
  o Answering
  o Refocusing
  o Casual conversation
  o Initiation
Student actions
- Entering classroom
- Movement around class
- Storage/retrieval of laptops
- Use of supplemental materials
- Finish of class period
- Interaction with other students

Student off-task behavior
- Frequency
- Number of students
- Computer-based or not/type

Description/type of Computer-based off task behavior
- Number of students
- Time
- Teacher awareness of

Student uses of laptops
- Basic functions (word processing, calculator)
- Communication with teacher or professionals
- Open research
- Guided research (eg webquests)
- Group assignment/presentation
- Free time
- Individual assignment/presentation
- Test or quiz
- Submitting assignment
- Retrieving assignment
- Record keeping
- Personal management/planner
- Off-task

Teacher uses of laptop computer
- Lecture/presentation
- Attendance
- Record keeping
- Monitoring student activity
- Personal email

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## APPENDIX D
### DOMAIN ANALYSES

<table>
<thead>
<tr>
<th>Included Terms</th>
<th>Semantic Relationship</th>
<th>Cover Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving around the room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helping students with laptops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting the lesson</td>
<td>Is a kind of</td>
<td>Teacher Action</td>
</tr>
<tr>
<td>Sitting at desk</td>
<td></td>
<td></td>
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<tr>
<td>Using the projector</td>
<td></td>
<td></td>
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<tr>
<td>Managing students</td>
<td></td>
<td></td>
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<tr>
<td>Taking attendance</td>
<td></td>
<td></td>
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<tr>
<td>Planning the lesson</td>
<td></td>
<td></td>
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<tr>
<td>Taking a student’s laptop</td>
<td></td>
<td></td>
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<tr>
<td>Getting situated</td>
<td></td>
<td></td>
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<tr>
<td>Opening and closing laptops</td>
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</tbody>
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<thead>
<tr>
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<th>Cover Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving around the room</td>
<td></td>
<td></td>
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<tr>
<td>Helping students with laptops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submitting assignments</td>
<td>Is a kind of</td>
<td>Student Action</td>
</tr>
<tr>
<td>Opening, saving, closing files</td>
<td></td>
<td></td>
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<tr>
<td>Working on the Internet</td>
<td></td>
<td></td>
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<tr>
<td>Answering questions</td>
<td></td>
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<tr>
<td>Completing assignments</td>
<td></td>
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<tr>
<td>Talking to peers</td>
<td></td>
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<tr>
<td>Working with laptops</td>
<td></td>
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<tr>
<td>Working out of textbooks</td>
<td></td>
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<tr>
<td>“Prime Time”</td>
<td></td>
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</tr>
<tr>
<td>Getting situated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening and closing laptops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Included Terms</td>
<td>Semantic Relationship</td>
<td>Cover Term</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Teacher questioning</td>
<td>Is a kind of</td>
<td>Student/Teacher interaction</td>
</tr>
<tr>
<td>Troubleshooting with laptops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student questioning</td>
<td></td>
<td></td>
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<tr>
<td>Sharing websites</td>
<td></td>
<td></td>
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<tr>
<td>Emailing/I-chatting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casual conversation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplining students</td>
<td></td>
<td></td>
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<tr>
<td>Reminding of copyright</td>
<td></td>
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<tr>
<td>Advising on presentations</td>
<td></td>
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<tr>
<td>Complimenting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reminding students to save work</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Included Terms</th>
<th>Semantic Relationship</th>
<th>Cover Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talking/casual conversation</td>
<td>Is a kind of</td>
<td>Student/Student interaction</td>
</tr>
<tr>
<td>Troubleshooting with laptops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working in groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emailing/I-chatting</td>
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<tr>
<td>Sharing websites</td>
<td></td>
<td></td>
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<tr>
<td>Sharing laptops</td>
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<tr>
<td>Discussing lesson content</td>
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<td>Helping each other</td>
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<th>Semantic Relationship</th>
<th>Cover Term</th>
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<tr>
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<td>Is a kind of</td>
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<td>Changing font, wallpaper,...</td>
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<tr>
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<td>Is a kind of</td>
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<td>Changing wallpaper/screensaver</td>
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<td>Opening/closing laptop</td>
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<td>Retrieving/storing laptop</td>
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<td>use a laptop</td>
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<td>Completing an assignment</td>
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<td>With a partner</td>
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<td>By oneself/individually</td>
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<tr>
<td>On a lap/knee</td>
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<td>Submitting an assignment</td>
<td>Is a reason for</td>
<td>using a laptop</td>
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<td>Making a presentation</td>
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<td>Prime Time</td>
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<td>Writing a report</td>
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<td>Retrieving an assignment</td>
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<tr>
<td>Internet surfing</td>
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<tr>
<td>Listening to music</td>
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<tr>
<td>Collaborating with others</td>
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<tr>
<td>Communicating</td>
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</tbody>
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APPENDIX E

DRAFT 1 OF IC MAP

- **Laptop-based Lesson Format (Opening, middle, closing)**

1. Students enter the room and take out laptops, open them and wait for further direction. Some students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students stop what they are doing and wait for direction for the lesson. Students are directed to assigned application and work on it as directed. At the end of the lesson, students put laptops back in backpack without being reminded and follow school routine of sitting silently at desk until dismissed by teacher.

2. Students enter the room, take their seat, and take laptops out of backpack. Laptops are opened but students are not using them, or they are on desk and closed. Students follow the direction of the teacher for opening and closing laptops at intervals throughout the lesson. When directed by teacher students put laptops back in backpacks and pack up following school routine for dismissal.

3. Students enter room and take out laptops. Some students open them and use the laptop for personal use until the bell rings and teacher starts class. Teacher asks several students where their laptops are and laptops gradually come out of backpacks. There are discussions between teacher and students about charging stations, broken laptops, reminders of forgotten laptops. Students work on laptops as directed for assignment. Students put laptops away or close them when they are finished with the activity. At the end of class, students who did not already put laptop away, unplug from charging station or close up laptops and pack up following school routine for dismissal.

4. Students enter the room and many students take out laptops and begin working on miscellaneous applications. Teacher starts class and students put laptops away/close them when asked to. Students open laptops when directed for assignment and work on laptops for duration of assignment. Teacher closes lesson and asks students to put laptops away. Several students have to be asked several times to comply. Students follow school routine for dismissal.
Student actions at start of laptop based lessons (Grouping, Classroom/desk arrangement, Dissemination of materials/assignment data)

1. Students mostly work in pairs or small groups and rearrange desks on an as needed basis. Students retrieve assignment via email, chat or school-based assignment program.
2. Students mostly work in pairs and/or small groups and rearrange desks on an as needed basis. Dissemination of materials and assignments is both electronic and manual.
3. Students work individually most of the time and assignments and materials are disseminated both electronically and manual.
4. Students work individually most of the time and assignments and materials are usually disseminated manually.

Student sharing of laptops during learning experiences.

- Control
- Position
- Decision making

1. Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.
2. Laptops are centrally positioned yet it is apparent that one student is sharing with the others. Control of laptop is generally by one person but consultation on navigation and aesthetics of content is evident.
3. Laptops are positioned in front of one individual but turned for others to see. Control is by one person, and others are observers.
4. No sharing of laptops. Students who do not have laptops use alternative learning tools.

Teacher instructional actions

- Use of technology
- Use of whiteboard
- Use of instructional materials

1. Teacher uses laptop and projector to demonstrate laptop-based activity, and leaves projector on for duration of assignment. Teacher uses whiteboard/blackboard/overhead projector for reminders, and technology for demonstration/mini-lessons. Technology is the primary instructional material for the lesson.
2. Teacher starts lesson by using laptop and projector but turns it off once students are set up. Whiteboard/blackboard/overhead projector is used for demonstration, mini-lesson, and reminders. Technology is supplemental material.
3. Teacher uses laptop and projector for starting lesson and leaves it on during lesson but does not use it for further demonstration. Intermittent instruction does not occur or teacher gives more specific directions on a one-on-one basis using student’s laptops.

4. Teacher does not use laptop and projector to start lesson because application is routine to students and/or demonstration is not necessary.

5. Teacher does not use laptop or projector to start lesson or for any part of the lesson.

☐ Student/Teacher interactions regarding technology use

- Questioning
- Answering
- Relevance
- Initiation

1. Students and teacher interact freely with questions being initiated by students and teachers. Both teacher and students answer technology questions. Content of discussion is not always relevant to assignment at hand but is how to use technology. Teacher often asks student to share the ‘tip’ with the class or teacher shares it.

2. Students usually initiate the question by asking the teacher how to do something specifically related to task at hand. Teacher either answers or asks the question of the whole class. Teacher occasionally initiates the discussion and it is usually relevant to what the teacher sees on a student’s laptop.

3. Students tend to not ask the teacher technology related questions, but ask peers for technological assistance. Teacher rarely asks student about technology use based on their work or for assistance.

4. Students tend to ask peers for technology questions and teacher initiates questioning related to technology troubleshooting relevant to assigned task.

5. Little or no interaction regarding technology use.

☐ Student actions

- Entering classroom
- Movement around class
- Storage/retrieval of laptops
- Use of supplemental materials
- Interaction with peers

1. Noise level is appropriate for students entering a class that has not begun. Students automatically sit at assigned seat and remain seated for lesson duration. Students take laptops out of backpacks in the same way they take out papers and texts. All materials are on desk at start of class. Student use of laptops is ‘invisible’ in that it is the same as other learning materials. Student movement around room is based on laptop charging or sharing laptops for instructional purposes. Students put laptops away at end of period or if directed earlier by teacher.
2. Noise level is either too loud or no talking at all as students enter room. Students sit at any desk and take out learning materials but not laptops. Students with laptops use texts as primary tool only retrieving laptops if directed to do so and not out of choice or habit. When used, laptops are put away immediately /shortly after use. Student laptop interaction with peers is both content and non-content based.

3. Noise level is appropriate for students entering a class and students entering late do not distract /interrupt the lesson. Some students take out laptops, but not all. Movement around class is appropriate for activity in that students move on an as needed basis for charging, retrieval of materials etc. Students use laptops from choice not requirement so some laptops never come out. Student interaction with peers is both laptop and non laptop based

☐ Student off-task behavior
  o Frequency
  o Number of students
  o Computer-based or not/type
1. More than half of the students are off-task more than half of the time. Off-task behavior is both laptop and non-laptop related.
2. Some students are off-task for a small percentage of the class, mainly during the ‘settling down’ time. Off-task behavior is both laptop and non laptop related.
3. Some students are off-task for part of the class. Off-task behavior is predominantly from non-laptop students
4. Some students are off-task for part of the class. Laptop students are more off-task than non-laptop students.
5. Minimal off-task behavior or off-task behavior is transitional (eg settling in, waiting for bell,...)

☐ Student off task behavior
  o Predominant type
  o Teacher awareness/management of
1. Students are engaged in both computer-based and non-computer based off task behaviors for a lot of the period. Teacher does little to redirect students.
2. Students are engaged in predominantly computer-based off task behaviors. Teacher does little to redirect students.
3. Students are engaged in predominantly non-computer based off-task behaviors. Teacher uses verbal effort to whole group to redirect. (eg “too much noise”)
4. Students are engaged in both computer based and non-computer based off task behaviors during the lesson. Teacher monitors behavior using proximity control
5. There is minimal student off-task behavior and teacher immediately controls any of it using proximity control and verbal redirection of individuals.
Teacher direction of student use of laptops

- Grouping
- Direction
- Assistance

1. Students are directed to work either individually or in pairs so that every student has access to technology. Teacher gives whole group instruction and then follows with individualized instruction as needed. Assistance is both content and technology based.

2. Students work individually or in pairs, but laptop access is 1:1. No direction is given for access to technology. Teacher gives whole group direction making reference to laptop-users and non-laptop user modifications. Assistance is predominantly content based.

3. Students work individually. Teacher gives whole group direction making references to laptop-users and non-laptop users. Assistance is content based.

Student uses of laptops in learning experiences

- Basic functions (word processing, calculator, dictionary/spellchecker)
- Communication with teacher or professionals/experts
- Open Internet research (eg Google, Yahoo,...)
- Multimedia based research (eg supplemental CD-Roms)
- Guided research (eg webquests, scavenger hunts)
- Group assignment/presentation
- Free time
- Individual assignment/presentation
- Test or quiz
- Submitting assignment
- Retrieving assignment
- Record keeping
- Personal management/planner
- Instructional Games/puzzles
- Homework expectation
- Virtual field trips
- Supplemental CDs, not research based

1. Technology/application is regularly integrated into learning experience
2. Technology/application is occasionally integrated into learning experience
3. Technology/application is a requirement of students who have laptop access
4. Technology/application is dependent on student choice not on availability of laptop
Teacher uses of laptop computer

- Lecture/presentation
- Attendance
- Record keeping
- Monitoring student activity
- Personal email/Interact
- Researching lesson ideas or content
- Demonstration/examples
- Own web page/creating web-based assignments
- Student communication/dissemination of lesson content

1. Occasional/just getting used to it
2. Sometimes because required
3. Sometimes based on choice
4. Always because required
5. Always out of choice
6. Variable based on content and goals

Teacher instructional strategies

- Prior knowledge
- Technology skills
- Articulation of expectations and outcomes
- Checking for understanding
- Modifications for laptop/non-laptops
- Monitoring student progress/understanding
- Summarization
- Closure

1. Lesson clearly follows effective elements (e.g., Madeline Hunter, Learning cycle,...) lesson format with expectations and outcomes articulated as per lesson format. Students’ prior knowledge is addressed. Technology and required skills for lessons are addressed in a mini-lesson or reminder of associated task. Lesson introduction includes modifications and/or considerations for students who do not have laptops, (either by grouping or supplemental materials). Teacher is a facilitator, monitoring students progress, making recommendations, and checking for understanding. Lesson closes with either teacher or student summary of lesson and has a defined ending.

2. Lesson generally follows effective lesson format with outcomes and goals articulated but not necessarily comprehended. Technology skills are introduced but direction or clarification not always/completely given. Modifications for students who do not have laptops are addressed but not integral to lesson directions. Teacher facilitates the lesson by monitoring student progress and making recommendations. Lesson closes with a defined ending.

3. Lesson follows lesson format but does not articulate goals and expectations. Technology expectation and modifications for non-laptops students are addressed informally. Teacher monitors students or asks students to report progress. Lesson closes with defined ending.

172

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4. Lesson vaguely follows set lesson format and/or has minimal direction or is choppy. Teacher articulates goals and expectations and briefly addresses prior knowledge and required technology and skills.

☐ Student off-task behavior
  ☐ Activity
  ☐ Individual or with peers
  ☐ Discussion
  ☐ Use of technology
1. Majority of students who are off-task are involved in non-laptop related off-task behavior. Off-task behavior is more on an individual basis and is not necessarily distracting to others (applying make-up, completing other work, drawing, listening to cds with headset/walkman, fidgeting in backpack, or not doing anything at all). Discussion is minimal.
2. Students who are off-task are predominantly involved in non-laptop related activities. Off-task behavior is distracting to others or involves more than one student per activity. Examples include talking, passing notes, looking at cds together, sharing food/gum. Discussion is irrelevant to content of lesson or technology.
3. Students who are off-task are involved in both laptop and/or non-laptop behaviors. Majority of students who are off-task are doing their own thing and not distracting others. Discussion is minimal
4. Students who are off-task are involved in both laptop and/or non-laptop behaviors which is distracting to others. Laptop-related behaviors are by group but are relatively quiet compared to non-laptop groups of off-task students. Laptop behavior is centered on one laptop.
5. Students are predominantly involved in laptop related off-task behaviors but aren’t distracting other students. Off-task behaviors include changing fonts and wallpaper of laptop, listening to music, email/I-chat, Internet surfing or playing games on laptop.
6. Students are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content.
APPENDIX F

DRAFT 2 OF IC MAP

☐ Student laptop behavior at commencement of Laptop-based Lesson (use of laptop, readiness for start of lesson)
1. Many students take out laptops with other required learning tools (binders, pens, texts,..). Laptops are opened and students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students close laptops or minimize window.
2. Some students take out laptops with other learning tools, open them and play games or other non-educational/personal activity. When the teacher starts class, students with open laptops keep them open until directed to close. Other students sit at desks and laptops do not appear until the teacher starts class and requests they take them out.
3. Only one or two students take out laptops as an integral part of preparing for class. Laptops sit on desk but are not opened. Once teacher starts class and requests laptops, more students retrieve laptops from backpacks.
4. Students prepare for class but do not take laptops out of backpacks unless requested by teacher.

☐ Teacher/student conversation prior to start of class (content, tone, initiation)
1. Conversation is casual and initiated by both students and teachers. Content is not related to instructional activity
2. Conversation is causal and is initiated by students about what will be happening in class today.
3. Conversation is more formal and mostly consists of teacher asking students about classwork, missing assignments,
4. No conversation prior to start of class

☐ Teacher instructional strategies at start of lesson (Prior knowledge, Technology skills, discussion of LO(learning objective), Checking for understanding, Modifications for laptop/non-laptops)
1. Lesson follows specific format (eg Madeline Hunter, Learning cycle,..). Expectations and LO articulated as per lesson format. Students’ prior knowledge is addressed through questioning of students. If necessary, technology and required skills for lessons are addressed in a mini-lesson or reminder of associated task. Lesson introduction includes modifications and/or considerations for students who do not have laptops.
2. Lesson generally follows effective lesson format with LO written on board, and briefly discussed. Student prior knowledge is addressed as a reminder of what they learned in the past or through brief questioning. If necessary, technology skills are introduced as a reminder with some direction or clarification. Modifications for students who do not have laptops are addressed but not integral to lesson directions.

3. Lesson begins with students copying LO from board, but no discussion of it. Technology skills are addressed informally. Prior knowledge is not addressed or is addressed very informally. Modifications for students who do not have laptops are addressed informally.

4. Lesson begins with students copying LO from board. Prior knowledge is not addressed. Technology skills are not introduced or addressed, and modifications for students without laptops are not addressed.

* Student actions at start of laptop based lessons (Grouping, Classroom/desk arrangement, Dissemination of materials/assignment data)

1. Students mostly work in pairs or small groups and rearrange desks on an as needed basis. Students retrieve assignment via email, chat or school-based assignment program.

2. Students mostly work in pairs and/or small groups and rearrange desks on an as needed basis. Dissemination of materials and assignments is both electronic and manual.

3. Combination of students working individually and in pairs/small groups. Dissemination of materials and assignment is either electronic or manually.

4. Students work individually most of the time and assignments and materials are disseminated either electronically or manually.

5. Students work individually most of the time and assignments and materials are usually disseminated manually.

* Student actions at start of lesson (Noise, seat selection, Movement around class)

1. Noise level is appropriate for students entering a class that has not begun. Students sit at any seat and are not directed to move by the teacher. Student movement around room is self-initiated and based on laptop charging or sharing laptops, retrieval of materials for instructional purposes.

2. Noise level is appropriate for students entering a class. Students have assigned seats. Movement around class (teacher directed and self initiated) is appropriate for activity in that students move on an as needed basis for charging, retrieval of materials etc.

3. Noise level is either too loud or no talking at all as students enter room. Students sit at any desk yet teacher moves student at commencement of class. Teacher moving student is based on management rather than instruction. Only student initiated movement is to a charging station or for off-task purposes.
Student/student laptop interactions before start of lesson (content, number of students, use of laptop)
1. Some students with laptops are looking at course content related material on one or more laptops. Students are discussing work completed for current class or an alternate class. Students are in groups of two or three with at least one computer.
2. Some students with laptops are viewing and discussing either course related material or laptop ‘logistics’ such as changing wallpaper, using the laptops etc. Each student has own laptop and students are in groups of two or three.
3. Some students are using laptops for personal goals such as email, ichat or looking up personal information with other students. Predominantly one laptop per group of two or three students.
4. Little or no interaction centering on laptops prior to start of class.

Student grouping during learning activity (initiation, basis,)
1. Students are specifically grouped by teacher based on availability of laptop.
2. Students are self-grouped at teacher request on a basis of proximity.
3. Students are self-grouped on own initiative on a basis of proximity
4. Students are self-grouped on own initiative on a basis of friendship, peer relations.
5. No grouping.

Student control of laptops during learning experiences (control, position, decision-making)
1. Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.
2. Laptops are centrally positioned yet it is apparent that one student is sharing with the others. Control of laptop is generally by one person but consultation on navigation and aesthetics of content is evident.
3. Laptops are positioned in front of one individual but turned for others to see. Control is by one person, and others are observers.
4. No sharing of laptops. Students who do not have laptops use alternative learning tools.

Teacher instructional actions (Use of technology, Use of whiteboard, Use of instructional materials)
1. Teacher uses laptop and projector to demonstrate laptop-based activity, and leaves projector on for duration of assignment. Teacher uses whiteboard/blackboard/overhead projector for reminders, and technology for demonstration/mini-lessons. Technology is the primary instructional material for the lesson.
2. Teacher starts lesson by using laptop and projector but turns it off once students are set up. Whiteboard/blackboard/overhead projector is used for demonstration, mini-lesson, and reminders. Technology is supplemental material.
3. Teacher uses laptop and projector for starting lesson and leaves it on during lesson but does not use it for further demonstration. Intermittent instruction does
not occur or teacher gives more specific directions on a one-on-one basis using student’s laptops.
4. Teacher does not use laptop and projector to start lesson because application is routine to students and/or demonstration is not necessary.
5. Teacher does not use laptop or projector to start lesson or for any part of the lesson.

Student use of learning materials (laptops, texts, supplemental materials)
1. Students take laptops out of backpacks in the same way they take out papers and texts. All materials are on desk at start of class. Student use of laptops is ‘invisible’ in that it is the same as other learning materials. Laptop is primary tool. Students put laptops away at end of period or if directed earlier by teacher.
2. Some students take out laptops, but not all. Students use laptops from choice not requirement so some laptops never come out. Many laptop students are using text or supplemental material while laptop sits on desk.
3. Students with laptops use texts as primary tool only retrieving laptops if directed to do so and not out of choice or habit. When used, laptops are put away immediately /shortly after use.

Student/student laptop interaction during laptop assigned work (content, behavior, discourse)
1. Most or all students interacting are doing so relevant to assigned work or troubleshooting with technology. Behavior and discourse are responsible.
2. Student interaction is both related to assignment and/or technology troubleshooting and non-related. Behavior and discourse are responsible.
3. Student interaction is predominantly non-assignment based and behavior and discourse are off-task.
4. Minimal or no student laptop interaction during assigned work.

Teacher instructional strategies during lesson (Monitoring student progress/understanding, student interaction)
1. Teacher monitors student understanding through higher-level questions, asking students to relate their answers to the essential question/LO. Interaction with students is on an individual or small group basis as the teacher walks around the room.
2. Teacher monitors student progress and understanding by looking at their work, and telling students to recheck particular items. Interaction with students is on individual basis as teacher walks around the room.
3. Teacher monitors student progress by reviewing students work and telling them which ones are incorrect or need to be looked at. Interaction with students is in conference format at teacher desk.
4. Teacher monitors student progress by walking around room and looking at students’ work, but does not make recommendations or comment. Interaction with students is primarily if a student asks a question.
5. Teacher does not monitor student progress or understanding.
Teacher direction of student use of laptops (Grouping, Direction, Assistance)
1. Students are directed to work either individually based on access rather than learning goal. Teacher gives whole group instruction and then follows with individualized instruction as needed. Assistance is both content and technology based.
2. Students work individually or in pairs, but laptop access is 1:1. No direction is given for access to technology. Teacher gives whole group direction making reference to laptop-users and non-laptop user modifications. Assistance is predominantly content based.
3. Students work individually. Teacher gives whole group direction making references to laptop-users and non-laptop users. Assistance is content based.

Teacher instructional strategies at close of lesson (Summarization, Closure, reminders)
1. Lesson closes with either teacher or student summary of lesson and has a defined ending. Students are reminded to charge laptops, bring laptops, work on project,...
2. Lesson closes with a defined ending.
3. Teacher monitors students or asks students to report progress. Lesson closes with defined ending.
4. Lesson vaguely follows set lesson format and/or has minimal direction or is choppy. Teacher articulates goals and expectations and briefly addresses prior knowledge and required technology and skills.

Student/Teacher interactions regarding technology use (Questioning, Answering, Relevance, Initiation)
1. Questions initiated and answered by students and teacher. Content of discussion is not always relevant to assignment at hand but is how to use technology.
2. Students usually initiate the question by asking the teacher how to do something specifically related to task at hand. Teacher either answers or asks the question of the whole class. Teacher occasionally initiates the discussion and it is usually relevant to what the teacher sees on a student’s laptop.
3. Students tend to ask peers for technology questions and teacher initiates questioning related to technology troubleshooting relevant to assigned task.
4. Students tend to not ask the teacher technology related questions, but ask peers for technological assistance. Teacher rarely asks student about technology use based on their work or for assistance.
5. Little or no interaction regarding technology use.
- **Student off-task behavior (Frequency, Number of students, Computer-based or not/type, Teacher awareness/management of)**
  1. More than half of the students are off-task more than half of the time. Off-task behavior is both laptop and non-laptop related. Teacher does little to redirect students.
  2. Some students are off-task for part of the class. Off-task behavior is predominantly from non-laptop students. Teacher uses verbal effort to whole group to redirect. (eg “too much noise”)
  3. Some students are off-task for part of the class. Laptop students are more off-task than non-laptop students. Teacher redirects students when aware of behavior or in extreme cases takes laptop.
  4. Some students are off-task for a small percentage of the class, mainly during the ‘settling down’ time. Off-task behavior is both laptop and non-laptop related. Teacher monitors behavior using proximity control.
  5. Minimal off-task behavior or off-task behavior is transitional (eg settling in, waiting for bell, …)

- **Student technology based off-task behavior (degree of disruption to others, hiding of, educational value)**
  1. Off-task behavior is individual and not disruptive to others. Off-task behavior is relative to education such as changing font, working on another assignment, checking dropbox/grades. Student does not minimize or stop unless directed by teacher specifically.
  2. Off-task behavior is not individual and is not disruptive to others. Off-task behavior may have educational value (e.g learning how to use technology, relative to another assignment,…). Students do not minimize or stop unless directed by teacher.
  3. Off-task behavior is not individual but is not disruptive to others. Off-task behavior is predominantly non-educational such as looking at websites, photos,… Windows are minimized when teacher approaches.
  4. Off-task behavior is individual and not disruptive to others. Off-task behavior has little educational value (e.g changing wallpaper of desktop, looking at non-educational websites, emailing,…) Student minimizes window when teacher approaches.
  5. Off-task behavior is not individual and is disruptive to others. Off-task behavior is non-educational (email, web surfing,…).
## Student off-task behavior category

<table>
<thead>
<tr>
<th>Off task behavior indicator</th>
<th>Frequent/Many students</th>
<th>Occasional/Some students</th>
<th>minimal students</th>
</tr>
</thead>
<tbody>
<tr>
<td>involvement in an entirely different task to the one assigned,</td>
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<tr>
<td>discussing topics that are not relevant to the assigned task,</td>
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<td></td>
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<tr>
<td>not completing any task at all</td>
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</tr>
<tr>
<td>use of learning tools for purposes other than intended or specified for the learning activity (e.g., surfing the Internet, email, iChat)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Teacher use of laptop computer

<table>
<thead>
<tr>
<th>Teacher uses of laptop computer</th>
<th>Always out of choice</th>
<th>Always because required</th>
<th>Sometimes based on choice</th>
<th>Sometimes because required</th>
<th>Variable based on content and goals</th>
<th>Occasional just getting used to it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture/presentation</td>
<td></td>
<td></td>
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<tr>
<td>Attendance</td>
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<tr>
<td>Record keeping</td>
<td></td>
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<td></td>
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<tr>
<td>Monitoring student activity</td>
<td></td>
<td></td>
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<tr>
<td>Personal email/Interact</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Researching lesson ideas or content</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Demonstration/examples</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Own web page/creating web-based assignments</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Student communication, dissemination of lesson content</td>
<td></td>
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</tr>
</tbody>
</table>

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Student off-task behavior (Activity, Individual or with peers, Discussion, Use of technology)

1. Majority of students who are off-task are involved in non-laptop related off-task behavior. Off-task behavior is more on an individual basis and is not necessarily distracting to others (applying make-up, completing other work, drawing, listening to CDs with headset/walkman, fidgeting in backpack, or not doing anything at all). Discussion is minimal.

2. Students who are off-task are predominantly involved in non-laptop related activities. Off-task behavior is distracting to others or involves more than one student per activity. Examples include talking, passing notes, looking at CDs together, sharing food/gum. Discussion is irrelevant to content of lesson or technology.

3. Students who are off-task are involved in both laptop and/or non-laptop behaviors. Majority of students who are off-task are doing their own thing and not distracting others. Discussion is minimal.

4. Students who are off-task are involved in both laptop and/or non-laptop behaviors which is distracting to others. Laptop-related behaviors are by group but are relatively quiet compared to non-laptop groups of off-task students. Laptop behavior is centered on one laptop.

5. Students are predominantly involved in laptop related off-task behaviors but aren’t distracting other students. Off-task behaviors include changing fonts and wallpaper of laptop, listening to music, email/I-chat, Internet surfing or playing games on laptop.

6. Students are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content.
### Student uses of laptops

<table>
<thead>
<tr>
<th>Student uses of laptops in learning experiences</th>
<th>regularly integrated at least 2X/wk.</th>
<th>occasionally integrated weekly</th>
<th>R'qmnt of laptop students</th>
<th>dependent on student choice</th>
<th>dependent on laptop avail.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic functions (word processing, calculator, dictionary/spellchecker)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication with teacher or professionals/experts</td>
<td></td>
<td></td>
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<tr>
<td>Open Internet research (eg Google, Yahoo,...)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Multimedia based research (eg supplemental CD-Roms)</td>
<td></td>
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<td></td>
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<tr>
<td>Guided research (eg scavenger hunts)</td>
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<tr>
<td>Webquest</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Group assignment/presentation</td>
<td></td>
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<tr>
<td>Free time</td>
<td></td>
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<tr>
<td>Individual assignment/present.</td>
<td></td>
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<tr>
<td>Multi-disciplinary assignment</td>
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<tr>
<td>Mini-clip/online movie for assignment content</td>
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<tr>
<td>Test or quiz</td>
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<tr>
<td>Inspiration software</td>
<td></td>
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<tr>
<td>Submitting assignment</td>
<td></td>
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</tr>
<tr>
<td>Retrieving assignment</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td></td>
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</tr>
<tr>
<td>Personal mgmt/planner</td>
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<tr>
<td>Instructional Games/puzzles</td>
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<tr>
<td>Homework expectation</td>
<td></td>
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<tr>
<td>Virtual field trips</td>
<td></td>
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<tr>
<td>Supplemental CDs, not research based</td>
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</tbody>
</table>

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### APPENDIX G

### IC MAP TABLE

#### Teacher cluster

<table>
<thead>
<tr>
<th>Component (dimensions) and variations</th>
<th>% teacher int.</th>
<th>% observ.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Teacher instructional strategies at start of lesson (Prior knowledge, Technology skills, discussion of LO(learning objective), Checking for understanding, Modifications for laptop/non-laptops)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Lesson follows specific format (eg Madeline Hunter, Learning cycle,...). Expectations and LO articulated as per lesson format. Students’ prior knowledge is addressed through questioning of students. If necessary, technology and required skills for lessons are addressed in a mini-lesson or reminder of associated task. Lesson introduction includes modifications and/or considerations for students who do not have laptops.</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>b. Lesson generally follows effective lesson format with LO written on board, and briefly discussed. Student prior knowledge is addressed as a reminder of what they learned in the past or through brief questioning. If necessary, technology skills are introduced as a reminder with some direction or clarification. Modifications for students who do not have laptops are addressed but not integral to lesson directions.</td>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>c. Lesson begins with students copying LO from board, but no discussion of it. Technology skills are addressed informally. Prior knowledge is not addressed or is addressed very informally. Modifications for students who do not have laptops are addressed informally.</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>d. Lesson begins with students copying LO from board. Prior knowledge is not addressed. Technology skills are not introduced or addressed, and modifications for students without laptops are not addressed.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>2. Teacher instructional actions (Use of technology, Use of whiteboard, Use of instructional materials)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Teacher uses laptop and projector to demonstrate laptop-based activity, and leaves projector on for duration of assignment. Teacher uses whiteboard/blackboard/overhead projector for reminders, and technology for demonstration/mini-lessons. Technology is the primary instructional material for the lesson.</td>
<td>50</td>
<td>17</td>
</tr>
</tbody>
</table>
b. Teacher starts lesson by using laptop and projector but turns it off once students are set up. Whiteboard/blackboard/overhead projector is used for demonstration, mini-lesson, and reminders. Technology is supplemental material. 50 11

c. Teacher uses laptop and projector for starting lesson and leaves it on during lesson but does not use it for further demonstration. Intermittent instruction does not occur or teacher gives more specific directions on a one-on-one basis using student's laptops. 0 11

d. Teacher does not use laptop and projector to start lesson because application is routine to students and/or demonstration is not necessary. 0 50

e. Teacher does not use laptop or projector to start lesson or for any part of the lesson. 0 11

3. Teacher instructional strategies during lesson (Monitoring student progress/understanding, student interaction)

a. Teacher monitors student understanding through higher-level questions, asking students to relate their answers to the essential question/LO. Interaction with students is on an individual or small group basis as the teacher walks around the room. 75 78

b. Teacher monitors student progress and understanding by looking at their work, and telling students to recheck particular items. Interaction with students is on individual basis as teacher walks around the room. 13 17

c. Teacher monitors student progress by reviewing students' work and telling them which ones are incorrect or need to be looked at. Interaction with students is in conference format at teacher desk. 13 5

d. Teacher monitors student progress by walking around room and looking at students' work, but does not make recommendations or comment. Interaction with students is primarily if a student asks a question. 0 0

e. Teacher does not monitor student progress or understanding. 0 0

4. Teacher direction of student use of laptops (Grouping, Direction, Assistance)

a. Students are directed to work either individually based on access rather than learning goal. Teacher gives whole group instruction and then follows with individualized instruction as needed. Assistance is both content and technology based. 75 72

b. Students work individually or in pairs, but laptop access is 1:1. No direction is given for access to technology. Teacher gives whole group direction making reference to laptop-users and non-laptop user modifications. Assistance is predominantly content based. 13 5

c. Students work individually. Teacher gives whole group direction making references to laptop-users and non-laptop users. Assistance is content based. 13 22

184
### 5. Teacher/student conversation prior to start of class (content, tone, initiation)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Conversation is casual and initiated by both students and teachers. Content is not related to instructional activity</td>
<td>88</td>
</tr>
<tr>
<td>b.</td>
<td>Conversation is causal and is initiated by students about what will be happening in class today.</td>
<td>0</td>
</tr>
<tr>
<td>c.</td>
<td>Conversation is more formal and mostly consists of teacher asking students about classwork, missing assignments...</td>
<td>13</td>
</tr>
<tr>
<td>d.</td>
<td>No conversation prior to start of class</td>
<td>0</td>
</tr>
</tbody>
</table>

### 6. Student laptop behavior at commencement of Laptop-based Lesson (use of laptop, readiness for start of lesson)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>Many students take out laptops with other required learning tools (binders, pens, texts,...). Laptops are opened and students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students close laptops or minimize window.</td>
<td>63</td>
</tr>
<tr>
<td>b.</td>
<td>Some students take out laptops with other learning tools, open them and play games or other non-educational/personal activity. When the teacher starts class, students with open laptops keep them open until directed to close. Other students sit at desks and laptops do not appear until the teacher starts class and requests they take them out.</td>
<td>25</td>
</tr>
<tr>
<td>c.</td>
<td>Only one or two students take out laptops as an integral part of preparing for class. Laptops sit on desk but are not opened. Once teacher starts class and requests laptops, more students retrieve laptops from backpacks.</td>
<td>0</td>
</tr>
<tr>
<td>d.</td>
<td>Students prepare for class but do to take laptops out of backpacks unless requested by teacher.</td>
<td>13</td>
</tr>
</tbody>
</table>

### 7. Student use of learning materials (laptops, texts, supplemental materials)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>Students take laptops out of backpacks in the same way they take out papers and texts. All materials are on desk at start of class. Student use of laptops is 'invisible' in that it is the same as other learning materials. Laptop is primary tool. Students put laptops away at end of period or if directed earlier by teacher.</td>
<td>50</td>
</tr>
<tr>
<td>b.</td>
<td>Some students take out laptops, but not all. Students use laptops from choice not requirement so some laptops never come out. Many laptop students are using text or supplemental material while laptop sits on desk.</td>
<td>38</td>
</tr>
<tr>
<td>c.</td>
<td>Students with laptops use texts as primary tool only retrieving laptops if directed to do so and not out of choice or habit. When used, laptops are put away immediately/shortly after use.</td>
<td>13</td>
</tr>
<tr>
<td>d.</td>
<td>Some students take out laptops, but not all. Students use laptops from choice not requirement so some laptops never come out. Many laptop students are using text or supplemental material while laptop sits on desk.</td>
<td>38</td>
</tr>
<tr>
<td>Component (dimensions) and variations</td>
<td>% teacher int.</td>
<td>% observ.</td>
</tr>
<tr>
<td>---------------------------------------</td>
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<td>-----------</td>
</tr>
<tr>
<td><strong>8. Student/student laptop interaction during laptop assigned work (content, behavior, discourse)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Most or all students interacting are doing so relevant to assigned work or troubleshooting with technology. Behavior and discourse are responsible.</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>b. Student interaction is both related to assignment and/or technology troubleshooting and non-related. Behavior and discourse are responsible.</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>c. Student interaction is predominantly non-assignment based and behavior and discourse are off-task.</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>d. Minimal or no student laptop interaction during assigned work.</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td><strong>9. Student actions at start of laptop based lessons (Grouping, Classroom/desk arrangement, Dissemination of materials/assignment data)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Students mostly work in pairs or small groups and rearrange desks on an as needed basis. Students retrieve assignment via email, chat or school-based assignment program.</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>b. Students mostly work in pairs and/or small groups and rearrange desks on an as needed basis. Dissemination of materials and assignments is both electronic and manual.</td>
<td>38</td>
<td>28</td>
</tr>
<tr>
<td>c. Combination of students working individually and in pairs/small groups. Dissemination of materials and assignment is either electronic or manually.</td>
<td>50</td>
<td>39</td>
</tr>
<tr>
<td>d. Students work individually most of the time and assignments and materials are disseminated either electronically or manually.</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>e. Students work individually most of the time and assignments and materials are usually disseminated manually.</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td><strong>10. Student actions at start of lesson (Noise, seat selection, Movement around class)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Noise level is appropriate for students entering a class that has not begun. Students sit at any seat and are not directed to move by the teacher. Student movement around room is self-initiated and based on laptop charging or sharing laptops, retrieval of materials for instructional purposes.</td>
<td>25</td>
<td>67</td>
</tr>
<tr>
<td>b. Noise level is appropriate for students entering a class. Students have assigned seats. Movement around class (teacher directed and self initiated) is appropriate for activity in that students move on an as needed basis for charging, retrieval of materials etc.</td>
<td>63</td>
<td>28</td>
</tr>
<tr>
<td>c. Noise level is either too loud or no talking at all as students enter room. Students sit at any desk yet teacher moves student at commencement of class. Teacher moving student is based on management rather than instruction. Only student initiated movement is to a charging station or for off-task purposes.</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Component (dimensions) and variations</td>
<td>% from teacher int.</td>
<td>% from observ.</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>11. Student/student laptop interactions before start of lesson (content, number of students, use of laptop)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Some students with laptops are looking at course content related material on one or more laptops. Students are discussing work completed for current class or an alternate class. Students are in groups of two or three with at least one computer.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b. Some students with laptops are viewing and discussing either course related material or laptop 'logistics' such as changing wallpaper, using the laptops etc. Each student has own laptop and students are in groups of two or three.</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>c. Some students are using laptops for personal goals such as email, ichat or looking up personal information with other students. Predominantly one laptop per group of two or three students.</td>
<td>50</td>
<td>39</td>
</tr>
<tr>
<td>d. Little or no interaction centering on laptops prior to start of class.</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>12. Student grouping during learning activity (initiation, basis,)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Students are specifically grouped by teacher based on availability of laptop.</td>
<td>63</td>
<td>28</td>
</tr>
<tr>
<td>b. Students are self-grouped at teacher request on a basis of proximity.</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>c. Students are self-grouped on own initiative on a basis of proximity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>d. Students are self-grouped on own initiative on a basis of friendship, peer relations.</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>e. No grouping.</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>13. Student control of laptops during learning experiences (control, position, decision-making)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.</td>
<td>50</td>
<td>28</td>
</tr>
<tr>
<td>b. Laptops are centrally positioned yet it is apparent that one student is sharing with the others. Control of laptop is generally by one person but consultation on navigation and aesthetics of content is evident.</td>
<td>25</td>
<td>39</td>
</tr>
<tr>
<td>c. Laptops are positioned in front of one individual but turned for others to see. Control is by one person, and others are observers.</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>d. No sharing of laptops. Students who do not have laptops use alternative learning tools.</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>14. Student/Teacher interactions regarding technology use (Questioning, Answering, Relevance, Initiation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Questions initiated and answered by students and teacher. Content of discussion is not always relevant to assignment at hand but is how to use technology.</td>
<td>38</td>
<td>61</td>
</tr>
<tr>
<td>b. Students usually initiate the question by asking the teacher how to do something specifically related to task at hand. Teacher either answers or asks the question of the whole class. Teacher</td>
<td>63</td>
<td>17</td>
</tr>
</tbody>
</table>

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occasionally initiates the discussion and it is usually relevant to what the teacher sees on a student’s laptop.

c. Students tend to ask peers for technology questions and teacher initiates questioning related to technology troubleshooting relevant to assigned task. 0 11

d. Students tend to not ask the teacher technology related questions, but ask peers for technological assistance. Teacher rarely asks student about technology use based on their work or for assistance. 0 0

e. Little or no interaction regarding technology use. 0 11

15. Student off-task behavior (Activity, Individual or with peers, Discussion, Use of technology)

| a. Majority of students who are off-task are involved in non-laptop related off-task behavior. Off-task behavior is more on an individual basis and is not necessarily distracting to others (applying make-up, completing other work, drawing, listening to cds with headset/walkman, fidgeting in backpack, or not doing anything at all). Discussion is minimal. | 13 11 |
| b. Students who are off-task are predominantly involved in non-laptop related activities. Off-task behavior is distracting to others or involves more than one student per activity. Examples include talking, passing notes, looking at cds together, sharing food/gum. Discussion is irrelevant to content of lesson or technology. | 13 11 |
| c. Students who are off-task are involved in both laptop and/or non-laptop behavior. Majority of students who are off-task are doing their own thing and not distracting others. Discussion is minimal. | 13 28 |
| d. Students who are off-task are involved in both laptop and/or non-laptop behavior which is distracting to others. Laptop-related behavior are relatively quiet compared to non-laptop off-task students. Laptop behavior is centered on one laptop. | 50 33 |
| e. Students are predominantly involved in laptop related off-task behavior but aren’t distracting other students. Off-task behavior includes changing fonts and wallpaper of laptop, listening to music, email/I-chat, Internet surfing or playing games on laptop. | 13 22 |
| f. Students are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content. | 0 5 |

16. Student technology based off-task behavior (degree of disruption to others, hiding of, educational value)

| a. Off-task behavior is individual and not disruptive to others. Off-task behavior is relative to education such as changing font, working on another assignment, checking dropbox/grades. Student does not minimize or stop unless directed by teacher specifically. | 13 33 |
| b. Off-task behavior is not individual and is not disruptive to others. Off-task behavior may have educational value (e.g. learning how to use technology, relative to another assignment,...). Students do not minimize or stop unless directed by teacher. | 13 0 |
| c. Off-task behavior is not individual but is not disruptive to others. Off-task behavior is predominantly non-educational such as looking | 13 0 |
at websites, photos,... Windows are minimized when teacher approaches

d. Off-task behavior is individual and not disruptive to others. Off-task behavior has little educational value (eg changing wallpaper of desktop, looking at non-educational websites, emailing,...) Student minimizes window when teacher approaches.  

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<td></td>
<td>50</td>
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<tr>
<td></td>
<td>56</td>
</tr>
</tbody>
</table>

e. Off-task behavior is not individual and is disruptive to others. Off-task behavior is non-educational (email, web surfing,...).  

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

17. **Student off-task behavior (Frequency, Number of students, Computer-based or not/type, Teacher awareness/management of)**

<table>
<thead>
<tr>
<th>a.</th>
<th>More than half of the students are off-task more than half of the time. Off-task behavior is both laptop and non-laptop related. Teacher does little to redirect students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b.</th>
<th>Some students are off-task for part of the class. Off-task behavior is predominantly from non-laptop students. Teacher uses verbal effort to whole group to redirect. (eg “too much noise”)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38 33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>c.</th>
<th>Some students are off-task for part of the class. Laptop students are more off-task than non-laptop students. Teacher redirects students when aware of behavior or in extreme cases takes laptop.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d.</th>
<th>Some students are off-task for a small percentage of the class, mainly during the ‘settling down’ time. Off-task behavior is both laptop and non-laptop related. Teacher monitors behavior using proximity control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>e.</th>
<th>Minimal off-task behavior or off-task behavior is transitional (eg settling in, waiting for bell,...)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38 33</td>
</tr>
</tbody>
</table>

189

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
<table>
<thead>
<tr>
<th>Off task behavior indicator</th>
<th>Frequent/Many students</th>
<th>Occasional Some students</th>
<th>Minimal students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Obs.</td>
<td>% Int</td>
<td>% Obs.</td>
</tr>
<tr>
<td>involvement in an entirely different task to the one assigned.</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>discussing topics that are not relevant to the assigned task.</td>
<td>28</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>not completing any task at all</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>use of learning tools for purposes other than intended or specified for the learning activity (eg surfing the Internet, email, ichtat)</td>
<td>28</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Student uses of laptops in learning experiences</td>
<td>Not at all</td>
<td>regularly integrated at least 2X/wk.</td>
<td>occasionally integrated weekly</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
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</tr>
<tr>
<td>Basic functions (word processing, calculator, dictionary/spellchecker)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Communication with teacher or professionals/experts</td>
<td>75</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Open Internet research (eg Google, Yahoo,…)</td>
<td>13</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>Multimedia based research (CD Roms)</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guided research (eg scavenger hunts)</td>
<td>13</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Webquest</td>
<td>63</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Group assignment/presentation</td>
<td>38</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Free time</td>
<td>50</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Individual assignment/presentation</td>
<td>13</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Multi-disciplinary assignment</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mini-clip/online movie for assignment content</td>
<td>63</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Test or quiz</td>
<td>88</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Inspiration software</td>
<td>38</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Submitting assignment</td>
<td>38</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Retrieving assignment</td>
<td>63</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Record keeping</td>
<td>63</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Personal management/planner</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional Games/puzzles</td>
<td>63</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Homework expectation</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Virtual field trips</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplemental CDs, not research based</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher uses of laptop computer</td>
<td>Not at all</td>
<td>Always out of choice</td>
<td>Always because required</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------</td>
<td>----------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Lecture/presentation</td>
<td>13</td>
<td>50</td>
<td>37</td>
</tr>
<tr>
<td>Attendance</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>13</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Monitoring student activity</td>
<td>50</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Personal email/Interact</td>
<td>75</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Researching lesson ideas or content</td>
<td>88</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Demonstration/examples</td>
<td>63</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Own web page/creating web-based assignments</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Student communication, dissemination of lesson content</td>
<td>26</td>
<td>50</td>
<td>12</td>
</tr>
</tbody>
</table>
APPENDIX H
INNOVATION CONFIGURATION MAP

Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 1
Teacher instructional strategies at start of lesson (Prior knowledge, Technology skills, discussion of LO (learning objective), Checking for understanding, Modifications for laptop/non-laptops)

<table>
<thead>
<tr>
<th>Description</th>
<th>Lesson generally follows effective lesson format with LO written on board, and briefly discussed. Student prior knowledge is addressed as a reminder of what they learned in the past or through brief questioning. If necessary, technology skills are introduced as a reminder with some direction or clarification. Modifications for students who do not have laptops are addressed but not integral to lesson directions.</th>
<th>Lesson begins with students copying LO from board, but no discussion of it. Technology skills are addressed informally. Prior knowledge is not addressed or is addressed very informally. Modifications for students who do not have laptops are addressed informally.</th>
<th>Lesson begins with students copying LO from board. Prior knowledge is not addressed. Technology skills are not introduced or addressed, and modifications for students without laptops are not addressed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson follows specific format. Students’ prior knowledge is addressed through questioning of students. If necessary, technology and required skills Expectations and LO articulated as per lesson for lessons are addressed in a mini-lesson or reminder of associated task. Lesson introduction includes modifications and/or considerations for students who do not have laptops.</td>
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<tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Lesson begins with students copying LO from board, but no discussion of it. Technology skills are addressed informally. Prior knowledge is not addressed or is addressed very informally. Modifications for students who do not have laptops are addressed informally.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesson begins with students copying LO from board. Prior knowledge is not addressed. Technology skills are not introduced or addressed, and modifications for students without laptops are not addressed.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 2
Teacher instructional actions (Use of technology, Use of whiteboard, Use of instructional materials)

Teacher uses laptop and projector to demonstrate laptop-based activity, and leaves projector on for duration of assignment. Teacher uses whiteboard/blackboard/overhead projector for reminders, and technology for demonstration/mini-lessons. Technology is the primary instructional material for the lesson.

Teacher starts lesson by using laptop and projector but turns it off once students are set up. Whiteboard/blackboard/overhead projector is used for demonstration, mini-lesson, and reminders. Technology is supplemental material.

Teacher uses laptop and projector for starting lesson and leaves it on during lesson but does not use it for further demonstration. Intermittent instruction does not occur or teacher gives more specific directions on a one-on-one basis using student’s laptops.

Teacher does not use laptop and projector to start lesson because application is routine to students and/or demonstration is not necessary.

Teacher does not use laptop or projector to start lesson or for any part of the lesson.
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 3
Teacher instructional strategies during lesson (Monitoring student progress/understanding, student interaction)

Teacher monitors student understanding through higher-level questions, asking students to relate their answers to the essential question/LO. Interaction with students is on an individual or small group basis as the teacher walks around the room.

Teacher monitors student progress and understanding by looking at their work, and telling students to recheck particular items. Interaction with students is on individual basis as teacher walks around the room.

Teacher monitors student progress by reviewing students work and telling them which ones are incorrect or need to be looked at. Interaction with students is in conference format at teacher desk.

Teacher does little monitoring of student progress.

Component 4
Teacher direction of student use of laptops (grouping, direction, assistance)

Students are directed to work individually based on access rather than learning goal. Teacher gives whole group instruction and then follows with individualized instruction as needed. Assistance is both content and technology based.

Students work individually or in pairs, but laptop access is 1:1. Teacher gives whole group direction making reference to laptop users and non-laptop user modifications. Assistance is predominantly content based.

Students work individually. Teacher gives whole group direction making references to laptop users and non-laptop users. Assistance is content based.
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 5
**Teacher/student conversation prior to start of class (content, tone, initiation)**

| Conversation is casual and initiated by both students and teachers. Content is not related to instructional activity. | Conversation is casual and initiated by students about what will be happening in class today. | Conversation is more formal and mostly consists of teacher asking students about classwork, missing assignments,... | No conversation prior to class. |

Component 6
**Student laptop behavior at commencement of laptop-based lesson (use of laptop, readiness for start of lesson)**

| Most students automatically take laptops out with other required learning tools (binders, pens,...). Laptops are opened and students are playing games, listening to music, looking at the Internet, or working on an assignment. Bell rings and students close laptops or minimize window. | Some students take out laptops with other learning tools, open them and play games or other non-educational/personal activity. When the teacher starts class, students with open laptops keep them open until directed to close. Other students sit at desks and laptops do not appear until the teacher starts class and requests they take them out. | One or two students take out laptops as an integral part of preparing for class. Laptops sit on desk but are not opened. Once teacher starts class and requests laptops, more students retrieve laptops from backpacks. | Students prepare for class but do not take laptops out of backpacks unless requested by teacher. |
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 7
Student use of laptops as another learning tool (laptops, texts, supplemental materials)

Students take laptops out of backpack in the same way they take out papers and texts. All materials are on desk at start of class. Student use of laptops is ‘invisible’ in that it is the same as other learning materials. Laptop is primary tool. Students put laptops away at end of period or if directed earlier by teacher.

Some students take out laptops, but not all. Students use laptops from choice not requirement, so some laptops never come out. Many laptop students are using text or supplemental material while laptops sit on desk.

Students with laptops use text as primary tool, only retrieving laptops if directed to do so and not out of choice or habit. When used, laptops are put away immediately/shortly after use.

Component 8
Student/student interaction during laptop assigned work (content, behavior, discourse)

Most or all student interaction is relevant to assigned work or troubleshooting with technology. Behavior and discourse are responsible.

Student interaction is both related to assignment and/or technology and non-related. Behavior and discourse are responsible.

Student interaction is predominantly non assignment based and behavior and discourse are off-task.

Minimal or no student laptop interaction during assigned seatwork.
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 9
**Student actions at start of laptop based lessons (grouping, classroom/desk arrangement, dissemination of materials/assignment data)**

<table>
<thead>
<tr>
<th>Students retrieve assignment via email, chat or school-based assignment program. Students mostly work in pairs or small groups and rearrange desks on an as-needed basis.</th>
<th>Dissemination of materials and assignments is both electronic and manual. Students mostly work in pairs/small groups and rearrange desks on an as-needed basis.</th>
<th>Dissemination of materials and assignments is either electronic or manual. Combination of students working individually and in pairs/small groups.</th>
<th>Assignments and materials are disseminated either electronically or manually and students work individually most of the time.</th>
<th>Materials are usually disseminated manually and students work individually most of the time.</th>
</tr>
</thead>
</table>

Component 10
**Student actions at start of lesson (noise, seat selection, movement around class)**

| Noise level is appropriate for students entering a class that has not yet begun. Students sit at any seat and are not directed to move by the teacher. Student movement around room is self-initiated and based on laptop charging or sharing of laptops or retrieval of materials for instructional purposes. | Noise level is appropriate for students entering a class. Students have assigned seats. Movement around class (teacher directed and self initiated) is appropriate for activity in that students move on an as-needed basis for charging, retrieval of materials,… | Noise level is either too loud or no talking at all as students enter room. Students sit at any desk, yet teacher moves student at commencement of class. Teacher moving of student is based on management rather than instruction. Only student initiated movement is to charging station or for off-task purposes. |
Component 11

**Student/student interactions before start of lesson (content, number of students, use of laptop)**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some students with laptops are looking at course content related material on one or more laptops. Students are discussing work completed for current class or an alternate class. Students are in groups of two or three with at least one computer.</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Component 12

**Student grouping during learning activity (initiation, basis)**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are specifically grouped by teacher based on availability of laptop.</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 13

**Student control of laptops during learning experiences (control, position, decision-making)**

Laptops are centrally positioned and students share control in relatively equal proportions during learning experience. It is difficult to determine whose laptop it is. Students consult with each other on navigation and aesthetics of content.

Component 14

**Student/Teacher interactions regarding technology use (Questioning, Answering, Relevance, Initiation)**

Questions initiated and answered by students and teacher. Content of discussion is not always relevant to assignment at hand but is how to use technology.
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 15

**Student off-task behavior (Activity, Individual or with peers, Discussion, Use of technology)**

<table>
<thead>
<tr>
<th>Behavior Description</th>
<th>Example Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majority of students who are off-task are involved in non-laptop related off-task behavior. Off-task behavior is more on an individual basis and is not necessarily distracting to others (applying make-up, completing other work, drawing, listening to cds with headset/walkman, fidgeting in backpack, or not doing anything at all). Discussion is minimal.</td>
<td>Students who are off-task are predominantly involved in non-laptop related activities. Off-task behavior is distracting to others or involves more than one student per activity. Examples include talking, passing notes, looking at cds together, sharing food/gum. Discussion is irrelevant to content of lesson or technology.</td>
</tr>
<tr>
<td>Students who are off-task are involved in both laptop and/or non-laptop behaviors. Majority of students who are off-task are doing their own thing and not distracting others. Discussion is minimal</td>
<td>Students who are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content.</td>
</tr>
<tr>
<td>Students who are predominantly involved in laptop related off-task behaviors but aren’t distracting other students. Off-task behaviors include changing fonts and wallpaper of laptop, listening to music, email/I-chat, Internet surfing or playing games on laptop.</td>
<td>Students who are involved in laptop related off-task behavior that is on a small group level. Students are looking at one laptop and discussing laptop content such as games, websites, or email content.</td>
</tr>
</tbody>
</table>
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 16

**Student technology based off-task behavior (degree of disruption to others, hiding of, educational value)**

- **Off-task behavior is not individual and not disruptive to others.** Off-task behavior is relative to education such as changing font, working on another assignment, checking dropbox/grades. Student does not minimize or stop unless directed by teacher specifically.

- **Off-task behavior is not individual and is not disruptive to others.** Off-task behavior may have educational value (e.g., learning how to use technology, relative to another assignment, ...). Students do not minimize or stop unless directed by teacher.

- **Off-task behavior is not individual but is not disruptive to others.** Off-task behavior is predominantly non-educational such as looking at websites, photos, ... Windows are minimized when teacher approaches.

- **Off-task behavior is not individual and is disruptive to others.** Off-task behavior has little educational value (e.g., changing wallpaper of desktop, looking at non-educational websites, emailing, ...). Student minimizes window when teacher approaches.

Component 17

**Student off-task behavior (Frequency, Number of students, Computer-based or not/type, Teacher awareness/management of))**

- **Some students are off-task for part of the class.** Off-task behavior is predominantly from non-laptop students. Teacher uses verbal effort to whole group to redirect. (e.g., “too much noise”)

- **Some students are off-task for part of the class.** Laptop students are more off-task than non-laptop students. Teacher redirects students when aware of behavior or in extreme cases takes laptop.

- **Some students are off-task for a small percentage of the class, mainly during the ‘settling down’ time.** Off-task behavior is both laptop and non-laptop related. Teacher monitors behavior using proximity control.

- **Minimal off-task behavior or off-task behavior is transitional (e.g., settling in, waiting for bell, ...).**
### Component 18
**Student uses of laptops in learning experiences**

<table>
<thead>
<tr>
<th>Basic functions (word processing, calculator, dictionary/spellchecker)</th>
<th>Not at all</th>
<th>regularly integrated at least 2X/wk.</th>
<th>Occasionally integrated weekly</th>
<th>requirement of laptop students</th>
<th>dependent on student choice</th>
<th>dependent on content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication with teacher or professionals/experts</td>
<td></td>
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<td>Open Internet research (eg Google, Yahoo,...)</td>
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<td>Multi-disciplinary assignment</td>
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</tbody>
</table>
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 19

Teacher uses of laptop computer

<table>
<thead>
<tr>
<th>% from teacher interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
</tr>
<tr>
<td>Always out of choice</td>
</tr>
<tr>
<td>Always because required</td>
</tr>
<tr>
<td>Sometimes based on choice</td>
</tr>
<tr>
<td>Sometimes because required</td>
</tr>
<tr>
<td>Variable based on content and goals</td>
</tr>
<tr>
<td>Occasional just getting used to it</td>
</tr>
</tbody>
</table>

Lecture/presentation
Attendance
Record keeping
Monitoring student activity

Personal email/Interact
Researching lesson ideas or content
Demonstration/examples
Own web page/creating web-based assignments
Student communication, dissemination of lesson content
Innovation configuration of student and teacher behavior and student off-task behavior in a one-to-one computing environment

Component 20

**Student off-task behavior indicators**

<table>
<thead>
<tr>
<th>Off task behavior indicator</th>
<th>Frequent/Many students</th>
<th>Occasional Some students</th>
<th>Minimal students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement in an entirely different task to the one assigned, discussing topics that are not relevant to the assigned task,</td>
<td>0 0</td>
<td>28 38</td>
<td>72 62</td>
</tr>
<tr>
<td>Not completing any task at all</td>
<td>0 0</td>
<td>28 0</td>
<td>72 100</td>
</tr>
<tr>
<td>Use of learning tools for purposes other than intended or specified for the learning activity (e.g. surfing the Internet, email, iChat)</td>
<td>28 25</td>
<td>28 25</td>
<td>44 50</td>
</tr>
</tbody>
</table>
REFERENCES


http://www.ed.gov/about/offices/list/os/technology/index.html


211

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