Student Engagement in a Computer Rich Science Classroom

A dissertation presented to

the faculty of

The Patton College of Education of Ohio University

In partial fulfillment

of the requirements for the degree

Doctor of Philosophy

Jeffrey C. Hunter

May 2015

This dissertation titled

Student Engagement in a Computer Rich Science Classroom

by

JEFFREY C. HUNTER

has been approved for

the Department of Teacher Education

and The Patton College of Education by

Ginger Weade

Professor of Teacher Education

Renée A. Middleton

Dean, The Patton College of Education

Abstract

HUNTER, JEFFREY C., Ph.D., May 2015, Curriculum and Instruction,

Science Education

Student Engagement in a Computer Rich Science Classroom

Director of Dissertation: Ginger Weade

The purpose of this study was to examine the student lived experience when using computers in a rural science classroom. The overarching question the project sought to examine was: How do rural students relate to computers as a learning tool in comparison to a traditional science classroom? Participant data were collected using a pre-study survey, Experience Sampling during class and post-study interviews.

Students want to use computers in their classrooms. Students shared that they overwhelmingly (75%) preferred a computer rich classroom to a traditional classroom (25%). Students reported a higher level of engagement in classes that use technology/computers (83%) versus those that do not use computers (17%). A computer rich classroom increased student control and motivation as reflected by a participant who shared; "by using computers I was more motivated to get the work done" (Maggie, April 25, 2014, survey).

The researcher explored a rural school environment. Rural populations represent a large number of students and appear to be underrepresented in current research. The participants, tenth grade Biology students, were sampled in a traditional teacher led class without computers for one week followed by a week using computers daily.

Data supported that there is a new gap that separates students, a device divide. This divide separates those who have access to devices that are robust enough to do high-

level class work from those who do not. Although cellular phones have reduced the number of students who cannot access the Internet, they may have created a false feeling that access to a computer is no longer necessary at home. As this study shows, although most students have Internet access, fewer have access to a device that enables them to complete rigorous class work at home.

Participants received little or no training at school in proper, safe use of a computer and the Internet. It is clear that the majorities of students are self-taught or receive guidance from peers resulting in lower self-confidence or the development of misconceptions of their skill or ability.

Dedication

This dissertation is dedicated to two influential figures. My father, Lowell Hunter (1934-2012), who died before this journey was complete. A simple man who deeply valued education. Dr. Najee Muhammed (1944-2014) who taught me that the student voice needs to be heard over the din.

Acknowledgments

My sincere appreciation is extended to The Gladys W. and David H. Patton College of Education, Ohio University. There have been so many incredible conversations, experiences, trials and tribulations, impossible to list without leaving out important people and events. So to all, professors, fellow doctoral students, support and administrative staff, thank you!

Special thanks are necessary for the committee who supported this research. Dr. Ginger Weade , Dr. Henning, I feel that I have always known you. You both provided consistent support and an ear when it was needed. Dr. Geist, thank you for stepping up and helping with the final steps. Dr. Machtmes, thanks for the time and structure that allowed me to reach this milestone.

Dr. Danielle Dani, thank you for opening my eyes to research materials and readings in science education. Dr. William Larson, it was a pleasure reconnecting with you, best wishes.

I would be remiss to leave out my family, Susan, Emma, Tim and Hunter, Eve, Justin and Bella, to Mom, Lowell and Kim. Thanks for understanding the time this project demanded from the first class to these final editing days.

Table of Contents

Page

List of Tables

List of Figures

Chapter One: Introduction

Computers, in their many forms, are ubiquitous. Computers are changing the notion of what it means to use leisure time (Gandossy, 2007), what is current information (Hoffman, 2013) and what is meant by the term “learning” in the classroom (Kerpen, 2013, McNight 2014). Due to the integration of computers in the classroom, this researcher feels that the process of education is at the beginning of great change in how and when ‘education’ is consumed.

Change in the delivery of education will in some way impact students. What is missing is the voice of the students themselves. The goal of this study is to examine the use of computers in a classroom from the perspective of the student. The study specifically focused on the experience of rural students in a science classroom.

Cilesiz (2010) suggested that “experiences with technology generally, and with teaching and learning with technology specifically, are phenomena distinct from experiences with traditional forms of teaching and learning” (p.488). Sharples, Taylor and Vavoula (2007) shared that “52 per cent of everyday learning episodes involved one or more pieces of electronic technology: mobile and fixed phones, laptop and desk top computers, televisions and video-recorders” (p. 231). It remains to be discovered what the students think about the use of technology in the classroom. This study will examine students’ lived experience as they learn with technology.

In this study, the researcher examined the impact the computer rich classroom had on a students’ lived experience, how they felt and engaged with the computer. To this goal, the study investigated students’ lived experience in a traditional, lecture and paper based science classroom in comparison with the experience of the same participants in a computer rich science classroom. The teacher and student participants of both classes were the same and the classes were parallel for content and types of experiences. The science classroom was not the focus of the research study; the focus was on the lived experience of the student as they participated in a computer rich classroom.

For the purpose of this study, the researcher combined aspects of blended learning with computer activities to create a definition of a computer rich classroom. The researcher defined a computer rich classroom as one where the student spends at least 70% of class time learning with computers (computers, laptops, smart phones, software) that had been selected by the researcher to provide complementary and organic experiences.

The students spent no more than 30% of class time in face-to-face activity with the teacher. The face-to-face time may have included presenting instruction, clarification or preparing for either group or lab experiences. Unlike an online course or blended course, the teacher remained with the class to assist with any student who faced a challenge.

Student participants met in their usual classroom for the traditional class week. The computer rich classroom met in a high school computer lab. Class experiences and assignments were managed through the learning management system (LMS) Blackboard. The class experience included the use of discussion boards, online web page development, formative and summative assessments using Blackboard, and creating documents. This study examined the student lived experience at the moment in time that they engaged in the learning task rather than the participant retrospectively reflecting on their inner experience.

Problem Statement

Students today not only face the challenge of being in an educational setting, but also having to integrate computers into their classroom learning. Teachers implement new technology as it becomes available and as they personally adopt it. School systems have been required to add computer technology in the classrooms in order to comply with state mandates such as Partnership for Assessment of Readiness for College and Careers (PARCC) and end-of-course examinations.

Changes in computer use in the classroom have not been examined through the lens of the student. Students have not been included in the decision making prior to bringing computers into the class. Review of the empirical literature has not yielded any research that examines if the changes have a positive or negative impact on the students' lived experience in the classroom.

Research Objectives

The purpose of this study is to examine the student lived experience when using computers in a rural science classroom. The overarching or central question the project sought to examine was "How do rural students relate to computers as a learning tool in comparison to a traditional science classroom?"

This study investigated how students experienced the computer during a lesson, but did not examine the lesson or the content of the lesson. The content covered was secondary to the student lived experience while interacting with computers as learning tools. The student participants shared their thoughts and experiences through a pre-survey to gather demographic and prior computer use, experience sampling to capture the experience as it was lived, and through post study interviews of key participants.

Rationale and Significance

There are a limited number of studies that examine the lived experience of high school students in a classroom as they use computers. It is even more limited when the students involved in such a study are from a rural area. Using Scholar Google, a search for articles using "experience sampling" and "rural" and "schools" and “adolescent” and 2000-2014 as search parameters, resulted in 367 items. Substituting urban for rural in the search resulted in 885 items. Based on this search, including international publications, studies of the rural adolescent is underrepresented by a ratio of 2.4 to 1. A review of recent dissertation submissions (2000-current) through Pro-Quest using the same search parameters, found 160 results for rural focused dissertations and 214 urban focused dissertation projects. Although not a scientific determination, these results suggest that research on the lived experience of rural adolescents using experience sampling is limited. This study seeks to inform the body of the literature in the areas of lived experience and rural studies.

Other studies of student lived experience and computers have focused on the students stated value of the computer, test scores or engagement through using pre-post test experimental design (Chandra & Lloyd 2008; So & Brush 2007). Studies using the Experience Sampling Method (ESM) examining technology have often focused on classroom outcomes, rather than the lived experience of the student. Examples include Shernoff & Schmidt 2008; Yair 2000; Karahoca, A., Karahoca, D. & Yengin 2010. Shernoff and Schmidt (2008) used ESM to examine the classroom engagement and achievement of students broken into racial and ethnic groups. Shernoff and Schmidt found that “on-task behavior is associated with higher intrinsic motivation and affect for black students than for white students" (p. 575), and suggested that engagement for low income and minority students could be enhanced by "relevant and challenging supplemental programs, including school and after-school programs featuring strong technological, athletic, arts and social components" (Shernoff & Schmidt, 2008, p. 577).

Karahoca, A., et al. (2010) used ESM to evaluate an active learning system using computers in an undergraduate history of civilization class. The study designed a "learning system aimed to create an active learning system enhancing students' critical thinking" (Karahoca, A., et al., 2010, p. 19). The ESM flow data was collected four times during the course. The results found that "students' attitudes and perceptions are positive" (Karahoca et al., p. 19).

Understanding students' lived experience with computers will help to ensure that the use of computers in the classroom is an effective tool rather than a response to a current trend. It will benefit the educational system to understand how well students feel that they are prepared to use technology versus more traditional learning methods.

Definition of Terms

The following definitions of terms are offered to assist in understanding the study.

Classroom: Refers to the physical location where the course is being taught

Class: Refers to the student participants involved in the study. In the study, the term class represents the participants in the 10th grade Biology classroom who have consent and assent forms on file.

Experience Sampling Form (ESF): The ESM Form (ESF) (Appendix B) is modified from the Sloan Study of Youth and Social Development (Schmidt & Shumow, 2011; Hektner, Schmidt, & Csikszentmihaly, 2007; Hunter & Csikszentmihaly 2003; Hektner

& Csikszentmihaly, 2002), and the Relationship of Instructional Method to Student Engagement study (Johnson, 2008). The form will collect information on the external and internal coordinates of the students' experience. According to Hektner, et al., 2007, 'external dimensions include date and time of day, physical location, activities and companions' (p. 43). The internal coordinates refer to 'thoughts and feelings as respondents interact with other people and perform the activities that make up their daily life' (Hektner et al., p. 43).

Experience Sampling Method (ESM): Refers to the Experience Sampling Method (ESM) developed by Mihaly Csikszentmihaly. It was designed as a way to explore the inner experience of individuals in a variety of situations. Csikszentmihalyi and Larson (1987) stated the "general purpose of this methodology (ESM) is to study the subjective experience of persons interacting in natural environments" (p. 526).

Lived experience: Refers to Van Manen (1990) described lived experience as "in its most basic form, lived experience involves our immediate, pre-reflective consciousness of life" (p. 34). "Reflection on lived experience is always recollective; it is a reflection on experience that is already passed or lived through" (Van Manen, 1990, p.10). Csikszentmihalyi (2007) described experience as those that are "naturally occurring contexts of everyday life. By experience we mean any of the contents of consciousness: thoughts feelings, sensations" (p. 4).

Intrinsic motivation: Refers to the interactions between individuals and in the relation between the individual and activities. Deci and Ryan (1985) state that "interest-excitement is said to be the basis of intrinsically motivated behavior" (p. 28). Satisfying basic psychological needs may occur if the activity is of itself interesting, novel, challenging or has aesthetic value for the individual. In this case, finding learning tasks that are interesting may increase motivation in the student. Learning tasks that provide feelings of competence or self-efficacy may also positively influence intrinsic motivation by meeting this basic need.

Extrinsic motivation: Refers to behavior that is not "performed out of interest but because they are believed to be instrumental to some separable consequence" (Deci & Ryan, 1991, p. 328). Extrinsic motivators such as reward and punishment systems are common to the educational system.

Rural: Refers to rural populations, which represent a large number of students and appear to be underrepresented in current research. According to de la Varre, Keane and Irvin (2011) "rural schools make up 30% of all schools in the U.S. and educate approximately 10 million children" and "it is important to focus on ways to support rural online learners and improve outcomes for these students" (p. 2). de la Varre, Keane and Irvin (2010) also suggested that technology rich online distance education "could potentially broaden educational and career opportunities for high school students, and rural schools better prepare their students for post-secondary education, where digital literacy is essential" (p. 195).

Computer rich classroom: Refers to a classroom where the student will spend at least 70% of class time learning with computer technology (computers, laptops, smart phones, software) that has been selected by the educator to provide complementary and organic experiences. The students will have no more than 30% of class time spent in face-to-face activity with the teacher.

Chapter 2: Technology Student Interaction

Computers are creating a new mix of classroom pedagogy from fully online (synchronous and asynchronous) to blended classes with both face-to-face and online components. Access to online information and classroom technology integration potentially create rich classes that include aspects of both blended and traditional classrooms. As computer rich classrooms become an integral part of the high school experience, understanding students' attitudes toward such classes and their impact on student learning becomes critical (Chandra & Fisher, 2009). Chandra and Fisher (2009) suggest, "given that students have positive perceptions of such an environment (web based learning), further strengthens the case for such an approach" (p. 43).

A standard definition for a "computer rich" classroom has not been established. Since there has been considerable research in the area of blended learning and the computer rich classroom shares attributes of blended learning (computer use, web access); a discussion of blended learning will be included to assist in defining a computer rich classroom.

Describing a computer rich classroom, Nora and Snyder (2009) suggested, "certain types of IT involvement (e.g., student-faculty interaction via the Internet or email outside of the class setting) could be perceived as types of engagement on their own" (p.16). In some cases, a computer rich classroom is simply one that uses computers without sharing the extent to which the computer is used (Pargas, Levin & Austin, 2005). Drijvers, Doorman, Boon, Reed and Gravemeijer (2010) define computer rich classrooms by the use of a specific "Java applet, Algebra Arrows" (p. 5). Zandvliet and Straker

(2001) defined computer use by students of "mean daily laptop use of 3.2 hours ranging up to 15 h and mean weekly laptop use if 16.9 h ranging up to 80 h" (p. 839).

Levin and Wadmany (2006) described the computer rich classroom to include "computers, multimedia and a variety of software" (p. 163) where the students "assume the role of tutors to their peers and teachers in operating and communicating with computers" (p. 173). Goos, Renshaw, Galbraith, and Geiger (2000) defined a computer rich classroom as one that included the use of graphic calculators and projecting white boards.

Van Rooy (2012) suggested that information and communication technology "might support or replace practical work" and "multimedia and the Internet could be used to develop scientific reasoning" (p. 66). In this study, the classrooms included computers for each student, data projector, electronic whiteboard, Internet and content specific software.

Use of computers offers flexibility for learning based on the individual needs of the student consumer. This flexibility can be woven into a traditional classroom in similar ways as it is being used in blended or online classes. Students may attend class at any location they choose, at any time they choose and receive feedback that is prompt and directed to their needs. "Hybrid or blended models most frequently emerge as the most effective learning strategy", suggested Skill and Young (2002), and that "the creation of new learning environments should embrace both virtual and real spaces" (p. 24). Hoadley (2007) suggested that the goals of e-learning in particular include "producing and evaluating interventions using technology that lead to student learning outcomes" (p. 139).

Blended Learning

Blended learning offers an example of a high use of computers and educational technology in the classroom. Blended learning includes learner focused synchronous and asynchronous components. Gayol (2010) defined blended learning as "a certain percentage of the program occurs in a face-to-face mode and the rest online" (p. 198). Bonk, Olson, Wisher and Orvis (2002) suggested that blended learning "is a learner-centered model" (p.99). de la Varre, Keane and Irvin (2011) defined blended learning as the "organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies" (p. 2).

Derntl and Motschnig-Pitrik (2004) defined blended learning experiences as a way to "blend face-to-face and web-supported learning such that the strengths of both settings can be exploited" (p. 916). Ginns and Ellis (2006) stated blended learning is "integrating learning experiences across face-to-face and online contexts toward the achievement of their learning outcomes" (p. 55). Chandra and Fisher (2009) described a blended course as one that spends 30-70% in using online content (p. 32).

Classroom Studies

Studies (Chandra & Lloyd 2008; So & Brush 2007) have looked at responses to or student's stated value of specific technology based classroom tasks. Chandra and Lloyd examined student enjoyment of the class by looking at test scores and retrospective interviews. So and Brush used the Student Perception Questionnaire and found that students who identified high levels of collaborative learning found greater satisfaction in distance learning courses.

Classroom specific studies have examined the engagement of students in computer rich blended classrooms. These have included blended learning in physics (Chandra & Waters 2011) using surveys and test-pretest experimental design; in biology (Yapici & Akbayin 2012) using pre-post test experimental design; and in geography (Korkmaz & Karakus 2009) through pre-post test experimental design. In these studies, students were generally positive about the instructional value of a blended classroom.

Goos et al. (2000) conducted a three-year longitudinal study to examine the role of technology in "facilitating students' exploration of mathematical ideas and in mediating teacher-student and student-student interaction" (p. 307). The data was collected by video and audio tape with interviews at regular intervals. The study developed four metaphors to describe the students' interaction with technology. "Technology as master" described a situation where the "student is reduced to blind consumption of whatever output is generated, irresponsive of its accuracy or worth" (Goos et al., 2000, p. 312). "Technology as servant" suggested that the "user is in control and instructs the technology as an obedient but dumb assistant" who's accuracy is monitored in case of errors (Goos et al., 2000, p. 312). "Technology as partner" showed the user in control with an understanding that outcomes needed to be judged for context and accuracy (Goos et al., 2000, p. 312). "Technology as an extension of self" was the "highest level of functioning" with the technology becoming "as much a part of the user's catalogue of resources as tabulated information and mathematical knowledge inside the head" (Goos et al., 2000, p. 312).

Van Rooy explored the use of computers in a Biology class through videotape and student work analysis. In the study, Van Rooy (2012) found that information and communication technology benefited student learning by “increasing students’ self management” which enabled “them to track their own progress, thereby allowing the teacher more time to support student learning” (p. 77). Students’ “in-depth intellectual engagement with content was supported by digital technologies” (Van Rooy, 2012, p. 79).

Barriers to Technology Use in the Classroom

Technology is common in students’ hands but barriers exist to its use in the classroom. Mueller, Wood, Willoughby, Ross and Specht (2008) reported, “computers are underused in many schools and the potential of computer technology is not being recognized” (p.1524). The underuse of computers may be caused by barriers teachers experience to implementing technology in their classroom. Identified barriers include support, state standards, money, access, time, assessments and the beliefs of other teachers (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, E., & Sendurur, P., 2012). In many states, non-charter public school systems are restricted from embracing a blended classroom due to mandatory student attendance with reimbursement tied to attendance versus student progress.

A risk to the adoption of technology in the classroom has been the assumption that all students are equally enamored with technology. “The persistent claim that students are adept with and interested in new technologies erases variation among students and the context specificity of interest and competency within each student” (Philip & Garcia, 2013, p. 308). According to Phillip and Garcia (2013) there continues to be a naïve belief “among educators and researchers that technological devices will evoke interest, relevance, and engagement in student learning because of their popularity among youth" (p. 308).

Self-Determination and Optimal Experience Theory

This project was grounded in the self-determination theory of Edward Deci and Richard Ryan and the optimal experience theory of Mihalyi Csikszentmihaly. Self-determination theory considers the variables that influence both the intrinsic and extrinsic factors of motivation. The Csikszentmihaly optimal experience or flow theory's main emphasis is on the lived experience when attention is focused on realistic goals and when skills match the opportunity for action. Both theories address the impact of factors that are internal and external to the student (see Figure 1) and how they can encourage or discourage engagement.

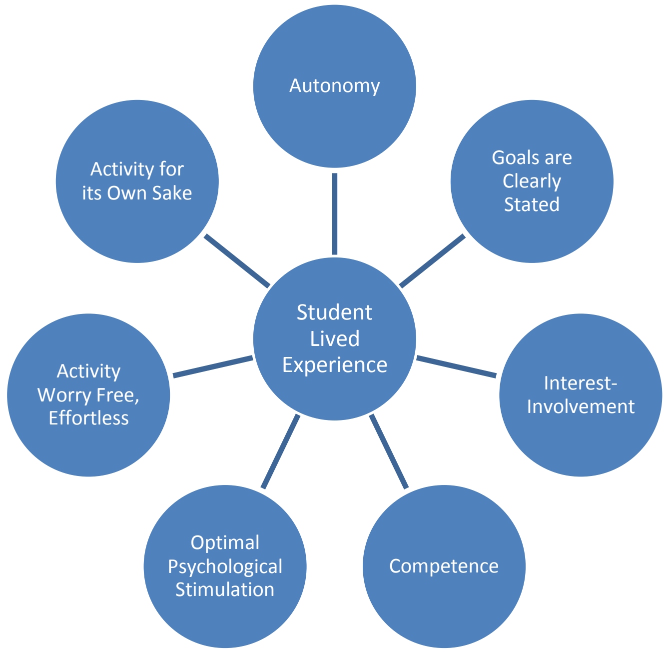

Figure 1. Variables from Self-Determination Theory and Flow that Influence Students Lived Experience.

Self-Determination Theory

"Self-determination theory addresses such basic issues as personality development, self regulation, universal psychological needs, life goals and aspirations, energy and vitality, non conscious processes, the relation of culture to motivation, affect, behavior, and well being" (Deci & Ryan, 2008, p. 182). The self-determination theory provided a lens through which to examine the basic psychological needs, intrinsic and extrinsic motivation and the idea of optimal stimulation of the participants.

The three basic psychological needs considered in both intrinsic and extrinsic motivation are "competence, relatedness, and autonomy (or self-determination)" (Deci & Ryan, 1991, p. 327). Self-determination theory is "framed in terms of social and environmental factors that facilitate versus undermine intrinsic motivation" (Deci & Ryan, 2000, p.58).

Intrinsic motivation exists in the interactions between individuals and in the relationship between the individual and activities. Deci and Ryan (1985) state that "interest-excitement is said to be the basis of intrinsically motivated behavior" (p. 28). Satisfying basic psychological needs may occur if the activity is of itself interesting, novel, challenging or has aesthetic value for the individual. In this case, finding learning tasks that are interesting may increase motivation for the student. Learning tasks that provide feelings of competence or self-efficacy may also positively influence intrinsic motivation by meeting this basic need.

Autonomy or being given the opportunity for choice and self-direction is another key intrinsic motivator. According to Deci and Ryan (2000), "students who were overly controlled not only loose initiative but also learn less well, especially when learning is complex or requires conceptual, creative processes" (p. 59). Where teachers encouraged autonomy for their students, the teachers "catalyze in their students greater intrinsic motivation, curiosity and the desire for challenge" (Deci & Ryan, 2000, p. 59).

For intrinsic motivation to occur, the individual must also experience an optimal level of psychological stimulation. Change from the optimal level "motivate the organism to engage in behavior that will restore the optimal stimulation" (Deci & Ryan, 1985, p. 21). The optimal level considers that both "threat and puzzle have positive motivating value, beyond that point negative value" (p. 21). Deci and Ryan (1985) suggested that people are more likely "to engage in intrinsically motivated behaviors, such as exploration and manipulation, to increase their level of stimulation" (p. 21).

Extrinsically motivated behavior is not “performed out of interest but because they are believed to be instrumental to some separable consequence” (Deci & Ryan, 1991, p. 328). Extrinsic motivators such as reward and punishment systems are common to the educational system. Although thought useful in controlling behavior, “they also tend to undermine intrinsic motivation for interesting tasks and to impede the internalization of regulations for uninteresting tasks” (Deci & Ryan, 1991, p. 335).

Deci and Ryan (1991) reported that when students are “given choices about what tasks to engage and how much time to allot”, that “highlighting choice” in the task and “acknowledging their feelings of not liking the task or not liking the requested way help them feel self determined” (p. 336).

Optimal Experience and Flow State

Csikszentmihalyi’s (2008) flow theory describes the optimal experience as one where the individual has the:

> sense that one’s skills are adequate to cope with the challenges at hand, in a goal directed rule-bound action system that provides clear clues as to how well one is performing. Concentration is so intense that there is no attention left over to think about something irrelevant, or to worry about problems. Self-consciousness disappears. (p. 71)

In activities where optimal experience, also known as flow, is experienced, individuals perform the activity for its own sake without seeking additional rewards. When individuals experience optimal or flow experience, at least one of the following are reported: working on a task they have a chance of completing, concentrating, task provides clear goals with immediate feedback, expending effortless involvement removed from the worries or frustration of everyday life, controlling their actions, removing concern for themselves and the sensing of time may feel altered (Csikszentmihalyi, 2008).

Flow is the "state which enables the development of aptitudes" (Albert-Lorincz, E., Albert-Lorincz, M., Kaddar, Krizbai & Lukas-Martin, 2010, p. 81). Aptitude in the classroom relates to the students ability, capability, innate or acquired capacity, readiness or quickness in learning ("aptitude", 2013). Achieving a flow experience is dependent on the personality of the individual, their being responsible for the outcome or objective and having the technical ability to accomplish the task.

If there is "conformity between the requirements and the existing abilities" of the participant, the flow state will be experienced (Albert-Lorincz, E., et al., 2010 p. 82). When flow occurs, the individual experiences a "subjective buoyancy of experience when skillful and successful action seems effortless, even when a great deal of physical or mental energy is exerted" (Shernoff & Csikszentmihalyi, 2010, p. 132).

Student engagement and flow are related. Johnson (2008) stated, "engagement refers to the quality of students' involvement and experience during learning" (p. 71). Involvement in the task affords the student with the desire to stay with the task. Shernoff and Csikszentmihalyi (2010) suggested that the relationship between flow and student engagement be described as the "simultaneous occurrence of high concentration, enjoyment and interest in learning activities" (p. 133). "When things are interesting, concentration comes easy and persisting at them is less laborious and burdensome" (Hunter & Csikszentmihalyi, 2003, p. 28).

Experience Sampling Method (ESM)

Optimal experience and flow state are examined using the Experience Sampling Method (ESM) developed by Mihaly Csikszentmihaly. It was designed as a way to explore the inner or lived experience of individuals in a variety of situations. Csikszentmihalyi and Larson (1987) stated the “general purpose of this methodology (ESM) is to study the subjective experience of persons interacting in natural environments” (p. 526).

Studies using the Experience Sampling Method (ESM) examining student computer use have focused on classroom outcomes. Examples of studies of blended classes include Shernoff & Schmidt 2008; Yair 2000; Karahoca, A., et al., 2010. Shernoff and Schmidt (2008) used ESM to examine the classroom engagement and achievement of students stratified into racial and ethnic groups. They found that “on-task behavior is associated with higher intrinsic motivation and affect for black students than for white students” (p. 575). They suggested that engagement for low income and minority students could be enhanced by “relevant and challenging supplemental programs, including school and after-school programs featuring strong technological, athletic, arts and social components” (Shernoff & Schmidt, 2008, p. 577).

Karahoca, A., et al. used ESM to evaluate an active learning system using computers in an undergraduate History of Civilization class. The study designed a “learning system aimed to create an active learning system enhancing students’ critical thinking” (Karahoca, A., et al., 2010, p. 19). The ESM flow data were collected four times during the course. The results found that “students’ attitudes and perceptions are positive” (Karahoca, A., et al., 2010, p. 19).

In many quality of life studies, only global assessments of complex phenomena have been presented. “The data are gathered in retrospect, outside of the context of the situation, thus permitting distortions and rationalizations to become important” (Csikszentmihalyi & Larson, 1987, p. 527). “Time budget studies have been obtained from observer data or diaries that do not provide direct access to the subjects’ internal states. Nor in these studies is it clear what the link is between behavior and psychological state or between time use and experience. The ESM, which assesses subjects in real time and context, attempts to overcome some of these shortcomings” (Csikszentmihalyi & Larson, 1987, p. 527).

Individual responses through surveys or retrospective diary studies have little consistency or may not be the most accurate method of data collection (Hektner & Csikszentmihalyi, 2002, p. 234). ESM, through repeated measures, allows for ‘questions such as the following to be answered: How much of the person’s variation in happiness (or any other state) is related to what the person does; to the company he or she keeps; to the time of day; to intervening events” (Csikszentmihalyi & Larson, 1987, p. 533). This will enable the researcher to “understand the actual experience of flow (not a memory of it) and how an individual’s state changes” (Finneran & Zhang, 2002, p. 1051). The repeated signaling nature of the ESM encouraged the participants to construct a “full description of his or her conscious experience” (Moustakas, 1994, p. 74). Moustakas (1994) called the description textural and includes “thoughts, feelings, examples, ideas situations that portray what compromises an experience” (p. 47).

ESM allowed the research to take place in the students’ usual environment, not in a laboratory setting. The reaction of individuals when in a laboratory setting may not be typical of the daily experience. Crano and Brewer (2009) called this the "self-consciousness effect" (p. 98). They suggested that responses "of the individual conscious of the fact that he or she is under observation could be expected to be very different from those of persons who do not posses this information" (Crano & Brewer, 2009, p. 98). Csikszentmihalyi and Larson (1987) suggest, "imagery evoked in a laboratory setting is not necessarily typical of experience encountered in real life situations" (p. 527). Therefore, studies that take place in the participants' familiar classroom environment, avoid the need to establish "experimental realism within the laboratory setting" (Crano & Brewer, 2009, p. 86).

Fischer (2009) suggested that ESM "is concerned with the experience that is covert to the eye of the observer, as it is subjectively perceived" (p. 1047). Koro-Llundberg, Bussing, Williamson and M'Cormack-Hale (2008) defined ESM as a method that "privileges the individual experiences and personal meanings of participants as it aims to collect data about both the context and content of their daily lives while utilizing systematic and controlled data-collection methods" (p. 340).

ESM Models

There are several models of ESM commonly used. Hektner, Schmidt and Csikszentmihalyi (2007) described the three most common types as interval-contingent, event-contingent and signal contingent sampling. Interval contingent sampling allows the participant to respond to "self reports at the same time every day or at regular intervals e.g., hourly reports" (Hektner, Schmidt & Csikszentmihalyi, 2007 p. 40). Interval contingent creates anticipation for the participant who knows when the next signal will occur. The anticipation or expectancy provides time for the participant to create a response that they feel the researcher may be searching.

Event-contingent sampling models have the "participant complete self reports when a pre-designated event or occurs (e.g., reporting after every social interaction) (Scollon, Kim-Prieto & Diener, 2003, p.7). Like interval contingent, the event-contingent model opens a study to anticipation or expectancy effects of the participants.

The signal-contingent sampling model has the participant complete the self-report form only when signaled by the researcher. The goal of the signal-contingent sampling is to gain a "representative sample of a person's everyday situations and the related experiences and activities" (Hormuth, 1986, p. 270). A benefit of the signal-contingent approach is that it "allows for the sampling at a representative sampling of times, and avoids any expectancy effects that may come from having prior knowledge of the sampling period" (Scollon, et al., 2003, p. 7).

Challenges

Koro-Llundberg, et al.(2008), suggested that collecting data through ESM is "ongoing and a part of participants' lives" and "influences participants' everyday lives in ways unanticipated" and "can result in participants withholding crucial, study related information" (p. 352). Withheld information might include mood or emotional state, day dreaming, being off task, and what the participant really experienced. Koro-Llundberg et al. (2008) stated that "self reports, are never complete descriptions of 'true' reality but are always at least partially misleading, inconsistent, or incomplete because of the nature of social research" (p.353) and that "individual differences can yield very different flow experiences from the same activity" (Finneran & Zhang, 2002, p. 1047).

Csikszentmihaly and Larson (1987) stated that the major limitation if the ESM is "its dependence on respondents' self reports" (p. 533). This issue becomes a "concern in situations in which it is conceivable that a large segment of one's sample provided inaccurate or distorted data" (Csikszentmihaly & Larson, 1987, p. 533).

According to Scollon, et al. (2003) the signal itself can become "an onerous task for most people" (p. 14). Signals can "disrupt one's activities, conversations, and work, and may not only annoy oneself but surrounding others as well, such as in church, classrooms, or meetings" (Scollon, et al., 2003, p14). Since ESM "can be intrusive in various social settings" (Koro-Llundberg et al., 2008, p. 341), an ESM study may lead to "certain types of individuals to be over- or underrepresented" (Scollon et al., 2003, p.14). "Less motivated participants may drop out" leaving participants who show "greater motivation, conscientiousness, agreeableness, or other characteristics that may not make them a representative sample" (Scollon et al., 2003, p.15). Participants must be able to "hear and respond to the signals" which may exclude certain elderly individuals and those who work in loud environments (Scollon et al., 2003, p.15).

Conner and Bliss-Moreau (2006) suggest that reactivity or the alteration of behavior due to being observed can be an issue with the use of ESM. "Sampling may sometimes lead participants to begin limiting risk behavior (presumably because they become aware of how much they partake in risky behavior)" (Conner & Bliss-Moreau, 2006, p. 115).

Since the ESM reduces each response to one activity choice, "it is likely that other tasks were reported more often than conversation" (Rah, Walline, Mitchell & Zadnik, 2006, p. 487). Rah et al. (2006) suggested that this could lead to a "skewed impression of the amount of time that is spent on conversation" for example (p. 487).

Lived Experience and ESM

The study sought to "describe the common meaning for several individuals of their lived experiences of a concept or phenomenon" (Creswell, 2013, p. 76). Van Manen (1990) described lived experience as "in its most basic form, lived experience involves our immediate, pre-reflective consciousness of life" (p. 34). "Reflection on lived experience is always recollective; it is a reflection on experience that is already passed or lived through" (Van Manen, 1990, p.10). Csikszentmihalyi (2007) described experience as those that are "naturally occurring contexts of everyday life. By experience we mean any of the contents of consciousness: thoughts feelings, sensations" (p. 4).

Literature that examines the current use of computers in the classroom is not uncommon (Chandra & Lloyd 2008; Goos et al. 2000; Korkmaz & Karakus 2009; So & Brush 2007; Van Rooy, 2012; Yapici & Akbayin 2012). Literature that examines the student lived experience using ESM is not as common. A recent ProQuest search found four dissertations that examined student lived experience using the ESM, all in urban schools (Anderson 2012, DiBianca 2000, Johnson 2004, Shernoff 2001).

Richard DiBianca (2000) examined student engagement in urban math and science classes. His study suggested that the "more an instructional format was student-paced, challenging, and interactive, the more likely student engagement would be higher" (p. xi).

Although not focused on science classroom experience, David Shernoff (2001) suggested, "activities and classrooms that combined academic intensity with features that provoke a positive emotional response would be most engaging in the short term and the long term" (p. xiv). Lisa Johnson (2004) examined non-traditional high schools that offered a "high degree of student choice and control within the classroom" fostered student engagement with their learning (p. iii). Brett Anderson (2012) found that "Classroom contextual factors of assessment and support" resulted in more engagement of students in a high school class (p. i).

In a meta-study of e-learning publications by European authors between 2003 and 2005, Gayol (2010) found that "only one third of the selected papers were related to teaching and learning issues, whereas 60% of them focused on technology issues and 10% were concerned with policies and strategies" (p. 200).

Using ESM, Johnson (2004, 2008) identified that schools that offered more collaborative learning resulted in greater student engagement. Shumow, Schmidt and Kackar (2008), examined high school students experience with homework and found that college bound students "reported doing homework the equivalent of three hours per day" (p. 22), "most students did focus on homework as their primary activity" (p. 23), and reported "more negative affect when homework is a primary activity are balanced by higher reported cognitive engagement in the same context" (p. 23). Schmidt and Shumow (2011) examined the perceived competence and subjective experience of ninth graders in science class and found that "they experience a rocky beginning in high school science class" (p. 13). The students "struggled in their science classes in that they felt less engaged, less successful and had lower self-esteem during class relative to older adolescents" (Schmidt & Shumow, 2011,p. 14).

Martinez (2009) found that Mexican American students reported the "highest average level of challenge as compared with students of other racial/ethnic groups" (p. 312). Latino students reported "significant decreases in levels of challenge when at home versus when not at home possible because of non-challenging homework assignments" (p. 312).

Moreno, Jelenchik, Koff, Eikoff, Diermeyer and Christakis studied Internet usage by undergraduate students. Results found "low correlation between the ESM measured internet use and self reported internet use" and social networking site "use was the most frequently reported internet activity" (Moreno et al., 2012, p. 1101).

Nett, Goetz and Hall (2011) examined boredom in a mathematics classroom. Results show "students to experience some level of boredom 58% of the time spent in mathematics classes" (Nett, Goetz, & Hall, 2011, p. 56). Nett et al. (2011) identified that "classroom environment is indeed a critical determinant of students' boredom experience and thus could potentially be modified to significantly reduce this deleterious emotion" (p. 56). Hunter and Csikszentmihaly (2003) examined interest in adolescents and found "interested children are much more likely to view themselves as effective agents in their world" (p. 33).

Rural

"Urban areas are defined as having 1,000 people or more per square mile, while rural communities have fewer than 150 people per square mile" (Truscott, D. & Truscott, S., 2005, p. 124). de la Varre, Keane and Irvin (2011) stated that "rural schools make up 30% of all schools in the U.S. and educate approximately 10 million children" (p.2). "This means that in 2001 about one of every six kindergarten classes, one out of every six biology classes, and one out of every six American government classes were held in a rural school (Arnold, 2004, p. 1). de la Varre et al. (2010) suggested that computer rich online distance education "could potentially broaden educational and career opportunities for high school students, and rural schools better prepare their students for post-secondary education, where digital literacy is essential" (p. 195). "It is important to focus on ways to support rural online learners and improve outcomes for these students" (de la Varre, et al., 2010, p. 2). "Rural students represent a significant population that is affected by decisions made by educators and policymakers at the local, state and federal levels" (Arnold, 2004, p. 1).

Although rural schools represent a considerable number of US students, attention is more easily directed to urban schools and youth "because major media outlets are located in cities, or because high population densities in cities make the challenges more visible, or because voters are concentrated in cities" (Truscott, D. & Truscott, S. 2005, p. 123). Evans, Vermeylen, Baras, Lefkowitz and Hutt (2009) stated, "contrary to media portrayals to the contrary, that in absolute terms, the largest number of low-income children and youth in America are white, and that a disproportionate number of them live in rural areas where both the depth and persistence of poverty is more severe than in urban settings" (p. 170-171).

For many years, rural areas were "thought to be an idyllic setting equated with the absence of stressors for rural adolescents, resulting in a lack of research on this population" (Atav & Spencer, 2002, p. 53). When health risk behaviors are compared between rural, suburban and urban youth, a different view is presented. Atav and Spencer (2002) found that rural adolescents, grades 7, 9, 11, "were at highest risk for the use of tobacco, alcohol and other drugs, history of pregnancy, carrying a knife, club or other weapon at school and carrying a gun at school or in the community" (p. 63).

While examining stressors of rural adolescents, Evans et al. (2009) found that generally their "lives were not characterized by profound storm and stress" (p. 170). Although school level stressors were focused on workload and performance, Evans et al. (2009) found many school level stressors focused on "inadequate teacher support" (p. 170).

"Students living in rural areas of the United States exhibit lower levels of educational attainment and a higher likelihood of dropping out of high school than do their nonrural counterparts" (Reeves & Bylund, 2005, p. 361). Rural schools "typically offer fewer advanced and college preparatory courses, and lower proportions of rural students take advanced classes such as physics and calculus" (Arnold, 2004, p. 3).

Rural schools "are at a considerable disadvantage in an increasingly competitive market for teachers" who meet the highly qualified requirement and are able to teach higher level classes (Arnold, 2004, p. 4). Teachers in rural schools "often must teach a number of different courses that span several subjects" and that "science and math teachers often had less subject-matter coursework than their nonrural peers" (Southern Rural Development Center, 2005, p. 57). This issue is shared with urban schools where "urban schools systematically receive less qualified teachers" (Lankford, Loeb, &Wyckoff, 2002, p.55). Rural areas have "disadvantages relative to urban areas in terms of offering workers competitive returns to education, or returns that are commensurate with the costs incurred by individuals as they pursue their education" (Southern Rural Development Center, 2005, p. 9).

A review of recent dissertation submissions (2005-current) through Pro-Quest, found no projects that evaluated adolescents' lived experience in a rural, technology rich science class. The search was completed using either technology or blended course as search terms. Neither search produced results that offered current dissertation research in this area. This was a novel research approach that would add to the pool of knowledge of rural students' lived experience.

A review of the literature shows that computer use in the classroom is increasing. Classroom studies have examined the use of the computer as a classroom tool. The use of experience sampling to examine computer use has focused largely on homework, perceived competence, challenge, Internet usage and boredom in predominately-urban classrooms. Rural classrooms do not appear to be studied robustly, leaving questions about rural students' engagement unasked and unanswered. Given this review there appeared to be a paucity of studies of computer use in rural classrooms. This research study endeavored to inform the area of rural students' use of computers in a science classroom.

Digital Divide

In the 1990s, personal computers became a household device. At the same time, access to the Internet and World Wide Web became more common. The growth and access led to "disparities in using computers across certain populations" (Strover, 2014, p. 115). The disparity was used to "define the digital divide as a matter of physical access to the technology" (Strover, 2014, p. 115). Brandtzaeg, Heim and Karahasanovic (2009) defined the digital divide as "not only the access divide but the imbalance of Internet useage" (p. 1). Wei, Teo, Chan and Tan (2011) suggested the access divide "covers both hardware access as well as use of software" (p. 171). Wei et al. (2011), suggested, "lack of access to IT is likely to deprive young people of opportunities to develop computer self-efficacy" (p. 170). Strover (2014) also suggested, "gaps in technology use and access are among many factors that keep certain population groups at a disadvantage (p. 117).

Wang (2013) stated that the digital divide "refers to the inequities among individuals who have access to technology and opportunities to learn ICT skills" (p. 128). In the context of the school environment Wang suggested three levels of the divide and the disparity between rural and urban school experiences. The first level addresses the "equitable access to hardware, software, the Internet, and technology support" (Wang, 2013, p. 128). The second level "addresses how frequently students and teachers use technology" and the third level of the digital divide focused on how "technologies are used to empower the individual within the context of a school (Wang, 2013, p. 128). Wang found that teachers in urban areas scored high in levels of being familiar and confident in use of technology. Rural teachers did not reach this level, perhaps due to "limited peer support and school pressure" (Wang, 2013, p. 137). Student scores in "attitudes (enjoyment and self efficacy)" were "positive toward technology integration, no matter if rural or urban schools" (Wang, 2013, p. 137).

In the most recent National Telecommunications and Information Administration (NTIA) report of October 2014, the evidence for a digital divide continues to persist. The NTIA has moved to focusing on access to the Internet mainly through the use of cell phones. Although the use has blossomed, accessing the Internet through a phone is still problematic "with 44 percent of urban dwellers reporting they used their mobile phones for that purpose compared to 31 percent of rural residents" (NTIA, 2014, p.vi). "Eightyfive percent of rural dwellers reported using a mobile phone in 2012", for urban Americans mobile phone use increased "from 86 to 88 percent" (NTIA, 2014, p. 6). Although the rates have increased, how the phone is used continues to exhibit a divide with:

> 45 percent of urban mobile phone users checked or sent email with their devices, only 29 percent of their rural counterparts reported doing so. Additionally, rural users were 13 percentage points less likely to browse the Web on their phones, 12 percentage points less likely to download apps, and 8 percentage points less likely to use social networks. Slower wireless network speeds in rural areas, in addition to demographic differences between urban and rural dwellers, may partially explain these disparities (NTIA, 2014, p. 9).

Cyberbullying

The use of computers in the classroom may create the unintended consequence of increasing cyber bullying. Bullying itself is not a new concern in the classroom. "According to the National School Safety Center, bullying is the most enduring and underrated problem in US schools" (Smokowski, Cotter, Robertson & Guo, 2013, p. 1). Smokowski et al. (2013) shared that "although prevalence rates of bullying in rural, urban, town, and suburban areas are equal, 3% to 5% more rural youth reported ever bullying than youth in urban, town, and suburban areas" (p. 2).

Cyber bullying is described as "using information and communication technology (ICT) to intentionally harm a target by affecting his or her social status, relationships, and reputation" (Bauman & Newman, 2012, p. 27). Features of cyberbullying include that the "harm inflicted on the victim is psychological rather than physical", more often occurs at "home rather than the school or social setting" and includes "anonymity, which results in an absence of accountability and identifiability" (Burton, Florell & Gore, 2012, p. 318). The perceived anonymous nature of the Internet "may create an online disinhibition effect which reduces the usual social sanctions against cruelty" (Bauman & Newman, 2012, p.28). Bauman and Newman (2012) found that the "emotional distress caused by victimization is a function of the nature of the specific incident, rather than the method of delivery" (p. 34). Research has found that "being a victim of cyberbullying was associated with negative mental health and behavioral concerns such as loneliness, conduct problems and feelings of fearfulness" (Parris, Varjas, Meyers, 2014, p. 587).

Chapter 3: Methodology

The study examined the lived experience of participants in a computer rich classroom, their engagement through computer use, motivation and thoughts or feelings as they completed tasks. In this respect, the researcher had no preconceived idea of what the experience of the participants would be.

The project examined how the participants experienced the computer, not the lesson. This study focused on the student-computer relationship. Moustakas (1994) used the term "phenomenological" studies for this approach "because it utilizes only the data available to consciousness" (p.45). The researcher was sensitive to the demands of phenomenological research including the necessity of epoche or refraining from judgment; phenomenological reduction, to bracket out presuppositions; use of imaginative variation, to sort for themes; and to seek the essence or unified expression of the experience as describes by the participants. The computer rich classroom itself had no meaning until the participants shared their thoughts and feelings of the experience.

Site Selection

Rural research.

The researcher explored a rural school environment. Rural populations represent a large number of students and appear to be underrepresented in current research. According to de la Varre, Keane and Irvin (2011) "rural schools make up 30% of all schools in the U.S. and educate approximately 10 million children" and "it is important to focus on ways to support rural online learners and improve outcomes for these students" (p. 2). de la Varre, Keane and Irvin (2010) also suggested that technology rich online distance education "could potentially broaden educational and career opportunities for high school students, and rural schools better prepare their students for post-secondary education, where digital literacy is essential" (p. 195).

A search of recent dissertation submissions (2000-current) through Pro-Quest found no projects that evaluated adolescents' lived experience in a rural, technology rich science class. Using the same search criteria and substituting "urban" for "rural" resulted in four dissertation projects, DiBianca (2000), Shernoff (2001), Johnson (2004), and Anderson (2012). Richard DiBianca (2000) examined student engagement in urban math and science classes. His study suggested that the "more an instructional format was student-paced, challenging, and interactive, the more likely student engagement would be higher" (p. xi).

Although not focused on a science classroom experience, David Shernoff (2001) suggested, "activities and classrooms that combined academic intensity with features that provoke a positive emotional response would be most engaging in the short term and the long term" (p. xiv). Lisa Johnson (2004) examined non-traditional high schools that offered a "high degree of student choice and control within the classroom" which fostered student engagement with their learning (p. iii). Brett Anderson (2012) found that "Classroom contextual factors of assessment and support" resulted in more engagement of students in a high school class (p. i).

The study was conducted in a rural Ohio school. The district had an average daily population of 525 students, K-12. The students were 98.2% White, with the balance of students reported as Asian (.16), American Indian/Native Alaskan (0.29), Black (0.32), Hispanic (0.65), Multi-racial (0.38). Thirty-three percent of the students lived in poverty and 11% had a cognitive and/or physical disability. The median income of the district was $29,600 per year. The 2014 poverty rate for a family of four is $23,850 per year.

Sampling and Participants

The participants in the study were grade ten Biology students. The student participants were first sampled in a traditional teacher led class without the use of computers for one week. Classroom activities included note taking, text reading, lab experience, paper based quiz, direct instruction, and worksheet completion. The specific lesson was not important to the study. The lesson used in the study was determined by the curriculum being taught to the students at the time of the study.

A computer rich pedagogical approach began the second week of data collection. The second week included the use of electronic text, note taking using Google docs, discussion board response and response to peers, quizzes with immediate feedback, and a web site development project (Table 1).

Due to the small size of classes in this rural school, all students in the Biology class were invited to participate. Participation in the study was voluntary. The number of student participants was 40 individuals. The final number of participants was determined by the number of students who returned parent consent, student assent forms and who were present for the class.

The researcher selected key informants from the sample who were asked to participate in post technology experience interviews. The key informants were identified by the researcher by direct observation during class and the results on the submitted ESF. The researcher focused upon participants who were observed to be most and least engaged with the technology. The researcher selected key informants that represented both genders and IEP/general status.

Table 1

Comparison of approaches of classroom activities

	Traditional Classroom	Technology Rich Classroom
Vocabulary	Terms and definitions from text book, written (term, definition, question)	Terms and definitions from interactive textbook (CK12), Google doc created
Formative/Summative Assessment	Paper based quiz/test	Computer based quiz/test using blackboard (instant feedback, multiple attempts)
Project		Web page (group)
Lab	Hands on Lab with write up(group)	
Assignment	Worksheet	Discussion board response
Learning Objectives	Written	E-journal
Teacher approach	Lecture based, pace controlled	Limited teacher direction, student managed pace

Table Note. The curriculum covered is considered insignificant to this study.

Data Collection

The study examined the lived experience of student-participants as they engaged with computers in a science classroom. The study strived to collect data in three ways: a pre-study survey, ESF, and interviews with key informants (Table 2).

Participants used a researcher-provided three-digit code as their identifier for each of the data collection tools. A master code list was kept by the researcher until all data has been verified and the dissertation is completed. The master code list was be kept in a locked cabinet until it was destroyed.

Pseudonyms are used when direct quotations are used in the data analysis and when transcriptions are created from the interviews. Interviews were digitally recorded. The recordings will be stored on an external hard drive and locked in a storage cabinet. Recordings will be destroyed after having been transcribed, all data has been verified, and the dissertation is completed.

Table 2

Research question and data source

Research Question	Method	Expected information
1. How do rural high school students in a grade ten Biology class experience computer technology in a technology rich lesson?	Pre-survey Question 3,4,5,6	Survey questions provide background data on students' access and prior use of technology in a classroom.
	ESF As you were beeped…section	ESF provides data on the experience as it is occurring, the experience, level of concentration, enjoyment, learning, self-awareness, expectation, choice
	Post interview Questions 1, 2	Post interview will gather information as the participants reflect over their experience
	Pre-survey Question 7, 8, 9, 10, 11, 12, 13, 16	Survey questions allow student voice to be expressed

Table 2 (Continued)

	ESF	ESF provide data on the
	Describe your mood as you were beeped: Were you: Tell how you felt about the main activity: Any Comments?	emotional status, challenge, skill level, success, relationship to future goal, directly share experience
	Post Interview Questions 3, 4, 7, 9	Post interview gathers data on what tools they found to be effective for learning
	Pre-Survey Question 1, 2, 14, 15, 17	Survey questions provide demographic information for differentiation of responses (gender, IEP status)
	ESF ID	ESF data will include ID for data to be clustered (gender, IEP status)
	Post Interview Question 5, 6, 8,	Post interviews will gather participant voice

Table Note. ESF = Experience Sampling form. IEP=Individualized Education Plan. Pre-survey questions can be found in Appendix A, ESF in Appendix B and Post interview questions in Appendix C

Survey

All participants were asked to complete a pre-study survey. The pre-study survey was used to gather information on participants' prior experiences with classroom or school computer use. The survey was selected since it provided initial observations in "natural" (i.e., non-laboratory) setting and involved a "minimum of interference over people's normal behavior or choices" (Crano & Brewer, 2009, p. 17).

The survey was given to the participants at a single point in time at the beginning of the study. The participants used the same code on the survey that would be used for tracking on the ESF. Using the same code enabled the researcher to compare the responses for each part of the study. Qualtrics was used for the development, delivery and analysis of the survey instrument. The survey gathered data using structured response (Likert-type scale, yes or no, selection from a list) and open-ended comment questions.

The seventeen survey questions (Appendix A) yielded information about access to computers or other technology; access to the Internet; actual experience of technology use in a classroom; how the student would prefer technology to be used; students' feelings about science class and basic demographic information.

Survey questions 4, 7, 8, 9, 10 and 13 were from the EDUCAUSE Center for Analysis and Research (ECAR) (2007) survey tool (Appendix F). ECAR had been surveying undergraduates from 2004 to 2012 to understand students' interaction with technology. Caruso and Salaway (2008) used the survey tool in a study of 27,846 college freshmen, senior and community college students to "provide information on undergraduate students' use of and preferences and expectations for IT" (p. 1). The survey questions focused on access, personal use and the students' opinions about computer technology. Question 12 examined student views of their own learning with technology and was from a study conducted by Qing Li (2007, p. 397). The study examined the views of both students (n=450) and teachers (n=15) on the use of technology in the classroom. Questions 1, 2, 3 and 5 collect background demographic information; 6, 15 and 16 collect data about actual class use of technology; questions 11, 14 and 17 collect data about enjoyment of the use of technology in the classroom.

ESM

The ESM Form (ESF) (Appendix B) was modified from the Sloan Study of Youth and Social Development form (Schmidt & Shumow, 2011; Hektner, et al., 2007; Hunter & Csikszentmihaly 2003; Hektner & Csikszentmihaly, 2002), and the Relationship of Instructional Method to Student Engagement study data collection form (Johnson, 2008).

The form collected information on the external and internal coordinates of the participants' experience. According to Hektner, et al., 2007, 'external dimensions include date and time of day, physical location, activities and companions' (p. 43). The external coordinate was identified through several questions including date, time of beep and time responded. Date and time allowed the researcher to examine differences in experience based on day of the week and of the class period in which the participant is enrolled. The external coordinate also provided information either activity, computer based or lecture, in which the participant is involved (What was the main thing you were doing?). Companionship, the last external coordinate, was addressed by asking whether the participant is working alone, with a partner or in a group.

The internal coordinates referred to 'thoughts and feelings as respondents interact with other people and perform the activities that make up their daily life' (Hektner et al., p. 43). For example, the questions, "How challenging was it? (Possible Response Low 0 High 9) and Your skills in the activity? (Possible Response Low 0 High 9)", directly collected data on the internal coordinates. Internal coordinate data was collected in the first Likert-type response statements (How well were you concentrating? Possible

Response Not at all 0 Very Much 9), in the "Describe your mood as you were beeped (Example Happy-very- quite-some-some-quite-very-Sad" and the "Tell how you felt about the main activity (Example How challenging was it? Low 0 High 9)" set (Appendix B).

Interviews

The third stage of data gathering consisted of semi-structured interviews of key informants. Patton (2002) calls the key informants "critical cases", "particularly important in the scheme of things" (p. 236). The key informant was the participant who was "knowledgeable about the inquiry setting and articulate about their knowledge" (Patton, 2002, p. 321). The researcher used observation as way to identify key informants to participate in the final interviews. The purpose of the observation was to assist in identifying the participants who would best be able to share their own and their peers' experiences with the technology.

Glesne (2011) suggested for the researcher to "consciously observe the research setting; its participants; and the events, acts, and gestures that occur within them" (p. 70). Following Glesne's suggestion, the researcher watched to see participants who were actively engaged in the class, were helpful to peers in need and were able to articulate their thoughts and opinions in the class. These participants, the participants who need additional assistance, and those who are uncomfortable and reluctant to share their opinions in class were selected to participate in interviews.

Observations can be either covert or overt. Patton (2002) reported, "people may behave quite differently when they know they are being observed versus how they behave naturally" (p. 269). The researcher understood that covert observations "are more likely to capture what is really happening" (p. 269). In this study, the observations were overt since the researcher was the teacher in the classroom. The researcher documented what he would "see, hear, feel and think" through the use of notes (Glesne, 2011, p.70).

Eight key informants were selected after the ESF data had been collected. The goal for selection was to have equal numbers of female and male participants, and for representation of participants with and without an IEP (2 female 2 male general students, 2 female 2 male students with an IEP). The researcher sought key informants who had been either successful or unsuccessful in the use of the computer. The key informants selected through researcher observation included those participants who needed additional support from the teacher or other participants, those who needed no support or provided support to other participants and those whom would be able to provide information in an interview.

Once participants were selected for interviews, semi-structured questions (Appendix C) were used to gather data concerning the core ideas of the experience of using computers and thinking about their learning. Questions were asked that explore how the participants viewed the computer rich experience and if they felt they had the necessary skills to be successful. Participants were also given the opportunity to share their opinion about using technology in the classroom.

Data Analysis

This study was designed to examine the lived experience of the participants, a phenomenological approach. For this study to be phenomenological, the researcher must view the data using four main considerations. Moustakas suggested that phenomenological research must include epoche, phenomenological reduction, imaginative variation and synthesis.

Epoche means to "to stay away from or abstain" (Moustakas, 1994, p. 85) or "stay away from the everyday, ordinary way of perceiving things" "to refrain from judgment" (Moustakas, 1994, p. 33). The researcher needed to be alert to his own "personal bias, to eliminate personal involvement with the subject material"; to be aware of preconceived ideas of what the participants would experience and the value of the computer based learning activities (Patton, 2002, p. 485).

During phenomenological reduction "the qualities of the experience become the focus, the filling in or the completion of the nature and the meaning of the experience become the challenge" (Moustakas, 1994, p.90). Patton (2002) described this as "bracketing out the world and presuppositions to identify the data in pure form" (p. 485). Patton (2002) suggested five steps to bracketing. The steps included to "seek key phrases and statements that speak directly to the phenomenon", to "interpret the meaning of these phrases as an informed reader", if possible to "obtain the subjects interpretations of these phrases", to examine "meanings for what they reveal about the essential, recurring features of the phenomenon", and to "offer tentative statement, or definition, of the phenomenon in terms of the essential recurring features" (p. 486).

After the bracketing had been applied, the data was examined with all data treated equally. The data was then "organized into meaningful clusters" (Patton, 2002, p. 486). Through a delimitation process, the data was examined where "irrelevant, repetitive, or overlapping data are eliminated" (Patton, 2002, p. 486). The clustering assisted in the identification of the main themes within the data.

The next step in the process was of imaginative variation. Moustakas (1994) defined this as "to seek possible meanings through the use of imagination, varying the frame of reference, applying polarities and reversals, and approaching the phenomenon from divergent perspectives, different positions, roles or functions" (p. 98). This step was highly reflective with many possibilities examined, focusing on the uncovering of the essence of the experience for the participants. The reflection included the uncovering of examples that "vividly illustrate the invariant structural themes and facilitate the development of a structural description of the phenomenon" (Moustakas, 1994, p. 99).

Finally, the researcher integrated the essence of the experience of the participants as a whole. Moustakas (1994) defined the essence as "that which is common or universal, the condition or quality without which a thing would not be what it is" (p. 100). The essence was synthesized through the work of imaginative variation. Moustakas (1994) stated that the essence of the experience is never exhausted, but "represents the experience at a particular time and place from the vantage point of an individual researcher following an exhaustive imaginative and reflective study of the phenomenon" (p. 100). In this respect, the analysis did not provide for universal truths but opened the way for future examination of participants in other computer rich class settings.

Survey Analysis

The survey was used to gather background information about the participants and their prior experiences using computers. Analysis included comparing responses within the group. Likert-type scale responses were evaluated using Excel to provide insight of the group. Graphic and numeric descriptive data was presented and compared with information gathered during the research study. Qualtrics analysis tools were used for descriptive statistics of the survey.

ESF Analysis

The ESF collected data through short response and Likert-type scale questions. Analysis of open-ended questions, Likert-type scale, day or point in time, activity, and by group was included. The data was examined for specific moment in time reaction to classroom tasks and for trends over the study.

The open-ended questions (What were you thinking about? What was the main thing you were doing?) were qualitatively examined for connections or disconnections to explore the thoughts of the students and the activity. This would offer insight into the computer based learning activity that the student was working on and their level of interest. This data was analyzed using open coding with emergent categories focused on participant to explore experiences. The data will also be evaluated for trends in the attention level of the participants.

Participant affect or mood will be explored through Likert-type scale questions. The questions ranged from a positive or negative emotion to the opposite emotion. The range used adjectives for participant selection (very, quite, some, neither, some, quite, very). The scale was converted to numeric values with 'very' positive mood/emotion scoring six (6) and 'very' negative mood/emotion scoring one (1). When converted to a numeric score, descriptive statistics were used to describe the population. The *Tell how you felt about the main activity* questions explored the flow or engagement of the participants. Hektner, et al. (2007) suggested the "most commonly measured conditions necessary for flow are individuals' perceptions of their challenges and skills" in the task as they were signaled (p. 93). For this study, participants were examined for high challenge and appropriate skill level for different learning activities using computers.

The Likert-type scale items will be examined at overall group status level. The Likert-type items captured the level of enjoyment, the intrinsic and extrinsic motivation, the optimal experience level and the flow state of participants. These items were considered the level of engagement of the participant in the learning activities.

Interview Analysis

The responses to the interviews were organized to identify key issues shared by the participants and analytically examined. Marshall and Rossman (1999) suggested that the "typical analytic procedures fall into six phases: (a) organizing the data; (b) generating categories, themes and patterns; (c) coding the data; (d) testing the emergent understandings; (e) searching for alternative explanations; and (f) writing the report" (p. 152).

The analysis of the interviews consisted of a "progressive process of sorting and defining" the interview transcripts (Glesne, 2011, p. 194). The analytic process included examination of each line of data. Through examination codes, themes or patterns emerged. The emerging codes or themes were compared to the research question to see if they are illuminating the participants' experience. The themes were critically examined to find "plausible alternative explanations for these data and the linkages among them" (Marshall & Rossman, 1999, p. 157).

Validation and Credibility

Robert Yin (2011) described a valid study as "one that has properly collected and interpreted its data, so that the conclusions accurately reflect and represent the real world (or laboratory) that was studied" (p. 78). The validity or the trustworthiness of the study will be strengthened by "prolonged engagement and persistent observation" (Glesne, 2011, p. 49), intercoder reliability or peer review and triangulation.

The researcher was the classroom teacher for the participants. The educator role provided for long-term engagement and observation of the participants. Creswell (2012) stated that the engagement and observation provided for "building of trust with participants, learning the culture, and checking for misinformation" (p. 250).

Coding of transcribed interviews included intercoder or peer review of content. Two peers (doctoral level) were recruited to analyze transcripts. Each transcript was reviewed by the researcher and peers. The different coders' analysis were examined for "correspondence between two (or more) coders' estimates of the same content" (Crano & Brewer, 2009, p. 255) and provided an "external check of the research process" (Creswell, 2012, p. 251).

Triangulation.

Patton and Glesne called the process of gathering data from multiple sources triangulation. Triangulation results in a richness in the variety or depth of data collected. Patton (2002) suggested that an important value of triangulation is as a "test for the consistency" of the data gathering strategies (p.248). "Different kinds of data may yield somewhat different results because different types of inquiry are sensitive to different real world nuances" (Patton, 2002, p. 248).

Crano and Brewer (2009) suggested that "theoretical concepts are never perfectly embodied in any single method of observation" (p. 10) and calls this approach multiple operationism. The different types of data gathered will result in "opportunities for deeper insight into the relationship between inquiry approach and the phenomenon being studied" (Patton, 2002, p. 248).

Patton describes four types of triangulation for qualitative analysis. They are methods triangulation, triangulation of sources, analyst triangulation and theory/perspective triangulation. This study will utilize triangulation of sources of data using surveys, ESF, observation and interviews (Table 3).

Table 3

Triangulation

Method of Triangulation[a]	Method of Triangulation for this study
Comparing observations with interviews	Participant observations in the classroom will be compared with key informant interviews
Checking for the consistency of what people say about the same thing over time	ESF explores consistency of participants experience over time, ESF data will be compared to interview and survey data
Comparing the perspectives of people from different points of view	Gender, IEP and general
Checking interviews against program documents and other written evidence that can be corroborate what interview respondents report	Interviews will be compared with initial survey and ESF

Table Note. ESF=Experience Sampling Form. IEP=Individualized Education Plan. [a]Adapted from *Qualitative Research & Evaluation Methods 3rd edition,* by Michael Quinn Patton, 2002, p. 559. Sage Publications.

Reflexivity

Glesne (2011) described reflexivity as "critical reflection on how researcher, research participants, setting, and research procedures interact and influence each other" (p. 131). There were considerations that needed to be disclosed about the researcher and the relationship with the school and participants.

The researcher was an employee of the Chestnut Oak Local School District as a secondary school science teacher. In this role, this researcher had daily contact with the participants. The role of the teacher had an impact on the participants taking part in the study. It would be vital for the researcher to bracket the two roles, to explain to the participants the difference between teacher and researcher and how the roles may influence them.

The researcher was an advocate for the use of computers in the classroom and felt that as the world changed, the classroom needed to change with it. The researcher was a teacher-leader for the inclusion of computers in the school. In addition, the researcher had certifications with Quality Matters (QM) for the development of high quality online and blended learning.

Researcher's Philosophy

Technology and computers are facts yet are excluded from many classrooms. I believe that the education system is poised for major change in how education is delivered and what is even considered education. The change will be a result of the increasing level of use of computers or other devices in the classroom.

I believe that all students have the right to an effective, engaging and relevant education. The environment in which today's student learns is very different from that of the experience of most teachers when they were in school. In order to successfully engage the student, educational delivery systems need to be perceived by the student as realistic and pertinent. An effective or realistic classroom should look like the world: connected, less focused on memorization and more focused on applying information.

I believe that education needs to reflect the times in which it exists. Change in the direction of the greater social culture speaks to the relevancy of the education. If a goal of education is to prepare young minds for the 'real world' of employment, their educational experience needs to be an accurate representation of that world.

Lens

I am not one who moved from high school to college back to high school as a teacher. Yet I am a lifelong learner and have always held a passion for the sciences. I posses degrees in Healthcare Administration (BBA), Natural sciences (BS), MBA and am pursuing a PhD in Curriculum and Instruction, Science Education.

Prior to becoming a life science teacher, I operated long-term care facilities as a licensed Nursing Home Administrator, the Executive Director of a retirement community and a division director for a home care services agency. During these experiences I witnessed the long-term care industry undergo a paradigm shift from a facility based to a home based care system.

As an educator, I taught at the Chestnut Oak Local School District. Teaching responsibilities included grade 9 Integrated/Physical Science, grade 10 Biology, Advanced Placement Biology and Anatomy and Physiology. I also served on the district leadership team (DLT), grant-writing team and as the High Schools that Work (HSTW) site coordinator. I am a Certified Resident Educator mentor. I served on the Collaborating on Economic Success in Appalachia (COESA) High School-Higher Education Alignment Project and was active with the South Central Ohio Computer Association (SCOCA), the provider of the learning management system (LMS) , Blackboard, and Internet backbone for most school districts in Southern Ohio.

In addition, I have presented at the Ohio Educational Technology Conference and at COHS technology in-services. I was a nominee for the Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST). Certifications from Quality Matters (QM) include K-12 Improving Your Online Course, Applying the Quality Matters Rubric Grades 6-12, K-12 Reviewer Course, K-12 Publisher Reviewer Course, K-12 Applying the Quality Matters Grades 6-12 Rubric Workshop, and QM Facilitator Course. I serve as a reviewer of online courses that are seeking QM certification.

Fully online asynchronous instruction includes teaching the Grades 6-12 applying the Quality Matters Rubric Online Course through QM. I have successfully completed the Collaborative Institutional Training Initiative (CITI) for the responsible conducting of research (Appendix H).

Role as Researcher

Glesne (2011) defined the researcher role as being "situationally determined, depending on your philosophical perspective, the context, the identities of the participants and your own personalities and values" (p. 59). In this study, the roles of researcher and of teacher were intertwined. I had to be acutely aware of my actions and responses as students received tones to complete the ESM form. Based on contacts and conversations in or out of the classroom, the role may have switched from researcher to teacher or vice versa at any time.

Patton (2002) suggested a need to be "as involved as possible in experiencing the setting as fully as appropriate and manageable while maintaining an analytical perspective" (p. 331). The involvement was inescapable when viewing your own classroom through a researcher's lens. After the ESM collection was completed, the researcher conducted interviews, moving from the role of observer to that of moderator in a conversation with the student participants.

Deception of participants was not a consideration. The researcher disclosed the role of researcher and of teacher to participants and to guardians.

Ethical and Political Considerations

Patton (2002, p. 408-409) described an Ethical Issues Checklist that the researcher used as a framework to identify ethical responsibilities. The framework included the issues of reciprocity, risk to the participant, expectation of confidentiality, informed consent, data access and ownership, researcher support and legal versus ethical issues.

Reciprocity

Although there was no monetary payment for participating in the study, the participants were contributing a considerable amount of their time. Glesne (2010) suggested that what the researcher can offer to the participant is to "be grateful, by acknowledging how important their time, cooperation, and words are; by expressing your dependence upon what they have to offer; and by elaborating your pleasure with their company" (p. 178). The participants in the study received sincere thanks for sharing their insights in the use of a computer rich science classroom.

Risk to Participant

No health and wellbeing risks were anticipated in the study.

Expectation of Confidentiality

Participants' information is confidential and kept anonymous. Confidentiality would be kept unless the information provided concerned illegal or abuse situations. This exception was shared with the participants at the beginning of the study. Names or data identifying participants will be excluded from all future publication. Pseudonyms were used for protection with interview data.

The researcher kept the ESM data forms in a locked cabinet, electronic data on an external hard drive password protected and stored in a locked cabinet. The identifiers and names of participants will be kept until the research project is completed. At which time the list of participant names will be destroyed leaving no way to identify the participants.

Informed Consent

Crano and Brewer (2009) defined informed consent such that 'participation will be voluntary and with the volunteer's full knowledge of what participation will involve" (p. 344). The researcher followed Ohio University's Office of Research Compliance for ensuring informed consent through the Institutional Review Board (IRB) process (Appendix G). Parental/Guardian consent forms were distributed and collected for each student participant(Appendix D). In addition, a minor assent form was distributed to each student to ensure willingness to participate and reinforce the cooperative nature of and their value as participants in the study(Appendix D). The researcher acknowledged that the Parental/Guardian Consent form takes precedent over any document signed by the minor.

Data Access and Ownership

The researcher will maintain ownership of the data gathered. Access to the data will be strictly limited to the researcher and to the researcher's committee if so requested. Data will not be available to participants, guardians or school officials for any purpose.

Researcher Support

Ethical issues that may have arisen during the study were discussed with the researcher's committee chair, other committee members or IRB as available. Ethical issues were addressed as quickly as possible. The researcher recognized that the study was a stressful event and used the committee for inspiration, support and as a sounding board.

Legal versus Ethical

The researcher, as a licensed teacher, was a mandatory reporter of abuse and neglect of children. As such, the researcher conducted the study within the guidelines required by law regardless of any expectation of confidentiality or anonymity.

Procedures

An optional pre-study meeting was available for parents, guardians and student participants. The goals of the meeting included to discuss the study, the participant role, and the activities and expectations during the study. The ESF would be explained to both students and parents. Informed consent was discussed and forms distributed at the meeting. Consent documents were sent home with each student. Each participant was also given an assent form for his or her participation in the study. Data was collected only from participants who had a signed consent and assent form.

Once the date of the study was set, the pre-survey was given to the participants. Time was allowed during the class period for completing the survey.

Participants were assigned a particular number to identify their ESF forms. Each daily form included the identification number written by the participant. Daily the blank ESFs were provided in a specific classroom location. Participants collected their form as they entered the classroom.

Participants were notified of when to complete the ESF by an individual alarm tone. Participants randomly selected a device (watch with an alarm pre-set) each class period from a box. All devices were the same make, model and color (Casio 3238). In order to allow for breakage, loss, and to insure random access, the researcher provided 30 devices. The ability to get the same device each day was minimized by mixing all devices after each class.

Each device was preset with one or two alarms during each class. Participants did not know if the alarm was set for one or two alarms per class period. Using a random number generator, (http://www.random.org), alarm times were selected (Appendix E). The alarm times allowed 30 devices to be set with random alarms beginning 5 minutes into class with the final alarm occurring no later than 48 minutes into class. Each class period ran 50 minutes. The participants returned the devices at the end of each class.

At the alarm tone, the participant completed the ESF. In order to reduce loss or retroactive completion, participants placed the ESF data forms in a sealed box in the classroom at the end of the class period. The ESF data was gathered for a five-day period for each segment of the study.

When the ESF data collection period ended, interviews of key participants were scheduled. The interviews were scheduled during the school day, lunch or before/after school during final exam week. The interviews were completed at the school and digitally recorded for ease of transcribing.

Assumptions, Delimitations and Limitations

Assumptions.

The researcher assumed that there was a benefit to student learning from the use of computers. The researcher also felt that in order to make education relevant to students, the tools that they use to understand the world should be brought into the classroom.

The ability and consistency of the students who participate in completing the ESF data forms and surveys was assumed. Consistency was assumed in the participant attending class during the time of the data gather. The ESF was dependent on the honesty of each participant in sharing his or her true experience. The potential value of the data gathered was dependent on the participants being able to express their inner thoughts as they participated in the class.

The approval of the Chestnut Oak Local School Board for the study was among the main assumptions. Support had already been given by the principal. The school, Chestnut Oak High School (COHS), had a reputation for academic rigor in the community. It was assumed that this level of rigor would continue for the duration of the study.

Delimitations.

The study took place at HS during the spring semester of school year 2013-14. The participants were grade ten students in the Biology class. The class might have been the first experience participants had with a computer rich learning experience. The participants included female, male and those with a variety of Individual Education Plans (IEP). Parents of participants were offered an orientation to the study before the study begins. The participants received training on how to complete the ESF before the project began.

Limitations.

The study would be limited by time. The study took place over two weeks, one week examining the lived experience in a traditional classroom and one week in a computer rich classroom. The brevity of the study affected the depth and quality of data gathered from participants.

The study was limited by the size of the participant pool. A small rural school may not exhibit some of the diversity, benefits or challenges faced in a larger school. The study was also limited by the rate of participant attendance. When a participant was not present to hear the tone, any datum was lost to the study. There was no way for a participant to make up or replace missed signals.

A limitation was the participants' self-theories about what they were experiencing. Englebert and Carruthers (2011) argued that the negative impact in ESM should be negligible within seconds of the beep "subjects own notes, worries about the reliability of memory, situational demands" are noted (p. 4).

The study was further limited by the inability to replicate results. The study cannot continue and the pool of participants who experienced the same situations would be impossible to recreate. Koro-Llundberg, et al.(2008), suggested that collecting data through ESM is "ongoing and a part of participants' lives" and "influences participants' everyday lives in ways unanticipated" and "can result in participants withholding crucial, study related information" (p. 352). Such withholding of information might include mood or emotional state, day dreaming, being off task, or what the participant really experienced. Koro-Llundberg et al. (2008) stated that "self reports, are never complete descriptions of 'true' reality but are always at least partially misleading, inconsistent, or incomplete because of the nature of social research" (p. 353). Finally, "individual differences can yield very different flow experiences from the same activity" (Finneran & Zhang, 2002, p. 1047).

Chapter 4: Results

This study examined the student lived experience when using computers in a science classroom. Specifically it informed the question of how students relate to computers as a learning tool in the science classroom. This chapter provides a description of the environment or setting in which the participants were studied, followed by the pre-survey results that provided information to inform the researcher about participants' technological background. Next, experience sampling data will be presented in two sections. The first section will present the data in the traditional paper based classroom. The second section will present the data from the computer rich classroom. Finally, results from key participant interviews will be presented.

Setting

A description of the setting provides a way to see what is obvious and yet too often unseen, the physical layout and the method, management, rules and activity of the classroom setting. This section will provide description for both the traditional classroom and the computer lab used in the study.

Classroom

Chestnut Oak High School is located in a new building, occupancy occurring two years prior to this study. Classrooms are very bright with natural light and designed to eliminate overcrowding in the classroom. In the classroom utilized for this study, students were seated in rows in freestanding desk-tables and chairs. The seating area was arranged in three rows of six desk-tables and two rows of five desk-tables (Appendix I). Students faced east toward the white boards and smart boards. To their right (south) were display cases with books, samples (bones, fossils, minerals) and lab materials. The north side of the classroom was separated to provide for lab work. The lab area was divided into six stations with air, gas, computer and water with sinks. Each lab station had storage in drawers and cabinets underneath. A lab station was ADA accessible. The north wall above the lab stations had windows that looked out over the gym and to the hills and river valley to the north and west.

Students did not have assigned seating. They were encouraged to sit where they could see and participate in classroom discussions. Students were not required to raise their hands to speak in class. They were required to be respectful of each other and their teacher. Students were encouraged to stand and move if feeling tired. If personal care was needed, students were allowed to leave the room by a discrete signal to the teacher. The teacher provided direction and support during class activities. Lecture information and slides were provided for the students on the class Blackboard site. Classes in the study began at 8:00 am, 8:55 am and 12:55pm. Classes were held for 50 minutes per day, Monday to Friday.

Computer Classroom

The computer classroom or lab was located four classrooms east of the students' usual classroom. The classroom was set up to provide each student access to a computer, common software, and the Internet. Tables with computers lined the north, east, and south walls (Appendix J). The classroom was arranged to include open table areas for workspace or for students who brought their own device to class. The open tables were located in the center of the classroom. The teacher work area and white boards were located on the west wall of the classroom. The south wall consisted primarily of windows with a view of the southern hills.

Students did not have assigned seating in the computer classroom. They were encouraged to sit where they could see, work with their group (if assigned), and participate in classroom discussions. Students were not required to raise their hands to speak in class. They were required to be respectful of each other and their teacher. Students were encouraged to stand and move if feeling tired. If personal care was needed, students were allowed to leave the room by a discrete signal to the teacher. The teacher provided direction and support during class activities by walking and observing student progress. Classes in the study began at 8:00 am, 8:55 am and 12:55 pm. Classes were held for 50 minutes per day, Monday to Friday.

Pre-study Survey

A survey was conducted to provide the researcher background information about participants' access to computers and other technology, use of computers in school, thoughts about the use of computers, how they enjoy common classroom tasks and their feelings about science classes. Data is provided for each question in the survey. Only participants present at the point in time of the survey are reported. Participants were allowed to skip questions that they were not comfortable or able to answer.

Question 1: Please enter your student ID number or code.

Participants were asked to use their assigned code for the survey. Data is not be presented for question one.

Question 2: Select your sex.

Participants selected their gender. Participants reported 65% female (24) and 35% male (13), n=37.

Question 3: Do you have an IEP (Individualized Education Plan).

Nineteen percent (7) of participants reported that they had an IEP, 11% (4) of participants were not sure and 70% reported that they did not have an IEP, n= 37.

Question 4: Do you have Internet access at home.

Participants reported that 92% (34) had Internet access at home with 8% (3) reporting no access, n= 37.

Question 5: At home, do you have access to the following.

The highest number of participants reported having home access to a smart phone with Internet access (86% n=31), a laptop computer (85% n=34) and computer (70% n=34). Not having home access to a computer (30% n=34), laptop (15% n=34), tablet (33% n=33) or a cell phone with Internet access (14% n=5) was reported in a sample of the participants (See table 1). For this question, participants had many possible selections and were encouraged to select all that apply.

Table 4

Participant reported access to computer or device

Device	Access	No access	n
Computer	70% (24)	30% (10)	34
Laptop	85% (29)	15% (6)	34
Tablet (IPad, Android, etc.)	67% (22)	33% (11)	33
Cell phone without Internet access	30% (9)	70% (21)	30
Cell phone with Internet access (smart phone)	86% (31)	14% (5)	36
Electronic music/video device (IPod, etc.)	84% (27)	16% (5)	32
Electronic gaming device (X box, etc.)	79% (27)	21% (7)	34

Question 6: Can you bring your device to school.

Participants reported that they could bring their device to school, 89% (32), with 11% (4) reporting that they could not, n=36.

Question 7: If you can bring your device but you don't, please explain why you don't. If you are not allowed to bring your device, please explain why you cannot.

The majority of responses from participants were focused on why they did not bring devices to school (83%). Participants reported the reasons they didn't bring a device to school included not using computers in class, "Because usually I wouldn't use it, I'd use the school's computers" (William, April 25, 2014, survey); family discipline, "I'm currently grounded but I may have it back soon" (Anna, April 25, 2014, survey); not having a device they can bring, "I don't have a mobile device" (Ben, April 25, 2014, survey); fear of damage, "I'm afraid I will either break it or forget it at school (Lilly, April 25, 2014, survey) "; and that staff told them not to bring their device, "My parents are not letting me bring my laptop to school because Ms. M. told them that she does not encourage students to bring their laptops in" (Gary, April 25, 2014), n=6. Only one participant reported that they bring their device every day.

Question 8: How often do you use a computer for the following classes.

Participants were asked to share how they used computers in their core courses (English Language Arts, Science, Math, History) using a scale ranging from Never One time a month Every other week Once a week to Daily. Responses indicate that Math (97%) and History (83%) classes used computer never or one time per month (see Table

5). Responses indicate that Science (94%) and English Language Arts (41%) classes used computer from every other week to daily.

Table 5

Participant reported classroom use of computers

Class	Never	One time a month	Every other week	Once a week	Daily	n
ELA	4	18	10	2	3	37
Science	0	2	14	14	6	36
Math	15	18	0	1	0	34
History	22	7	0	4	2	35

Table Note. ELA=English Language Arts

Question 9: What programs have you used for classes.

Participants reported the following software used in classes. Comments do not add to 100% since participants had many possible selections and were encouraged to select all that apply.

Table 6

Participant reported software used in class

Answer	Response	%
Word processing (Word, Open Office, etc.)	33	92%
Presentation software (PowerPoint, Prezi, etc.)	36	100%
Spreadsheet software (Excel, Open office, etc.)	8	22%
Creating graphics (Photoshop, etc.)	5	14%

Question 10: List any other software programs teachers have had you use in class.

Respondents reported the following software or applications used in classes: BlackBoard 34% (8), Google documents or drive 22% (5), Study Island 17% (4) StudyMate 9% (2) Auto Desk 9% (2), Open office 4.5% (1), Accelerated Reader 4.5% (1), n=23.

Question 11: Please give us your opinion about the following statements regarding your experiences with information technology/computers in your courses.

Respondents reported a higher level of engagement (Agree and Strongly Agree) in classes that use technology/computers (83%) versus those that do not (Strongly Disagree and Disagree) use computers (17%).

Table 7

Participant experience with classroom technology

Question	Strongly disagree	Disagree	Agree	Strongly Agree
I am more engaged in courses that require me to use technology than in courses that do not use technology.	0	6	22	8
Overall, my instructors use information technology well in my courses.	0	4	25	7
My school needs to give me more training on the information technology that I am required to use in my courses.	0	18	17	1

Respondents reported that their instructors used computers/ information technology well in their courses (88%). Half of respondents (50%) reported that they needed more training in how to use technology required in their courses (n=36).

Question 12: The use of information technology/computers in my courses.

Respondents stated that use of technology in the classroom gives them greater control (87%). Respondents stated that the use of technology helps them to do better research (97%) n=36.

Table 8

Participant use of classroom technology

Question	Strongly disagree	Disagree	Agree	Strongly Agree
Allows me to take greater control of my course activities than in courses that do not use technology.	1	7	21	7
Helps me do better research for my courses than in courses that do not use technology	0	1	13	22

Table Note. Adapted from "Student and teacher views about technology: A tale of two cities?" by Q. Li, 2007, *Journal of Research on Technology and Education, 39*(4), 377-397.

Question 13: How useful do you find the following course features.

Respondents reported an online syllabus as somewhat useful n=36, online readings and links to other text-based course materials as very useful, online discussion board as useful, online access to sample exams/quizzes for learning/practice purposes as extremely useful and taking exams/quizzes online for grading purposes as extremely useful n=35.

Table 9

Usefulness of course features

Question	Not useful	Somewhat useful	Useful	Very useful	Extremely useful	Did not use
Online syllabus	2	14	13	1	3	3
Online readings, links Table 9 (Continued) to other text-based course materials	1	6	10	14	4	0
Online discussion board (posting comments, questions, responses)	7	7	10	5	3	3
Online access to sample exams/quizzes for learning/practice purposes	2	3	7	11	12	0
Taking exams/quizzes online for grading purposes	1	3	10	7	14	0

Table Note. Adapted from EDUCAUSE Center for Analysis and Research (ECAR) (2007) survey tool (Appendix F).

Question 14: How important is it for you to use computers in your classes.

Respondents reported that using computers in their classes was important (44%) with an additional 17% saying computers were very important and 33% saying slightly important. Only 6% of respondents stated computers were not important in their classes.

Table 10
Importance of using computers in classes

Answer	Response	%
Not important	2	6%
Slightly important	12	33%
Important	16	44%
Very important	6	17%
Total	36	100%

Question 15: Please comment in writing on the use of technology/computers in your learning: Is it effective for your own learning? If yes, how? If no, why not.

Participants were strongly supportive of the use of computer as an effective tool for their learning, 26 positive responses (78%), and seven negative responses (21%) n=33. Coding of responses suggested three themes for the "yes" responses. Themes include personal control of or engagement with learning, rich sources of information and online access to class or information. Coding of responses suggested four themes for the "no" responses. Themes include test stress, traditional classroom, distraction and misuse.

The theme personal control of or engagement with learning was mentioned in 12 (46%) of positive responses and 36% of total responses. Participants stated they could "look up things and find things on my own" (Sally, April 25, 2014, survey, that "if the teacher explains something in a way I don't understand I can look up what the teacher is talking about and help me understand it better"(Rice, April 25, 2014, survey). Participants shared that when using "the computer or my phone I actually try harder to find what I need to" (Emma, April 25, 2014, survey). The use of a computer "gets me more interested in what I'm learning or going to learn. And, more than likely I'll do better" (Star, April 25, 2014). "I feel more involved when I'm not just looking at the teacher and listening to him/her talk" (Ben, April 25, 2014, survey) shared a participant. Using computers "it helps me grow" (Mary, April 25, 2014, survey) and "allows me to get more practice and understand the material better" (Lilly, April 25, 2014). A participant stated, "Using technology in classes is effective because it takes something that we use in our everyday lives and lets us use it in school" (Thomas, April 25, 2014, survey).

The theme rich sources of information was mentioned in ten (38%) of positive responses and 30% of total responses. Four responses, 15% of positive responses, centered around doing "better research on a project or assignment" (Cay, April 25, 2014, survey) or "helping me gain info on a project or it helps me complete assignments" (Rusty, April 25, 2014, survey). "We have all the information we could ever ask for at our fingertips and it is nice when a teacher appreciates that information and allows us to use it" (Thomas, May19, 2014, survey) stated one respondent.

It was shared that a computer "allows us to elaborate on what we already know and to find answers to things we do not" (Kate, April 25, 2014, survey). Textbooks were mentioned in two responses (33%). Participants stated that a computer "gives more information than a textbook would" (Katie, April 25, 2014, survey) and that "not a lot of the books schools have are updated" (Cass, April 25, 2014, survey) that the textbooks are "falling apart and don't fully help with the website papers the teachers print out. They will find a worksheet over current things and tell us to look in our books but there isn't any answers" (Cass, April 25, 2014, survey).

The theme of online access to class or information was mentioned in five (19%) of positive responses and 15% of total responses. Online access to class or information included use of the Internet by a computer or device to connect to the participants' class or increasing the ease of finding information. Participants shared that if they "miss school you know what you are missing in class" (Kime, April 25, 2014, survey) and that it "allows me to get my homework online if I forget something at school" (Maggie, April 25, 2014, survey). Participants also suggested that using a computer was "much more efficient" (Katie, April 25, 2014, survey) and "easier to find information" (Anna, April 25, 2014, survey).

For negative responses, the themes of test stress, traditional classroom, distraction and misuse were submitted. Test stress represented 28% of the negative responses. Test stress was identified when participants shared that they "don't like taking tests on the computer" (Lisa, April 25, 2014, survey) and that tests "can be somewhat confusing when larger and longer tests" (Lowell, April 25, 2014, survey) are used.

There was concern shared about the loss of traditional classroom structure by 42% of negative responses. It was felt that computers "cheat you of learning from books and handwriting" (Melissa, April 25, 2014, survey) and would "rather have class work than work on the computer" (Sue, April 25, 2014, survey). The computer as a distraction represented 15% of the negative responses. A participant shared that "when using a computer, I just get too distracted" (Myra, April 25, 2014, survey). Misuse of the computer in the classroom represented 15% of the negative responses. A participant shared that "some people use their phone to cheat on a test" (Tim, April 25, 2014, survey) or to "just write the answer that they find on Google" (Tim, April 25, 2014, survey) when doing homework.

Question 16: How do you like to learn with technology.

Respondents reported that they liked to learn through contributing to Web sites, blogs, wikis (81%), through video games, simulations (80%) and by running Internet searches (80%). Text-based conversations over e-mail, instant messaging, and text messaging were not perceived as an enjoyable learning experience (60%).

Table 11

How do you like to learn with technology?

Question	Yes	No	n
I like to learn through text-based conversations over e-mail, instant messaging, and text messaging.	11	16	27
I like to learn through programs I can control, such as video games, simulations, etc.	28	7	35
I like to learn through contributing to Web sites, blogs, wikis, etc.	26	6	32
I like to learn by running Internet searches	28	7	35

Question 17: Rank the following from most enjoyable to least enjoyable.

Respondents were asked to rank common classroom activities in order of most to least enjoyable. The respondents selected as most enjoyable (Enjoyable plus Very enjoyable) creating something (poster, booklet, cartoon) with my hands (78%), creating something (poster, booklet, cartoon, podcast) online (68%) and looking up terms on the Internet (57%). Problem solving using the computer (42%) and reading from a website (28%) followed. Solving problems using textbook (11%), looking up terms in a textbook (8%) and reading textbook (3%) scored least enjoyable classroom activities.

Table 12

Ranking classroom activities

Question	Not Enjoyable	Slightly enjoyable	Enjoyable	Very enjoyable	n
Reading text book	25	10	1	0	36
Creating something online (poster, booklet, cartoon, podcast)	4	8	18	7	37
Looking up terms in a text book	28	5	3	0	36
Solving problems using text book	29	3	3	1	36
Looking up terms on the Internet	4	12	15	6	37
Reading from a website	10	16	10	0	36
Problem solving using the computer	4	17	13	2	36
Creating something (poster, booklet, cartoon) with my hands	5	3	14	14	36

Question 18 Have you done lab simulations on the computer for science class.

Respondents shared that 61% had done lab simulations in science class while 39% had not.

Table 13

Have you used lab simulations in science class

Answer	Response	%
Yes	22	61%
No	14	39%
Total	36	100%

Question 19: If yes, did you like them? Please tell me why or why not.

Participants submitted 25 responses to question 19. From the coding of "yes", responses emerged five themes. They included skills, increasing understanding or depth of knowledge, personal control, motivation and hands on. Participants provided six comments that focused on skills including that computer work was "very straight forward" (Rusty, April 25, 2014, survey), "easier to use" (Janet, April 25, 2014, survey) and "fun" (Star, April 25, 2014, survey). Participants provided five comments focused on the theme increasing understanding or depth of knowledge including "easier to understand the lab" (Anna, April 25, 2014, survey), "showed us how actual scientists find out" (Myra, April 25, 2014, survey) and that the simulation "provide an in close view on something so we can see how it really is" (Thomas, April 25, 2014, survey). Participants provided four comments focused on the theme personal control including "rather be doing something on the computer I can control" (Marta, April 25, 2014, survey) and "gave me a chance to discover more information than I would have just from someone telling me" (Cass, April 25, 2014, survey). Participants provided four comments that focused on motivation including "by using computers I was more motivated to get the work done" (Maggie, April 25, 2014, survey) and "more interesting than working on paper" (Gary, April 25, 2014, survey). Participants provided two comments that focused on the theme hands on including "always liked doing labs" (Ben, April 25, 2014, survey) and "hands on feeling, more interactive and enjoyable" (Colby, April 25, 2014, survey).

Participants provided two comments for the no response focused on a lack of skills in using computers. The respondents stated that simulations "were confusing to understand" (Lowell, April 25, 2014, survey) and that "they were alright" (Steve, April 25, 2014, survey). One participant had stated no opinion.

Question 20: Rank the following classes in order of actual technology use (1=highest 5 = lowest).

Question 20 was removed from the survey. The wording and use of the survey tool produced a question the respondents were not able to clearly understand and answer.

Question 21: Write 3 words that describe your feelings about science classes in general.

Participants were asked to write the words that came to mind when they thought of science class. The total number of words submitted were n=89. Of these 67 were positive (75%), 20 were negative (22%) and two were neutral (3%). The most frequently used positive adjectives included fun (15 times), interesting (9), enjoyable (8), cool/awesome (5), exciting (4), entertaining (4), like (2) and hands-on (2). The most frequently used negative adjectives included hard (6), boring (5), difficult (3), hate (2) and complicated. Three times the use of the word "hard" was included with positive words and three times it was included in combination with other negative words.

Experience Sampling Data Traditional Classroom

Prior to the ESF being used in the traditional classroom, the pre-survey was used to gather background data about the participants. The analysis did not occur immediately and the ESF was not dependent on the survey data. During the week of the traditional class, the curriculum content focused on evolution. Students participated in the following activities: reading and reading note taking using a paper textbook, paper work sheet, lecture, hands on simulation, and paper quiz. Participants were asked to complete an experience sampling form (ESF) by being "toned". Participants selected a watch and a blank ESF when they entered the classroom. To receive a tone, participants selected a device (Casio 3238 watch) with an alarm, pre-set each class period, from a box. The boxes of watches and blank ESF were located in the lab section of the classroom. At different times during the class, tones could be heard. The watch tones were not overly loud. A tone could be heard two students away from the watch. When the class period ended, participants dropped the watches into the designated box and the forms in the form box.

Traditional classroom task one: Text reading.

The participants answered the question "What was the main thing you were doing?" in their own words and the responses were coded. The open response allowed participants to share if they were doing class work or if they were focused on another activity. The first activity in the traditional classroom to be examined using Experience Sampling was reading from a textbook and taking reading notes. When participants were asked "Was the main thing you were doing more like work? More like play? Both?", the responses expressed that the task was more like work. Participants shared this in 83% of responses with 17% stating that text reading was both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranges from Not at all scored as 0 to Very well scored as 9.The average of all respondents ranked concentration as a six (6) on the scale for the task reading the textbook.

Participants' mood and activation with the task text reading were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 14.

Table 14

Participant mood and activation with text reading

	Very(1)	Quite (2)	Some- (3) what	Some- (4) what	Quite(5)	Very(6)	
Happy				4.0			Sad
Proud					4.2		Ashamed
Clear						5.5	Confused
Relaxed			2.5				Worried
Excited			2.3				Bored
Active					4.3		Passive
Involved					4.9		Not Involved
Competitive					4.5		Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 1.2 on the 9-point scale and participants rated their skills as 7.2 on the 9-point scale.

Traditional classroom task two: Lecture/instruction.

The second activity in the traditional classroom to be examined using Experience Sampling was listening to lecture and instruction. When participants were asked "Was the main thing you were doing more like work? More like play? Both?", the responses expressed that the task was more like work. Participants shared this in 78% of responses with 22% stating that the task was like both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranges from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as a 6.24 on the scale for the task lecture and instruction.

Participants' mood and activation with the task text reading were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 15.

Table 15

Participant mood and activation with lecture/instruction

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy					4.1		Sad
Proud			2.8				Ashamed
Clear						5.2	Confused
Relaxed		2.3					Worried
Excited			2.7				Bored
Active				3.1			Passive
Involved					4.3		Not Involved
Competitive					4.6		Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 1.7 on the 9-point scale and participants rated their skills as 6.8 on the 9-point scale.

Traditional classroom task three: Worksheet.

The third activity in the traditional classroom to be examined using Experience Sampling was working on a worksheet. When participants were asked “Was the main thing you were doing more like work? More like play. Both?” the responses expressed that the task was more like work. Participants shared this in 92% of responses with 8% stating that the task was like both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranges from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as a 6.6 on the scale for the task worksheet.

Participants' mood and activation with the task text reading were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 16.

Table 16

Participant mood and activation with worksheet

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy					4.3		Sad
Proud			2.7				Ashamed
Clear					4.8		Confused
Relaxed			2.4				Worried
Excited				3.2			Bored
Active				3.0			Passive
Involved						5.0	Not Involved
Competitive					4.5		Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 3.4 on the 9-point scale and participants rated their skills as 6.4 on the 9-point scale.

Traditional classroom task four: Activity.

The fourth activity in the traditional classroom to be examined using Experience Sampling was group work during a hands on activity. When participants were asked "Was the main thing you were doing more like work? More like play? Both?", the responses expressed that the task was both work and play. Participants shared this in 46% of responses. In addition, 25% stated that the task was more like work and 28% stated that the activity was more like play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranges from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as a 6.0 on the scale for the task activity.

Participants' mood and activation with the task activity were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 17.

Table 17

Participant mood and activation with activity

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy						6.0	Sad
Proud		2.2					Ashamed
Clear					5.03		Confused
Relaxed		2.0					Worried
Excited				4.1			Bored
Active		2.3					Passive
Involved					5.2		Not Involved
Competitive				4.2			Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 4.48 on the 9-point scale and participants rated their skills as 5.9 on the 9-point scale.

Experience Sampling Data Computer Rich Classroom

Prior to the ESF being used in the computer rich classroom, the ESF was used in the traditional classroom. The analysis of the traditional classroom ESF data did not occur immediately and the ESF in the computer rich classroom was not dependent on the traditional classroom ESF data. During the second week of the study, the week of the computer rich classroom, the curriculum content focused on ecology. Students were assigned reading in an e-text, note taking using Google Docs, a discussion board prompt (student's own response and to respond to two other student postings) and a web project to design and build a website for a biome of their choosing.

The process for receiving a tone and completing an ESF did not change from week one. The watch and form boxes were moved to the open worktables in the computer classroom. The tones were not overly loud in the computer lab. The keyboarding sounds reduced the tone sound across the larger room. The tone could be heard two adjacent students away from the watch. Due to the layout of the room and natural social clustering, students had more distance from each other than in the usual classroom.

Computer rich classroom task one: Reading interactive text.

The participants answered the question "What was the main thing you were doing?" in their own words and the responses were coded. The open response allowed participants to share if they were doing class work or if they were focused on another activity. The first activity in the computer rich classroom to be examined using Experience Sampling was reading from an interactive online textbook and taking reading notes. When participants were asked "Was the main thing you were doing more like work? More like play. Both?", the responses expressed that the task was more like work. Participants shared this in 97% of responses with 3% stating that the task reading interactive text was both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranges from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as 5.9 on the scale for the task reading interactive text.

Participants' mood and activation with the task reading interactive text were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood".

Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 18.

Table 18

Participant mood and activation with reading interactive text

	Very(1)	Quite (2)	Some- (3) what	Some- (4) what	Quite(5)	Very(6)	
Happy				3.1			Sad
Proud			2.8				Ashamed
Clear		1.8					Confused
Relaxed			2.7				Worried
Excited					4.1		Bored
Active		2.0					Passive
Involved			2.6				Not Involved
Competitive				3.9			Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 1.6 on the 9-point scale and participants rated their skills as 6.3 on the 9-point scale.

Computer rich classroom task two: Discussion board.

The participants answered the question "What was the main thing you were doing?" in their own words and the responses were coded. The open response allowed participants to share if they were doing class work or if they were focused on another activity. The second activity in the computer rich classroom to be examined using Experience Sampling was responding to a discussion board prompt. When participants were asked “Was the main thing you were doing more like work? More like play. Both?”, the responses expressed that the task was more like work. Participants shared this in 74% of responses with 26% stating that the task discussion board was like both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranged from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as 5.2 on the scale for the task discussion board.

Table 19

Participant mood and activation with discussion board

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy			2.5				Sad
Proud			2.7				Ashamed
Clear		1.8					Confused
Relaxed			2.4				Worried
Excited				3.5			Bored
Active			2.6				Passive
Involved		2.2					Not Involved
Competitive					4.2		Cooperative

Participants’ mood and activation with the task reading interactive text were measured using a Likert scale with paired responses. The participants were asked to “Describe your mood as you were beeped: circle the description for each mood”. Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). . The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 19.

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 2.7 on the 9-point scale and participants rated their skills as 5.4 on the 9-point scale.

Computer rich classroom task three: Website development.

The participants answered the question “What was the main thing you were doing?” in their own words and the responses were coded. The open response allowed participants to share if they were doing class work or if they were focused on another activity. The third activity in the computer rich classroom to be examined using Experience Sampling was website development. When participants were asked “Was the main thing you were doing more like work? More like play. Both?”, the responses expressed that the task was more like work. Participants shared this in 57% of responses with 3% sharing the task was more like play and 40% stating that the task website development was like both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranged from Not at all scored as 0 to Very well scored as 9. The average of all respondents ranked concentration as 7.1 on the scale for the task discussion board.

Participants’ mood and activation with the task website development were measured using a Likert scale with paired responses. The participants were asked to

"Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 20.

Table 20

Participant mood and activation with website development

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy		2.19					Sad
Proud		2.3					Ashamed
Clear		2.03					Confused
Relaxed		2.0					Worried
Excited			2.8				Bored
Active		2.3					Passive
Involved		1.7					Not Involved
Competitive					4.5		Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 2.5 on the 9-point scale and participants rated their skills as 6.2 on the 9-point scale.

Computer rich classroom task four: Online LMS quiz.

The participants answered the question "What was the main thing you were doing?" in their own words and the responses were coded. The open response allowed participants to share if they were doing class work or if they were focused on another activity. The fourth activity in the computer rich classroom to be examined using Experience Sampling was online LMS quiz. When participants were asked "Was the main thing you were doing more like work? More like play. Both?", the responses expressed that the task was more like work. Participants shared this in 93.5% of responses with 6.5% sharing the task online quiz was like both work and play.

Participants were asked to rank how well they were concentrating using a Likert scale. The scale ranged from Not at all scored as 0 to Very well scored as 9. The average of all Respondents ranked concentration as 6.16 on the scale for the online quiz.

Participants' mood and activation with the task online quiz were measured using a Likert scale with paired responses. The participants were asked to "Describe your mood as you were beeped: circle the description for each mood". Participants selected a description of their mood. For example, between the emotions happy and sad, participants would select the modifier that best matched their mood at the time they were beeped (Happy very quite somewhat somewhat quite very Sad). Mood and activation were scored from one (1) to six (6). The pairs included Happy-Sad, Proud-Ashamed, Clear-Confused and Relaxed-Worried, Excited-Bored, Involved-Not Involved, Competitive-Cooperative. Results for each pair are shown in Table 21.

Table 21

Participant mood and activation with online LMS quiz

	Very(1)	Quite (2)	Some-what (3)	Some-what (4)	Quite(5)	Very(6)	
Happy			2.8				Sad
Proud					4.2		Ashamed
Clear		1.9					Confused
Relaxed			2.5				Worried
Excited					4.0		Bored
Active		1.8					Passive
Involved			2.2				Not Involved
Competitive					4.6		Cooperative

Participants were asked to share how they felt about the classroom task as it related to the level of challenge and their skill level. The scales ranged from No challenge 0 High challenge 9 and from Low skills 0 High skills 9. Challenge was ranked at 4.5 on the 9-point scale and participants rated their skills as 5.6 on the 9-point scale.

Post Study Interviews

After the pre-survey, the ESF in the traditional classroom and the ESF in the computer rich classroom, post survey interviews were completed. The researcher selected key informants from the class who were asked to participate in the post computer experience interviews. The key informants were identified by the researcher by direct observation during class and pre analysis results on the submitted ESF. The researcher's focus was upon the participants who were observed to be most and least engaged with the technology. The most engaged participants were those who showed excitement, who helped other students who were having difficulty and whose questions to the researcher showed application beyond that of the assignment. The least engaged participants were those who needed the most assistance with low-level tasks, those who did not complete their tasks or those who were found to wander to Internet sites not related to the assignments. The researcher selected key informants that represented the naturally occurring groups of gender and IEP/general status. The key informants included two general female, two general male, two female with an IEP and two male participants with an IEP. Interviews occurred in the participants' regular Biology classroom during the week of final exams.

The interviews were focused on four key areas that would help to inform the research question of student engagement with computers in the classroom. The areas examined in the interviews were the experience of the participant as they attended the traditional and computer rich class; the skill level of the participant and peers; their opinion of using experience sampling and how they perceived the future of a science classroom. The interviews were semi-structured and conversational. The researcher followed up with comments shared during the interviews to allow the participants' voice to be heard.

Coding of the interviews suggested nine main themes or categories with subcategories that inform each main theme. The main themes included participant opinion of traditional or computer rich class (convenience, depth of information, task, student success, pace, isolation teacher), Internet access (convenience, fairness, teacher awareness), skills of self and others (discernment, skill level, type of training needed, training received, feeling, teacher), sources of information (depth of information, current, teacher), social (groups, self, class type, teacher), pace (student control), misuse of computers (cyber bullying, focus, frequency), future of school (computer and other technology, structure change) and experience sampling (awareness, ease, interruption).

Opinion of traditional class.

Each participant provided information about the theme traditional class. The majority of respondents, 75% stated that they preferred a computer rich class while 25% stated they "respond the same for both" (Gary, May 16, 2014, interview). Coding of responses suggested the subcategories convenience, information and student impact to inform the theme. Responses in the theme may appear in the other main themes to add clarity.

Participants shared that in the area of convenience for a traditional classroom, "it's easier to take notes with, it's not really that complicated, you just take down the notes and do the worksheets" (Gary, May 16, 2014, interview). Participants stated, "it's all straight forward, it's like everything is in the book" (Gary, May 16, 2014, interview). moreover, "it's a lot of writing" (Gary, May 16, 2014, interview).

Participants shared that information in the traditional class book is "a little outdated" (Gary, May 16, 2014, interview) and you "only get what you or any other teacher would tell us, nothing else" (Katie, May 19, 2014, interview). Participants stated, "the regular book was not interesting at all" (Star, May 16, 2014, interview).

The student impact included that "it gets hard to focus on the book when you're sitting there staring at it so long" (Melissa, May 20, 2014, interview). Participants shared that in the traditional class, "we've just done what we've always done, so we were used to that" (Thomas, May 19, 2014, interview). Participants stated, "I don't like doing everything in the book" (Melissa, May 20, 2014, interview) and "book work was all the same and it got boring and you didn't want to focus on it" (Melissa, May 20, 2014, interview).

Participants also shared that “reading notes, I don’t feel like they should be on a computer…I like writing those out” (Katie, May 19, 2014, interview). “People still need hardback books because they are normal, and I still think they need to write” (Katie, May 19, 2014, interview). Participants stated, “some people might not understand the traditional way better than the modern way…it depends on how you have to teach the thing to the person” (Star, May 16, 2014, interview).

Opinion of computer rich class.

Each participant provided information about the theme of a computer rich class. The majority of respondents, 75% stated that they preferred a computer rich class while 25% stated they “respond the same for both” (Gary, May 16, 2014, interview). Coding of responses suggested three sub categories to inform the theme. The sub categories included convenience, information, and student impact. Responses in the theme may appear in the other main themes to add clarity.

In providing information about convenience, participants shared that they “liked online text book better” (Star, May 16, 2014, interview) because it “would be easier to take around” (Star, May 16, 2014, interview), that “it’s easier, it’s simpler” (Melissa, May 20, 2014, interview) and “faster” (Cass, May 19, 2014, interview). Participants stated that computers “are useful” (Steve, May 20, 2014, interview), that “you can just type what you need to say and bam you find your answer” (Steve, May 20, 2014, interview). “I always do my homework on it” (Katie, May 19, 2014, interview) shared a participant. A participant stated, “with a computer you literally just need to see it, you can save it as a document then you can just read over that” (Gary, May 16, 2014, interview).

Participants shared that information found using the computer was “more up to date" (Melissa, May 20, 2014, interview) and that the computer "helps you out in finding the whole meaning for that word and stuff" (Steve, May 20,2014, interview). Participants stated that "its' faster to type than write" (Cass, May 19, 2014, interview) and "if we ever have a question we could just look it up" (Cass, May 19, 2014, interview). "I like to look up information if we don't know what it is instead of having to flip through the book trying to hunt for answers" (Katie, May 19, 2014, interview) stated a participant. Participants shared that "students can find more information than what's in the book" (Gary, May 16, 2014, interview).

Participants shared that students can be impacted by the use of computers in the classroom. Participants stated, "people would do better if more people would use technology in classes" (Katie, May 19, 2014, interview). Participants shared that "you can really get into it and find out more about what you want to know" (Katie, May 19, 2014, interview) and "you can have it help you" (Steve, May 20, 2014, interview). "When people do something with computers it's in their head" (Gary, May 16, 2014, interview) and "on the computer you're not listening to other people, you're like reading at your own pace, or you're going at your own pace" (Star, May 16, 2014, interview).

Participants stated that there was also a negative student impact. Participants stated, "if you're on a computer for hours your eyes hurt" (Star, May 16, 2014, interview) and that they did not like "typing everything" (Melissa, May 20, 2014, interview). A participant shared that "it would be boring if you're just going to be on a computer" (Steve, May 20, 2014, interview). Participants stated, "computers can't do dissection" (Steve, May 20, 2014, interview), that it's "not realistic, not three dimensional" (Steve, May 20, 2014, interview). Participants stated that when you find "the answer, but like it's not always right but if you see a lot of it and be watchful then you know it's right" (Cass, May 19, 2014, interview).

Sources of information.

Each participant provided information about the theme sources of information. Coding of responses suggested four sub categories to inform the theme. The sub categories included depth of information, convenience, being current and teacher. Depth of information was further divided into sub-sub categories to allow for rich and limited information.

Participants provided fourteen comments that focused on depth of information sources. Comments (9) about rich information sources focused on the use of the computer. They included that there are "other resources you can find, like everywhere around the world on the computer" (Star, May 16, 2014, interview), that "there's more information found now than were in the books today" (Gary, May 16, 2014, interview). Comments (5) about limited information sources focused on the traditional class. They included that with a paper book "it was just that one source" (Thomas, May 19, 2014, interview), "you don't have all the information" (Thomas, May 19, 2014, interview) and that "you only get what you or any other teacher would tell us, nothing else" (Katie, May 19, 2014, interview).

Participants provided six comments that focused on ease of use. They included that it was easier to use a computer "instead of having to flip through the book trying to hunt for the answer" (Katie, May 19, 2014, interview), and "the reading is hard, man, because I don't understand some of the big words in there but a computer you can look up everything" (Tim, May 16, 2014, interview), "it's easier to find more information about everything" (Gary, May 16, 2014, interview), "it's easier to put it all together" (Gary, May 16, 2014, interview). However, a participant shared a contrary view against the computer, that "you can use your book…you can just look up and research from your book" (Steve, May 20, 2014, interview).

Participants provided two comments that focused on information being current. They included that "we don't really update our books and like all the worksheets the teachers print out are like from newer stuff" (Cass, May 19, 2014, interview) and the "books are a little outdated" (Gary, May 16, 2014, interview).

Participants shared two comments about the theme "teacher". Thomas stated, [in a traditional class] "there's only one teacher there with thirty students" (Thomas, May 19, 2014) and you "we're just used to it but it's still just like I guess you don't have all the information" (May 19, 2014, interview). Cass commented that printed work sheets often do not match the book and the teacher's were "like 'look in your books' and it's not in our books so we'd go towards the technology to get the answers" (Cass, May 16, 2014, interview).

Skills.

Each participant provided information about the theme skills. Coding of responses suggested five sub categories to inform the theme. The sub categories included skill level, training desired, training received, self-evaluation, and staff expectation. The participants (62%) shared that they felt that they did not have the skills necessary to be successful in using computers for education. Responses included "not completely" (Melissa, May 20, 2014, interview), "no I just learned it myself" (Melissa, May 20, 2014, interview), "I'm not very good with computers, that's why I have to call you over every 5 minutes to fix it" (Thomas, May 19, 2014, interview), "clueless" (Thomas, May 19, 2014, interview) , "I'm good at typing if I take my time" (Melissa, May 20, 2014, interview).

Participants shared that they desired training. Participants stated they need "to know how to use Google" (Star, May 16, 2014, interview), "just finding stuff easier, shortcuts" (Star, May 16, 2014, interview), "typing" (Tim, May 16, 2014, interview), and how to "load up stuff" (Tim, May 16, 2014, interview). Participants shared that they needed to know how to select information, "some things is like ridiculous and you shouldn't use it" (Star, May 16, 2014, interview), "figuring out what to get out of it" (Katie, May 19, 2014, interview) and how to use "it within their own stuff, but also be able to quote it" (Gary, May 16, 2014, interview).

Participants shared that in the subcategory of training received, "we learned some of that at home too, like your parents will teach you how to get on and stuff" (Thomas, May 19, 2014, interview). Participants reported that they received "a little bit" (Melissa, May 20, 2014, interview) of instruction at school, "well they told us what to do with it, I mean like we logged in and clicked through stuff" (Thomas, May 19, 2014, interview) and "we were told to click on an answer in fourth grade" (Katie, May 19, 2014, interview). All respondents shared that to learn how to use most applications, "I trained myself to do it" (Steve, May 20, 2014, interview), "we never trained" (Thomas, May 19, 2014, interview), "dive in and figure it out" (Tim, May 16, 2014, interview), "no one really taught me" (Cass, May 19, 2014, interview), and "we had to figure it out on our own, nobody really helped us with it" (Katie, May 19, 2014, interview).

Participants shared that when they thought about self-evaluation, they felt "a little unprepared, a little ignorant I guess you could say. I go in there and stare at it and not know" (Thomas, May 19, 2014, interview). A participant stated, "I felt like, really left out because everyone was like all doing it and I was like Stone Age over here" (Cass, May 19, 2014, interview).

> Not a lot of cases we know what to do, as people would think we do, 'cause teenagers are like 'woo' on technology, like websites, we didn't know how to do that. And it's just getting more as we go, so it's more stuff we need to learn about, as if like with this we can like teach us right there how to do it (Cass, May 19, 2014, interview).

Participants stated that staff "just expected us to know, like they showed us how to do our password and stuff like that but that was about it" (Thomas, May 19, 2014, interview), to "just get on there and type" (Thomas, May 19, 2014, interview), to "use this software, figure it out" (Katie, May 19, 2014, interview). A participant who transferred in to the school stated, "I was like, how do I do this and like someone had to show me and I still didn't understand it" (Cass, May 16, 2014, interview).

Internet access.

Five participants provided insight around the theme Internet access. Coding of responses suggested three sub categories to inform the theme. The sub categories included convenience, fairness and teacher awareness. The sub category of convenience was further divided into the sub-sub categories of have Internet access and no Internet access.

Participants provided nine comments that focused on convenience of using the Internet. Statements were either supportive (4) of Internet access or concerned about lack of access. Participants supportive comments included that "it's more convenient for us, instead of taking a big book home, you can just get on your computer or tablet, it's easier to access" (Star, May 16, 2014, interview) the class or assignments. Participants stated that "anywhere that has like Internet or you can just download the book and just like have it with you everywhere" (Star, May 16, 2014, interview), "everything was accessible" (Thomas, May 19, 2014, interview), that "most kids have Internet access and they can get on and see stuff like Progress Book and check our grades and if we have homework or anything like that so that works out pretty well" (Thomas, May 19, 2014, interview).

Participants shared concerns (5) about not having Internet access such as "a lot of people don't have Internet at home and that's a problem" (Katie, May 19, 2014, interview), "for people that don't have, like computers or Internet that'd be harder" (Star, May 16, 2014, interview). "Not a lot of people have it at home and where we are relying on it too much in schools it's not giving a chance for people" (Cass, May 19, 2014, interview).

Fairness was raised when participants talked about their peers. Participants shared that if the class did not use a physical book "people don't have computers at home so they couldn't like, go on Google and, like, redo it at home, like as if with their book they can just go home and finish it" (Cass, May 19, 2014, interview) and "I think if we are going to rely on technology as much as we do we should provide it for students who can't have it at home" (Cass, May 19, 2014, interview).

Participants shared three comments that focused on teacher awareness. Statements about assignments and access included "If people have enough time in class to do computer stuff then they should do it, but I know about half our class didn't have Internet access so I don't know" (Katie, May 19, 2014, interview). Participants also stated that teachers needed to be aware of access issues and that students "have to somehow figure out how to get on a computer to do their work" (Tim, May 16, 2014, interview) and that "where we are relying on it too much it's not really giving the people who don't have it a chance" (Cass, May 19, 2014, interview).

Social.

Five participants shared comments that focused on the social theme. Sub categories of the theme social included groups, individual, class type and teacher. Participants shared four comments that focused on group learning. All comments were positive for group work, "I like working in groups" (Katie, May 19, 2014, interview) with one participant clarifying that "I would put not like all the smart people together but I would mix it up so that everyone has a chance to say something" (Star, May 16, 2014, interview). Two comments addressed working alone with the computer "helps me learn for myself" (Steve, May 20, 2014, interview) and with a book "you have to teach your own self" (Steve, May 20, 2014, interview).

Class type was further reduced to a comparison of computer rich and traditional class. Participants shared (2) that a computer class "was fun" (Melissa, May 20, 2014, interview) but "not as social" (Thomas, May 19, 2014, interview) as a traditional classroom.

Participants shared four comments about teachers in the classroom. A traditional class had interaction that is more social, "we had a human teaching us instead of a computer, it's nice to have that" (Thomas, May 19, 2014, interview). Participants shared that they "still need a teacher there" (Thomas, May 19, 2014, interview) in a computer rich classroom. Participants shared that in a traditional classroom "there's only one teacher there with thirty students" (Thomas, May 19, 2014, interview) while in a computer rich classroom, the computer "is like having another teacher beside you telling you what the meaning really is like a word or, what the animal's body part is, what part you need to find out maybe" (Steve, May 20, 2014, interview).

Pace.

During the post study interviews, six participants shared comments about the student pace or control over the class work. In all comments, the participants were discussing the computer rich class. Comments included "on the computer you're not listening to other people, you're like reading at your own pace, or you're going at you own pace" (Star, May 16, 2014, interview), "if we ever have a question we could just look it up and there's the answer" (Cass, May 19, 2014, interview). A participant shared that using the computer "I liked it way better because I actually stayed up on my work because I didn't lose a paper" (Melissa, May 20, 2014, interview). A participant shared that:

> a lot of people would do better if more people would use technology in classes…because they could figure things out at their own pace and how they want to figure it out. It's not seeing us as a group; it's seeing us as individuals (Katie, May 19, 2014, interview)

Misuse of computers.

Five participants provided information about the theme misuse of computers. Coding suggested two sub categories to inform the theme. The sub categories included cyber bullying and student focus.

Participants shared comments (6) that a concern in the increase of computer use is cyber bullying, that "it will always be a problem" (Star, May 16, 2014, interview). Participants shared that "people do things to get back at people…take pictures and post everywhere. Ridiculous stuff like that" (Star, May 16, 2014, interview) and that friendships suffered, “X lost one of her friends to that” (Tim, May 16, 2014, interview), “I lost one of mine a longtime ago” (Tim, May 16, 2014, interview). Participants stated that stopping cyber bullying “will never happen, you’ll always have your preps, jocks and jerks” (Tim, May 16, 2014, interview) it could be reduced by blocking “certain websites” (Tim, May 16, 2014, interview) of social media.

Participants shared eight comments related to students focus or using the computer for non-school purposes. “They’ll text or they’ll just listen to music” (Star, May 16, 2014, interview), that students will “just goof off on them and don’t put forth the effort to do their work” (Cass, May 19, 2014, interview), “playing games” (Cass, May 19, 2014, interview). Participants shared that students will short cut class work by using the first item that appears in a search, “they just like copy it right there” (Cass, May 19, 2014, interview). Participants suggested that it was “most students” (Cass, May 19, 2014, interview) who used the computer for non-school purposes during class. Participants suggested that this has increased because in the traditional class “they don’t have options to get on different websites to look up games, or videos” (Cass, May 19, 2014, interview).

Future of school.

Each participant provided information about the theme future of school. Coding of responses suggest two sub categories to inform the theme. The sub categories included computers and structure change.

All participants stated that schools would become more technology based. Participants stated schools would have “more computers than books” (Star, May 16, 2014, interview), every student “would have their own work station” (Thomas, May 19, 2014, interview) or “IPad I guess or some sort of tablet device” (Thomas, May 19, 2014, interview). Class material, “everything will be on the Internet so everybody can have some kind of access to it” (Star, May 16, 2014, interview).

Participants shared that the physical structure of schools would look very different, “technology is getting to the point where schools probably won’t even exist” (Cass, May 19, 2014, interview), that “everything is going to be at home, like home schooling” (Cass, May 19, 2014, interview). Participants shared that “all paper would probably be switched over onto computers” Thomas, May 19, 2014, interview). Participants felt that students would “learn how to use a computer in preschool so throughout the years they gain more information on how to use the computer” (Gary, May 16, 2014, interview) and “will probably learn to program” (Gary, May 16, 2014, interview). Participants stated that “it can be good as long as you get some of the traditional stuff in there too…people still need hardback books and I still think they need to write” (Katie, May 19, 2014, interview).

Experience sampling.

Participants were asked to share their comments about the experience sampling method used to gather data during the study. All participants provided information about the theme experience sampling. Coding of responses suggested theme three sub categories to inform the theme. Sub categories included ease, interruption and awareness.

Participants provided four comments about the ease of using the form. Participants responded that completing the form was “pretty much just doing paperwork” (Steve, May 20, 2014, interview), “was easy to follow” (Cass, May 19, 2014, interview) and that the form collected "what kind of mood I'm in…and what I'm thinking" (Steve, May 20, 2014, interview).

Participants in four statements shared that experience sampling was an interruption at times. Participants stated that the alarm tone was "annoying sometimes" (Cass, May 19, 2014, interview) "because you heard the watches go off 24/7 but I mean it wasn't bad" (Katie, May 19, 2014, interview). A participant shared "it was like right in the middle of something and just like can you not, not right now" (Cass, May 19, 2014, interview).

Participants shared nineteen comments about their awareness while engaged in the experience sampling. Participants shared that the study had been the first time they were asked to think about their own thinking. Participants stated "I was surprised like about how honest I was about it" (Cass, May 19, 2014, interview), "I never thought of that until we got the papers" (Cass, May 19, 2014, interview), "it was the first time I had a problem say what are you thinking about here" (Thomas, May 19, 2014, interview), "it was the first time we did that" (Thomas, May 19, 2014, interview) and that it helped to "get focused or whatever" (Thomas, May 19, 2014, interview).

Participants stated, "I just wanted to put nothing but really I was thinking about, like something" (Star, May 16, 2014, interview), "other times you just sit there and you're like what was I thinking and what was I really doing?" (Melissa, May 20, 2014, interview). Participants shared that "some of the things I was thinking about was way off topic…It did pull you back in there, because you were like I was thinking" (Melissa, May 20, 2014, interview), that "it was weird because I'd be doing one thing but thinking about something else" (Gary, May 16, 2014, interview). "Most of the time my mind was on work but I think there was occasionally I was off in LaLa Land and it surprised myself a little" (Thomas, May 19, 2014, interview).

Participants stated, "I was surprised like about how honest I was about it because I was goofing off just a little bit" (Cass, May 19, 2014, interview). A participant stated

> I actually realized like how much I was doing, how much, like, if I was paying attention or if I wasn't….if I had a choice to pick what I was doing. Like I never thought of that until we got the papers (Cass, May 19, 2014, interview).

A participant shared that "sometimes I was really bored and I just wrote that I was bored and, um, then when we were doing the website I always put like I was really enjoying it and I was happy and everything" (Katie, May 19, 2014, interview). A participant stated:

> it was the random little things that stuck in my head. Like when you were doing lecture notes and you were talking about evolution and you put up a picture of a baby turtle, I thought about that baby turtle for the rest of class. I don't know why (Katie, May 19, 2014, interview)

"After a few days, even without the watch going off but hearing someone else's watch go off, I'd stop and think about what I was thinking about" (Gary, May 16, 2014, interview).

Chapter 5 Discussion

This chapter presents a summary of the study itself and discusses the findings from the data presented in Chapter 4. Findings from each step of the study will be discussed including pre-survey, experience sampling in a traditional classroom, experience sampling in a computer rich classroom and post study interviews of key participants. Chapter 5 also includes implications, recommendations for further research, and study limitations.

The purpose of this study was to examine the rural student lived experience when using computers in a science classroom. The specific research question examined in the study was “How do rural students relate to the technology as a learning tool in comparison to a traditional science classroom?” To inform this question, the participants completed a pre-survey to gather demographic information, background on computer use at home and school, how they experienced common classroom tasks and their feelings about science classes.

After the pre-survey, participants were surveyed using the experience sampling method (ESM). The ESM used a random tone and survey document to gather data about the participant experience (Appendix B). Each participant was toned at random times during each class. ESM gathered information about what the participants were doing, experiencing and thinking about during typical classroom activities in both a traditional classroom and a computer rich classroom.

The final dimension of data gathering was of post study interviews. The researcher identified key informants by direct observation during class and through pre analysis of the submitted ESF. The researcher’s focus was upon the participants who were observed to be most and least engaged with the technology. The most engaged participants were those who showed excitement, who helped other students who were having difficulty and whose questions to the researcher showed application beyond that of the assignment. The least engaged participants were those who needed the most assistance with low-level tasks, those who did not complete their tasks or those who were found to wander to Internet sites not related to the assignments. The researcher selected key informants that represented the naturally occurring groups of gender and IEP/general status. The key informants included two general education females, two general education males, two females with an IEP and two male participants with an IEP.

Pre-survey

The study began with a pre-survey (Appendix A). The survey described the gender of the participants as 65% female (24) and 35% male (13). Nineteen percent (7) of participants reported that they had an IEP (individualized education plan), 11% (4) of participants were not sure while 70% reported no such assistance. The actual number of participants with an IEP was 12 (32%).

Science class.

Students were generally positive about their science class experiences. When students were asked to write three words that describe their feelings about science classes, 67 descriptions were positive (75%), 20 were negative (22%) and two were neutral (3%). The most frequently used positive adjectives included fun (15), interesting (9), enjoyable (8), cool/awesome (5), exciting (4), entertaining (4), like (2) and hands-on (2). The most frequently used negative adjectives included hard (6), boring (5), difficult (3), hate (2) and complicated (Figure 2).

Figure 2. Student Description of Science Class
Students were asked to write the first three words that came to mind when thinking about science classes. The word "hard" was in conjunction with positive words in half of the responses and negative in half. The site Wordle TM (http://www.wordle.net/) was used to create the word cloud.

Computer and internet access.

Participants reported that 92% (34) had Internet access at home with 8% (3) reporting no Internet service at home. Of those that reported having Internet access, service was available through the use of Internet linked smart phones (86%), laptop computer (85%) or desktop computer (70%). Although 92% reported having Internet access at home, participants reported not having access to a computer (30% n=34), laptop (15% n=34), or tablet (33% n=33), leaving their only Internet accessible device a smart phone.

Device divide.

Access to the Internet as reported by the students, 92% with and 8% without access, may be masking a larger access issue. Smart phones have great functionality and are available to a majority of students. However, student access to a device that will allow word processing, research, calculation or spreadsheet development and class preparation becomes apparent. The digital divide expanded in an unforeseen way.

The digital divide identifies the lack of access to the Internet by a certain populations and the problems this lack of access brings. The digital divide does not address the changes this study has been able to identify. While a large number of students in the study reported having Internet access, 92%, the reported number includes those students who can access the Internet only through their phone.

This in turn creates a new divide, a device divide where the line is between those who have access to the tools to do school work, a computer or tablet device, and those who can access the Internet only through their cell phone. Although cell phone technology has and will continue to advance, at this time the cell phones used by most students are sufficient only to browse the Internet. Creation of research documents, spreadsheets or accessing many proprietary software programs used in classes cannot be accomplished using a cell phone.

To establish the size of the digital device divide in this study, of the participants who reported having Internet access, 34% have no home access to a computer, laptop or tablet. At 34%, student access to online class work or research appears to be even more limited than the 8% rate of no Internet access suggests. The divide between those who can access and complete class work through the Internet may be closer to 42% of students; 8% of students who have no access at all and the 34% who have no access to a robust device compatible with school work.

The accessibility of school outside of the its' physical location has become important to students, reducing missed learning experiences when sick or when forgetting physical books or documents or simply choosing to not attend the physical class. Students shared that by using computer access if they "miss school you know what you are missing in class" (Kime, April 25, 2014, survey) and that it "allows me to get my homework online if I forget something at school" (Maggie, April 25, 2014, survey). An increase in the device divide is contrary to the stated desires of the majority of students.

Classroom computer use.

The reported use of computers in classrooms was very limited. Students reported that Math (97%) and History (83%) classes used computer never or one time per month. Responses indicate that Science (94%) and English Language Arts (41%) classes used computer from every other week to daily. Contrary to actual experience, students reported a higher level of engagement in classes that use technology/computers (83%) versus those that do not use computers (17%). Mueller et al. (2008) state that "computers are underused in many schools and the potential of computer technology is not being recognized" (p.1524). Although barriers to the use of computer have been identified and include support, state standards, money, access, time, assessments and the beliefs of other teachers (Ertmer et al., 2012), students clearly recognize the potential for computers to create a more engaging classroom setting.

The increase of student perceived engagement is supportive of an earlier study by Van Rooy. As reported by Van Rooy (2012), students' "in-depth intellectual engagement with content was supported by digital technologies" (p. 79). For classes using computers, students reported the most common uses included presentation software (100%) (Power point, Prezi) and word processing (92%) (Office, Open office) software. The use of spreadsheets (22%) and graphic design software (14%) was lower.

Student control.

The use of the computer in the classroom greatly increased student control. Students shared that they would "rather be doing something on the computer I can control" (Marta, April 25, 2014, survey) and that computers "gave me a chance to discover more information than I would have just from someone telling me" (Cass, April 25, 2014, survey). Increasing student control increased motivation; "by using computers I was more motivated to get the work done" (Maggie, April 25, 2014, survey) and was "more interesting than working on paper" (Gary, April 25, 2014, survey). Student comments of the value of "control" and the resulting increase of their motivation to learn are supported by the self-determination theory of Deci and Ryan. Deci and Ryan (2000) shared that where classroom autonomy is encouraged, the teachers "catalyze in their students greater intrinsic motivation, curiosity and the desire for challenge" (p. 59).

Failure of schools to use computers for student learning appears to be in conflict with how students prefer to learn. Students shared that they liked to learn through contributing to Web sites, blogs, wikis (81%), through video games, simulations (80%) and by running Internet searches (80%). Students shared that they prefer creating items by hand (poster, booklet, cartoon 78%), creating items online (poster, booklet, cartoon, podcast 68%) and looking up terms on the Internet (57%).

The traditional classroom activities of reading and problem solving with paper worksheets were areas of concern identified by students. Students shared that solving problems using textbook (11%), looking up terms in a textbook (8%) and reading textbook (3%) were their least enjoyable classroom activities. The students have suggested that classroom activities that are looked at as unpleasant negatively influence their flow. Hunter and Csikszentmihalyi (2003) found that when examining flow state, "When things are interesting, concentration comes easy and persisting at them is less laborious and burdensome" (p. 28). This suggests that educators' awareness of student level of interest or enjoyment in tasks and thereby changing tasks to increase interest, can lead to greater engagement and enjoyment of the learning task by the students.

Students reported that using computers in class was very important or important (61%). Only 6% of respondents stated computers were not important in classes. A participant stated, "Using technology in classes is effective because it takes something that we use in our everyday lives and lets us use it in school" (Thomas, April 25, 2014, survey). Students went on to share that the use of technology in the classroom gives them greater control (87%) and helps them to do better research (97%). A participant shared, "I feel more involved when I'm not just looking at the teacher and listening to him/her talk" (Ben, April 25, 2014, survey).

In science classes, students shared that using a computer "showed us how actual scientists find out" (Myra, April 25, 2014, survey). The rural students in this study were aware of the advantage the use of computers brings to their overall classroom learning. According to de la Varre et al. (2010) technology "could potentially broaden educational and career opportunities for high school students, and rural schools better prepare their students for post-secondary education, where digital literacy is essential" (p. 195).

Textbooks.

Books have historically been an important source of classroom information. Students' are concerned about the relevance and timeliness of the information used in their science textbooks. Students shared, "We have all the information we could ever ask for at our fingertips and it is nice when a teacher appreciates that information and allows us to use it" (Thomas, May19, 2014, survey). Students felt that a computer "gives more information than a textbook would" (Katie, April 25, 2014, survey), that "not a lot of the books schools have are updated" (Cass, April 25, 2014, survey), that the textbooks are "falling apart and don't fully help with the website papers the teachers print out. They will find a worksheet over current things and tell us to look in our books but there isn't (sic) any answers" (Cass, April 25, 2014, survey).

Student training.

Half of students (50%) reported that they needed more training in how to use computer technology required in their courses. Lack of training in computer use can lead to student stress and disengagement with the classroom technology. A number of students (28%) shared that they "don't like taking tests on the computer" (Lisa, April 25, 2014, survey) and that tests "can be somewhat confusing when larger and longer tests" (Lowell, April 25, 2014, survey) are used.

Students are required to take more standardized tests online. If students are not receiving the support and training they say they need, failure rates may be artificially inflated simply due to students not having the needed experience working with a computer. When the student statements about training are examined using flow theory, a hurdle to engagement is exposed. It is only when there is “conformity between the requirements and the existing abilities” of the participant; the flow state will be experienced (Albert-Lorincz, E., et al., 2010 p. 82). The training deficit will lower the chances students have to experience flow in the classroom.

Experience Sampling

The experience sampling of the students provided rich detail about how they felt about and engaged with specific activities in both a traditional and a computer rich classroom. Data was gathered that will allow for future comparisons among female and male students and between students with an individualized education plan and general students. For this study, the student responses were clustered into a single group. The group responses were examined for mood and activation with the task, if the task was work or play like, concentration and challenge and skill level.

Text reading and relevancy were shared as an issue with participants. Reading scored very high in being work-like in both traditional (83%) and computer rich class experiences (97%). The skill level was lower and the challenge level slightly higher for the interactive text than the paper book. In this situation, the interactive text would require more work in which to engage the material.

Table 22

Traditional classroom student feedback

Task	Work/Play/Both[a]	Concentration[b]	Challenge[c]	Skill Level[d]
Text Reading	83/0/17	6.0	1.2	7.2
Lecture	78/0/22	6.24	1.7	6.8
Worksheet	92/0/8	6.6	3.4	6.4
Activity	25/46/28	6.0	4.48	5.9

Table Note. [a] Percent for work/play/both
[b] Likert scale from Not at all (0) to Very well (9)
[c] Likert scale from No challenge (0) to High challenge (9)
[d] Likert scale from Low skills (0) to High skills (9)

Table 23

Computer rich classroom student feedback

Task	Work/Play/Both[a]	Concentration[b]	Challenge[c]	Skill Level[d]
Reading Interactive Text	97/0/3	5.9	1.6	6.3
Discussion Board	74/26/0	5.2	2.7	5.4
Website Development	57/40/3	7.1	2.5	6.2
LMS Quiz	93.5/0/6.5	6.16	4.5	5.6

Table Note. [a] Percent for work/play/both
[b] Likert scale from Not at all (0) to Very well (9)
[c] Likert scale from No challenge (0) to High challenge (9)
[d] Likert scale from Low skills (0) to High skills (9)

As shared by Deci and Ryan (1985), “interest-excitement is said to be the basis of intrinsically motivated behavior” (p. 28). In addition, Shernoff and Csikszentmihalyi (2010) suggested that the relationship between flow and student engagement could be described as the “simultaneous occurrence of high concentration, enjoyment and interest in learning activities” (p. 133).

Traditional classroom activities showed the highest reported skill levels for students. As mentioned by both Deci and Ryan and Shernoff and Csikszentmihalyi, high skill and low challenge result in a reduction in student intrinsic motivation or satisfaction with the tasks. A participant shared that in the traditional class “we’ve just done what we’ve always done, so we were used to that” (Thomas, May 19, 2014, interview). Excluding the hands on lab activity in the traditional classroom, the computer rich activities had a higher level of student enjoyment as shown by the ranking of the task to be more like both work and play or play. The computer tasks also had a lower skill level and a higher challenge level, which would result in higher intrinsic enjoyment of the activities.

When examining the data provided by the participants regarding their emotional state and activation with the tasks in both classrooms, several items stand out (Table 24, Table 25). The data shows a noteworthy difference in indicators such as the moods happy and sad. In the traditional classroom, students scored their happiness at 4.6, between somewhat and very sad while they scored happiness in the computer enhanced class as 2.6, between somewhat happy and somewhat sad. This suggests that the students are much happier while in a classroom that is computer rich. Feeling clear or confused with the task was also suggesting a large difference between the types of classes. Traditional class tasks scored a 5.1 or quite confused with tasks while the computer rich tasks scored 1.8 or between very and quite clear.

Students also reported a large difference in how involved they felt they were with tasks. Traditional classroom tasks scored 4.7 (somewhat to quite uninvolved) while computer rich tasks scored 2.2, between quite and somewhat involved.

Areas that presented similar data between class types include proud and ashamed with 2.7 in traditional and 3.0 in computer (quite and somewhat proud); relaxed and worried with 2.3in traditional and 2.4 in computer (quite and somewhat relaxed); excited and bored with 3.2 in traditional and 3.6 in computer (somewhat excited) and competitive and cooperative with 4.5 in traditional and 4.3 in computer (somewhat and very cooperative).

Table 24

Participant mood and activation with traditional class

	Very(1)	Quite (2)	Some- (3) what	Some- (4) what	Quite(5)	Very(6)	
Happy					4.6		Sad
Proud			2.7				Ashamed
Clear						5.1	Confused
Relaxed			2.3				Worried
Excited				3.2			Bored
Active			2.6				Passive
Involved					4.7		Not Involved
Competitive					4.5		Cooperative

Table 25

Participant mood and activation with a computer rich classroom

	Very(1)	Quite (2)	Some- (3) what	Some- (4) what	Quite(5)	Very(6)	
Happy			2.6				Sad
Proud				3.0			Ashamed
Clear		1.8					Confused
Relaxed			2.4				Worried
Excited				3.6			Bored
Active			2.2				Passive
Involved			2.2				Not Involved
Competitive					4.3		Cooperative

Post Study Interviews

After using experience sampling to explore students' engagement with both a traditional paper based and computer rich science class, a sample of students were selected for interviews. The researcher selected key informants from the class for the post computer experience interviews. The researcher identified the key informants by direct observation and pre analysis results on the submitted ESF.

The researcher's focus was upon the participants who were observed to be most and least engaged with the technology. The most engaged participants were those who showed excitement, who helped other students who were having difficulty and whose questions to the researcher showed application beyond that of the assignment. The least engaged participants were those who needed the most assistance with low-level tasks, those who did not complete their tasks or those who were found to wander to Internet sites not related to the given assignments. The researcher selected key informants that represented the naturally occurring groups of gender and IEP/general status. The interviews provided student voice in the themes of student opinion of classes, sources of information, skills, access, social, pace, misuse of computers, future trends and the process of experience sampling.

Opinion of class.

Students shared that they overwhelmingly preferred a computer rich classroom, 75% for to 25% preferring a traditional classroom. Students stated, "people would do better if more people would use technology in classes" (Katie, May 19, 2014, interview). Another shared that "you can really get into it and find out more about what you want to know" (Katie, May 19, 2014, interview). Information is traditional classrooms was limited, students felt that they "only get what you or any other teacher would tell us, nothing else" (Katie, May 19, 2014, interview).

The statements by the students are in conflict with their classroom experience. As they shared in the pre-study survey, most of the student class time is spent in traditional pedagogy. The feeling of "we've just done what we've always done, so we were used to that" (Thomas, May 19, 2014, interview) when discussing a traditional class does not suggest high levels of engagement:

> a lot of people would do better if more people would use technology in classes…because they could figure things out at their own pace and how they want to figure it out. It's not seeing us as a group; it's seeing us as individuals (Katie, May 19, 2014, interview)

Sources of information.

"There's more information found now than were in the books today" (Gary, May 16, 2014, interview) shared a student. Students were aware of a gap between their sources of information in a traditional and a computer rich classroom. Paper books were "just one source" (Thomas, May 19, 2014, interview) and that with the computer there were "other resources you can find, like everywhere around the world" (Star, May 16, 2014, interview). It was noted that students understood that "we don't really update our books and like all the worksheets the teachers print out are like from newer stuff" (Cass, May 19, 2014, interview) and the "books are a little outdated" (Gary, May 16, 2014, interview). When there is a perceived disconnect between a worksheet given and their textbook was identified by the students, they would "go towards the technology to get the answers" (Cass, May 16, 2014, interview).

The frustration of a reader who faced challenges with the text book were made clear with the statement "the reading is hard, man, because I don't understand some of the big words in there but a computer you can look up everything" (Tim, May 16, 2014, interview). In the same area of concern, a student stated, "it's easier to put it all together" (Gary, May 16, 2014, interview) when they can use a computer for coursework. Getting help from the teacher with reading or comprehending the textbook was a concern when "there's only one teacher there with thirty students" (Thomas, May 19, 2014).

A disconnect between the student sources of information and the reality they know may result in a chilling effect on their intrinsic motivation. Deci and Ryan (1985) state that "interest-excitement is said to be the basis of intrinsically motivated behavior" (p. 28). The use of outdated and misconnected student work will lead to students losing interest in their science class.

Skills.

The majority (62%) of students felt that they did not have the requisite skills to effectively use computers in their own education. Skill deficits were identified in doing searches as shared by Star, "know how to use Google" (Star, May 16, 2014, interview), typing or keyboarding and in identifying what information is valid as shared by Katie, "figuring out what to get out of it" (Katie, May 19, 2014, interview).

Perceived skills deficits negatively influence student outcomes. Comments such as feeling "a little unprepared, a little ignorant I guess you could say. I go in there and stare at it and not know" (Thomas, May 19, 2014, interview) and that "I felt like really left out because everyone was like all doing it and I was like Stone Age over here" (Cass, May 19, 2014, interview) show students who question their ability to be successful when they aren't given proper training. Students also shared their frustration in that:

> Not a lot of cases we know what to do, as people would think we do, 'cause teenagers are like 'woo' on technology, like websites, we didn't know how to do that. And it's just getting more as we go, so it's more stuff we need to learn about. (Cass, May 19, 2014, interview)

Training occurs in several layers: at home, in the classroom and by exploration. Parents were the first people to help train the student to use a computer, "we learned some of that at home too, like your parents will teach you how to get on and stuff" (Thomas, May 19, 2014, interview). Students shared that they received "a little bit" (Melissa, May 20, 2014, interview) of instruction at school. When asked to explain, students stated "well they told us what to do with it, I mean like we logged in and clicked through stuff" (Thomas, May 19, 2014, interview). However, to actually learn how to use applications students replied, "I trained myself to do it" (Steve, May 20, 2014, interview) and "we never trained" (Thomas, May 19, 2014, interview). Students shared that they were told to "dive in and figure it out" (Tim, May 16, 2014, interview), "no one really taught me" (Cass, May 19, 2014, interview), and "we had to figure it out on our own, nobody really helped us with it" (Katie, May 19, 2014, interview).

Teachers and staff "just expected us to know, like they showed us how to do our password and stuff like that but that was about it" (Thomas, May 19, 2014, interview). Students were told to "just get on there and type" (Thomas, May 19, 2014, interview) and to "use this software, figure it out" (Tim, May 16, 2014, interview). The frustration for students transferring in from a different school was related in the following comment, "I was, like, how do I do this and someone had to show me and I still didn't understand it" (Cass, May 16, 2014, interview).

As was suggested in the examination of students' pre-study survey results, the ability to use technology enhanced with training will increase both the students' intrinsic motivation and the possibility of experiencing flow in their learning activities. Deci and Ryan (1991) state that "competence, relatedness, and autonomy (or self-determination)" are the three basic psychological needs considered for both intrinsic and extrinsic motivation (p. 327). Csikszentmihalyi (2008) stated that in order to experience flow one has to "sense that one's skills are adequate to cope with the challenges at hand" (p. 71).

Internet access.

Students felt that using the Internet was convenient for them. It was easy such that "anywhere that like has Internet or you can just download the book and just like have it with you everywhere" (Star, May 16, 2014, interview). Students felt that "most kids have Internet access and they can get on and see stuff" (Thomas, May 19, 2014, interview). However, strong statements were made in support of those who do not have access.

Students stated, "for people that don't have, like computers or Internet that'd be harder" (Star, May 16, 2014, interview) than using physical books. They were concerned about the issue of fairness stating: "Not a lot of people have it at home and where we are relying on it too much in schools it's not giving a chance for people" (Cass, May 19, 2014, interview). Students felt that if schools were to continue to increase the use of computers, "we should provide it for students who can't have it at home" (Cass, May 19, 2014, interview).

Access or lack of access by students should become an awareness issue for teachers. When teachers made computer or Internet based assignments, students felt, "If people have enough time in class to do computer stuff then they should do it, but I know about half our class didn't have Internet access" (Katie, May 19, 2014, interview). A failure of the teacher to know or to find out about student access became an issue of how students could do their class work.

Students without had to "somehow figure out how to get on a computer to do their work" (Tim, May 16, 2014, interview). In rural communities, finding public access to the Internet, such as in a library, becomes challenging. Students may not have transportation or the library might be many miles from their home. Access to classes through computers and the Internet are vital to the success of rural students. "Students living in rural areas of the United States exhibit lower levels of educational attainment and a higher likelihood of dropping out of high school than do their nonrural counterparts" (Reeves & Bylund, 2005, p. 361). Since rural schools "typically offer fewer advanced and college preparatory courses", computer use may make a difference if teachers are aware of the limitations students' face (Arnold, 2004, p. 3).

Social.

All students enjoyed group work in both the traditional and the computer rich classroom. It was stated that the computer rich class "was fun" (Melissa, May 20, 2014, interview) but "not as social" (Thomas, May 19, 2014, interview) as a traditional classroom. Even though the computer "is like having another teacher beside you" (Steve, May 20, 2014, interview), students still demanded human interaction. Students also felt that it was important to have "a human teaching us instead of a computer, it's nice to have that" (Thomas, May 19, 2014, interview), they "still need a teacher there" (Thomas, May 19, 2014, interview) in a computer rich classroom. Student comments are supported by the self-determination work of Deci and Ryan. The supportive role of a teacher provides for the "universal psychological needs" of students (Deci & Ryan, 2008, p. 182).

Pace.

Students greatly enjoyed the idea of moving at their own pace, of being in control. It was stated "you're like reading at your own pace, or you're going at your own pace" (Star, May 16, 2014, interview). A student shared that control was positive since "I liked it way better because I actually stayed up on my work because I didn't lose a paper" (Melissa, May 20, 2014, interview).

Autonomy is a key issue in both self-determination and flow theory. Deci and Ryan (2000) stated that "students who were overly controlled not only loose initiative but also learn less well, especially when learning is complex or requires conceptual, creative processes" (p. 59). Where teachers encouraged autonomy for their students, the teachers "catalyze in their students greater intrinsic motivation, curiosity and the desire for challenge" (Deci & Ryan, 2000, p. 59). In flow, students' control of their learning pace can be described as a "simultaneous occurrence of high concentration, enjoyment and interest in learning activities" (Shernoff & Csikszentmihalyi, 2010, p. 133).

Misuse.

Cyber bullying was a concern of the students. The intentional misuse of computers has a negative impact with friendships lost and "people do things to get back at people…take pictures and post everywhere. Ridiculous stuff like that" (Star, May 16, 2014, interview). Students stated that cyber bullying would not go away, "you'll always have your preps, jocks and jerks" (Tim, May 16, 2014, interview). According to students, the only possible way to limit cyber bullying would be blocking certain websites like social media. Parris et al. (2014) found that students suggested that in order to reduce cyberbullying, schools needed to train and educate students about cyberbullying and to focus on the people doing the bullying and not blame the technology. Participants in Parris' study also shared that they also felt that there was "no way to reduce cyberbullying" (2014, p. 591).

Other issues of misuse included texting, listening to music or the ability to "just goof off on them and don't put forth the effort to do their work" (Cass, May 19, 2014, interview). Students suggested that misuse included using computers for non-school use during class time. This has increased as a result of increased availability of computers because in the traditional class, "they don't have options to get on different websites to look up games, or videos" (Cass, May 19, 2014, interview).

Future.

All students in the study shared that they felt that schools would continue to focus more on learning using computers or other technology. Students felt "everything will be on the Internet so everybody can have some kind of access to it" (Star, May 16, 2014, interview) and that school's would have "more computers than books" (Star, May 16, 2014, interview). Individual access to a device was also part of students' vision; each student "would have their own work station" (Thomas, May 19, 2014, interview) or "I Pad I guess or some sort of tablet device" (Thomas, May 19, 2014, interview). Students could envision a time where the concept of a school building itself would change, "technology is getting to the point where schools probably won't even exist" (Cass, May 19, 2014, interview); where learning could occur anywhere, "like home schooling" (Cass, May 19, 2014, interview).

Experience sampling.

Using experience sampling as a data collection tool was new for the students, as was being asked to think about their own thinking. The experience sampling form itself "was easy to follow" (Cass, May 19, 2014, interview) and students were aware that it collected information about "what kind of mood I'm in…and what I'm thinking" (Steve, May 20, 2014, interview). Students shared, "it was the first time I had a problem say what are you thinking about here" (Thomas, May 19, 2014, interview).

Being aware of their thinking helped students to "get focused or whatever" (Thomas, May 19, 2014, interview). Students found that at times they had to "just sit there and you're like what was I thinking and what was I really doing?" (Melissa, May 20, 2014, interview). The students became more aware of how they were thinking, "it was weird because I'd be doing one thing but thinking about something else" (Gary, May 16, 2014, interview). Awareness of their level of distraction came as a surprise to most, "Most of the time my mind was on work but I think there was occasionally I was off in LaLa Land and it surprised myself a little" (Thomas, May 19, 2014, interview). A participant shared:

> it was the random little things that stuck in my head. Like when you were doing lecture notes and you were talking about evolution and you put up a picture of a baby turtle, I thought about that baby turtle for the rest of class. I don't know why (Katie, May 19, 2014, interview)

Students found that they began to examine their thinking at other times during the class, "After a few days, even without the watch going off but hearing someone else's watch go off, I'd stop and think about what I was thinking about" (Gary, May 16, 2014, interview). Fischer (2009) suggested that ESM "is concerned with the experience that is covert to the eye of the observer" (p. 1047). In the study, the use of ESM allowed the participant to have the opportunity to observe that that had been covert to them. For the students this meant the chance to think about their own thinking.

Conceptual Framework

The study gathered rich data about the students' experience with computers. Analysis and synthesis of the data show connections among many variables. The variables may either hinder or assist students in successfully engaging with computers. The conceptual framework attempts to show these variables and their relationships.

The focus of the study was on the rural student experience and so the framework begins with the student. Before the student interacts with the computer in the classroom, several variables have influenced the student (Figure 3). Rural students are impacted by the digital divide, having access to and quality of Internet services. In addition, students are directly impacted by what the researcher calls the "device divide".

The device divide suggests that there is a new gap that separates students. This divide separates those who have access to devices that are robust enough to do high-level class work from those that do not. Although cellular phones have reduced the number of students who cannot access the Internet, cellular phones may have created a false feeling that access to a computer is no longer necessary at home. As this study has shown, although most students have Internet access, fewer have access to a device that enables them to complete rigorous class work at home.

Access also influences development of student skill level in computer use. Little or no access drives student skill levels down, reducing engagement and successful use. Students have shared that parents assist in acquiring the basics of computer use. They receive little or no training at school in proper, safe use of a computer and the Internet. It is clear that the majority of students is self-taught or receives guidance from peers resulting in lower self-confidence or the development of misconceptions of their skill or ability. The awareness of educators and the school system to these factors has either a supportive or a chilling effect on the students' experience. Asking or assessing student readiness before assigning computer directed assignments might result in more positive student outcomes.

Students value and want a teacher to be available in a computer rich classroom. The teacher's role as coach, advisor and mentor is valued by the student. Students ask for the teacher to be there, to keep the lesson personal and lend support. The social component of learning is important in a computer rich classroom. Students understand that they are at risk for cyber bullying and need to have adult leadership to minimize the problem and keep the learning environment safe.

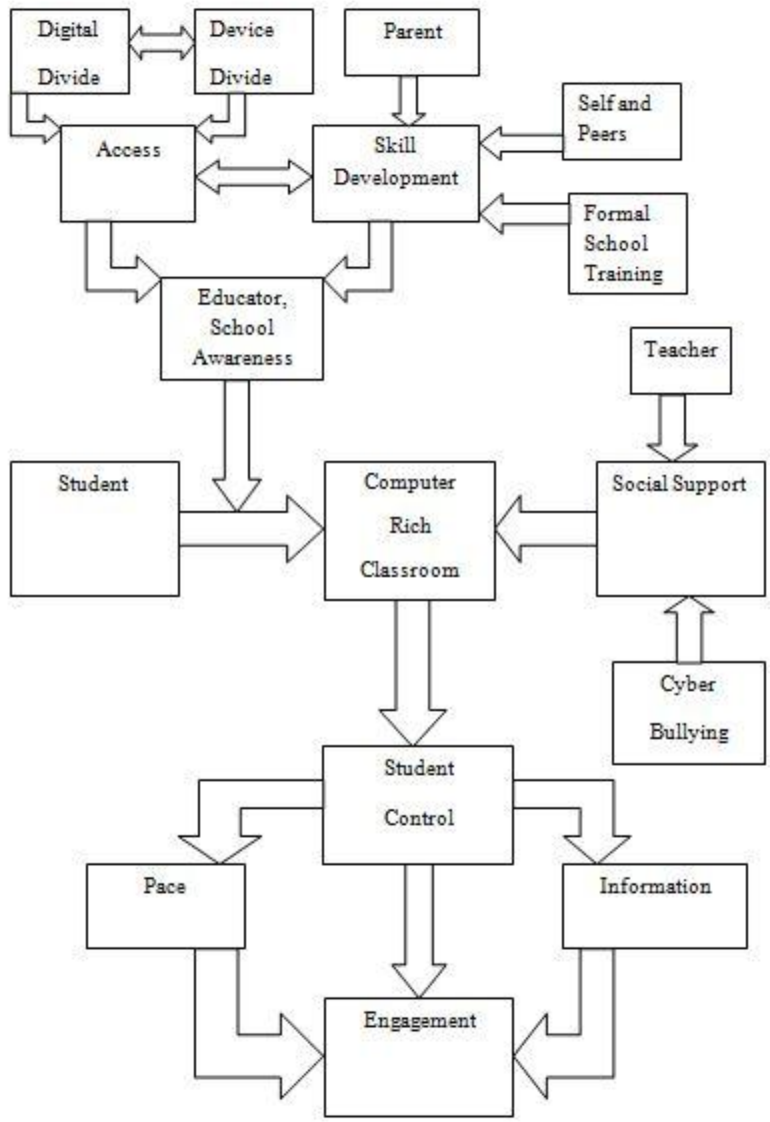

Figure 3. Conceptual Framework for Student Engagement in a Computer Rich Rural Science Classroom

The concept map provides a representation of the variables that influence the engagement of students with computers in a rural classroom. Students are initially impacted by access to the Internet (Digital Divide) and to a robust device that can be used for schoolwork (Device Divide). Access impacts and is impacted by student skill development and the awareness of educators of differences in skills and access. When using the computer in a class, support from the teacher and awareness of cyber bullying impact the student. As the students' skill with the computer and challenge level for the task mesh, the student increases their control of learning through self-directed pace along with access to different types of information. The increase of control leads to higher levels of engagement in the science class.

Once a student has developed computer skills and has a supportive environment, the computer rich classroom offers her the ability to set her own pace. In a class of thirty or more students, problems of boredom due to a slower class pace or of stress due to a quick pace can be minimized by the student taking charge of the pace of their own learning. As time allows, students will be able to extend learning by seeking out information needed to fill gaps in knowledge or to follow areas of interest aroused in an assignment. By setting their own pace and receiving support as needed, student engagement is increased and students feel more in control of their learning.

Implications

Several implications can be drawn from this study. Primarily is the increase of student engagement that occurs when computers are used as a learning tool. Although there may be other variables that influenced the engagement of students during the study, the self-reported increase in engagement while using computers was shared by most students. Increasing student engagement with computers in the classroom will require an investment in student and staff training to ensure that skill levels meet the demand for classroom technology.

As Goos et al., shared, “Technology as an extension of self” was the “highest level of functioning”, with technology becoming “as much a part of the user’s catalogue of resources as tabulated information and mathematical knowledge inside the head” (Goos et al., 2000, p. 312). It is the desire of education for the student to arrive at this level of performance, however training and teacher expertise may hinder the development.

For school administrators there are implications. As mentioned, professional development of teachers needs to be focused on giving each teacher the skill set to be proficient in the use of technology. Teachers may need to receive training to align computer-based assignments to the resources to which the student has access. In addition, rural schools often lack the resources for specialized teachers (AP, etc.) and the use of technology can broaden the curriculum available to students for a lower cost than that of recruiting and hiring these specialized teachers.

Awareness of cyberbullying is an issue raised by the students that needs constant attention. Administrators will need to invest time and attention to being sure that students are using school-based equipment, including Wi-Fi connections, for educational purposes. Students want a safe educational environment. Awareness and vigilance is the only way to be sure that they are safe. Student involvement in the discussion may make a reduction in cyberbullying more achievable.

Students shared that the ESM was the first experience they had in metacognition, thinking about their learning. The ESM can be simplified to a small number of responses. A classroom teacher could implement this type of data collection methodology to gather data about any learning activity and student engagement with the activity. This would also encourage students to think about how they think and how they address distractions when attempting to engage in the class activity.

Recommendations for Further Research

This study presents an opening for further study in several different student focused areas. Of interest are the ideas of a "device divide" and the impact of the divide among rural students. Further study will be necessary to clarify and define the issue of a device divide. It would also be valuable to understand if urban poor students face the same situation of access to a device robust enough to do class work.

The students in the study raised the question of why teachers use worksheets that are not connected to the resource, the book, students have available. This issue of a curriculum disconnection would need to be evaluated through conversations with additional students and teachers. This research might also include examination of artifacts including the student work and the books students have available to use.

Students stated that the use of the ESM was the first time that they were asked to describe what they were thinking. Students were interested in their own reactions to exploring their thoughts. Therefore, it may be valuable to use ESM as a tool to evaluate the effectiveness of a single or group of teaching strategies for classroom teachers.

Students are taking more computer based standardized tests for summative evaluations. The study identified that there could be a chilling effect between the training students receive in the proper use of a computer and their test scores. Due to the increase in this type of test, a study should be undertaken to examine student readiness and preparation in the use of a computer and their test scores.

As schools spend a smaller percentage of their budgets on replacing textbooks, the students' question of how long to use a text book and when or if to migrate to an interactive (computer based) text needs to be examined. As the students shared, textbooks are usually ignored by the student when they are seeking answers or trying to solve problems. Is the textbook in its current incarnation an effective tool for learning or a hindrance to students? Additionally, the process a school system goes through as it decides if and how to migrate from a paper based to an electronic or other alternative text needs to be examined and understood.

Since cyberbullying was identified as an issue by many participants in the study, more in-depth studies of the nature and occurrences of cyber bullying in rural communities appear to be needed. There is also an opportunity to see if there are differences between rural and urban students in accepting or taking stands against cyberbullying.

Students clearly stated that they prefer to learn with computers. Studies that would examine computer based learning activities would help to clarify the student preference. This might include which tasks are perceived by students as better when on a computer and which the student would prefer in a more traditional form.

Conclusions

Computers have become ubiquitous. Students expect their learning experience to include technology in its varied forms. This study's results show that students not only want and expect to use computers in their classes, but also to be taught how to effectively and efficiently use computers for their learning.

Challenges will arise and answers will need to be found as the educational system moves through perhaps one of its most profound changes. Administrators, educators, students and interested parties will need to examine and challenge how education is delivered in all aspects. Students have already begun to ask the questions, if only we choose to hear their voices. Are texts as vital as they once were? Is a building vital? Where must a classroom be? Can I be in class without being in class? Can students design their own curriculum?

The device divide will need to be examined. In terms of social democracy, any variable that causes a group to be placed at a disadvantage should be scrutinized. Change is real and happening now. The decisions of how to reshape the educational system must be well considered. If not, change will be thrust upon the educational system and the time for planning will have passed.

This is an exciting time for education.

References

Albert-Lorincz, E., Albert-Lorincz, M., Kadar, A., Krizbai, T., & Lukacs-Marton, R. (2010). Flow and anti-flow as predictive and protective factors in the life of adolescents. *The New Educational Review, 22* (3-4*)*, 81-92.

Anderson, B. G. (2012). *Temporally linking classroom contextual factors and instructional practices to procedural and substantive engagement in the high school classroom.* (Order No. 1519700, Northern Illinois University). *ProQuest Dissertations and Theses,* 126. Retrieved from http://search.proquest.com.proxy.library.ohiou.edu/docview/1102670968?accountid=12954. (1102670968)

Arnold, M. (2004). *Guiding rural schools and districts: A research agenda* (ED-01-CO-0006 Deliverable #2004-08). Washington, D.C.: U.S. Department of Education.

aptitude. (n.d.). *Dictionary.com Unabridged*. Retrieved August 12, 2013, from Dictionary.com website: http://dictionary.reference.com/browse/aptitude

Atav, S. Spencer, G. (2002). Health risk behaviors among adolescents attending rural, suburban, and urban schools: A comparative study. *Family and Community Health*, *25*(2), 53-64.

Bauman, S., Newman, M. (2012). Testing assumptions about cyberbullying: Perceived distress associated with acts of conventional and cyberbullying. *Psychology of Violence, 3*(1), 27-38. doi: 10:1037/a0029867

Bonk, C., Olson, T., Wisher, R., & Orvis, K. (2002). Learning from focus groups: An examination of blended learning. *Journal of Distance Education, 13*(3), 97-118.

Brandtzaeg, P., Heim, J., Karahasanovic, A. (2009). Understanding the new digital divide-A typology of users in Europe. International Journal of Human Computer Studies, 1-16. doi: 10.1016/j.ijhcs.2010.11.004

Burton, K., Florell, D., Gore, J. (2013). Differences n proactive and reactive aggression in traditional bullies and cyberbullies. *Journal of Aggression, Maltreatment, and Trauma, 22*, p. 316-328. doi: 10.1080/10926771.2013.743.938

Chandra, V., & Lloyd, M. (2008). The methodological nettle: ICT and student achievement. *British Journal of Educational Technology, 39* (6), 1087-1098. doi:10.1111/j.1467-8535.2007.00790.x

Chandra, V., & Fisher, D. (2009). Students' perceptions of a blended web-based learning environment. *Learning Environments Research, 12*, 31-44. doi: 10.1007/s10984-008-9051-6

Chandra, V., & Watters, J. (2012). Re-thinking physics teaching with web-based learning. *Computers and Education, 58*, 631-640. doi:10.1016/j.compedu.2011.09.010

Cilesiz, S. (2011). A phenomenological approach to experiences with technology: current state, promise, and future directions for research. *Educational Technology Research & Development, 59,* 487-410. doi: 10.1007/s11423-010-9173-2

Conner, T. & Bliss-Moreau, E. (2006). Sampling human experience in naturalistic settings. In S. Hesse-Biber and P. Leavy (Eds), Emergent methods in social research (pp.109-129). Thousand Oaks, Ca: Sage.

Crano, W., & Brewer, M. (2009). *Principles and methods of social research*. New York: Psychology Press.

Creswell, J. (2012). *Qualitative inquiry& research design*. Los Angeles: Sage.

Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the experience-sampling method. *The Journal of Nervous and Mental Disease, 175*(9), 526-536.

Csikszentmihalyi, M. (2008). *flow.* New York: Harper Perennial Modern Classics.

Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Press.

Deci, E., & Ryan, R. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist, 26*(3+4), 325-346.

Deci, E., & Ryan, R. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology, 25*, 54-67. doi: 10.1006/ceps.1999.1020

Deci, E., & Ryan, R. (2008). Self-determination theory: A macrotheory of human motivation, development and health. *Canadian Psychotherapy, 49*(3), 182-185.

de la Varre, C., Keane, J., & Irvin, M. (2010). Enhancing online distance education in small rural US schools: a hybrid, learner-centred model. *ALT-J, Research in Learning Technology, 18*(3), 193-205. doi: 10.1080/09687769.2010.529109

de la Varre, C., Keane, J., & Irvin, M. (2011). Dual perspectives on the contribution of on-site facilitators to teaching presence in a blended learning environment. *The Journal of Distance Education, 25* (3), 1-13.

DiBianca, R. P. (2000). *Teaching adolescents: Relationships between features of instruction and student engagement in high school mathematics and science classrooms.* (Order No. 9990539, The University of Chicago). *ProQuest Dissertations and Theses,* 201. Retrieved from http://search.proquest.com.proxy.library.ohiou.edu/docview/304645364?accountid=12954. (304645364)

Drijvers, P., Doorman, M., Boon, P., Reed, H., & Gravemeijer, K. (2010). The teacher and the tool: instrumental orchestrations in the technology-rich mathematics classroom. *Educational Studies in Mathematics*, *1*-22. doi: 10.1007/s10649-010-9254-5

Educause Center for Applied Research (2007). Students and Information Technology in Higher Education [Survey Instrument].

Englebert, M., & Carruthers, P. (2011). Descriptive experience sampling: what is it good for? *Journal of Consciousness Studies, 18*(1), 130-149.

Ertmer, P., Ottenbreit-Leftwich, A., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education, 59*, 423-435. doi: 10.1016/j.compedu.2012.02.001

Evans, G., Vermeylen, F., Barash,A., Lefkowitz, E., Hutt, R. (2009). The experience of stressors and hassles among rural adolescents from low- and middle-income households in the USA. *Children, Youth and Environments, 19*(2), 164-175.

Finneran, C., & Zhang, P. (2002).The challenges of studying flow within a computer-mediated environment. *AMCIS 2002 Proceedings,* 1047-1054.

Fisher, J. (2009). Experience-sampling tools: A critical review. *Journal of Youth and Adolescence, 57*(3), 1-3. doi: 10.1080/10635150802172192

Gandossy, T. (2007). Technology transforming the leisure world. Retrieved from http://edition.cnn.com/2007/US/03/29/leisure.overview/index.html?eref=sitesearch

Gayol, Y. (2010). Online learning research. In K. Rudestan, J. Schoenholtz-Read (Eds.) *Handbook of online learning* (197-225). California: Sage.

Ginns, P., & Ellis, R. (2007). Quality in blended learning: Exploring the relationships between on-line and face-to-face teaching and learning. *Internet and Higher Education, 10,* 53-64. doi:10.1016/j.iheduc.2006.10.003

Glesne, C. (2011). *Becoming qualitative researchers*. Boston: Pearson.

Goos, M., Renshaw, P., Galbraith, P., Geiger, V. (2000). Reshaping teacher and student roles in technology-enriched classrooms. *Mathematics Education Research Journal, 12*(3), 303-320.

Hektner, J., & Csikszentmihalyi, M. (2002). The experience sampling method: Measuring context and content of lives. In R. Bechtel & A. Churchman (Eds.), *Handbook of Environmental Psychology,* 233-243. New York: John Wiley and Sons.

Hektner, J., Schmidt, J., & Csikszentmihalyi, M. (2007). *Experience sampling method Measuring the quality of everyday life*. California: Sage.

Hoadley, C. (2007). Learning sciences theories and methods for e-learning researchers. In R. Andrews & C. Haythornthwaite (Eds.) *The sage handbook of e-learning research*, 139-156. California: Sage.

Hoffman, L. (2013). How technology has changed the way we understand national tragedy. Retrieved from http://www.huffingtonpost.com/lindsay-hoffman/how-technology-has-changed_b_3327908.html

Hormuth, S. (1986). The sampling of experiences in situ. *Journal of Personality, 54*(1), 262-293.

Hunter, J., & Csikszentmihalyi, M. (2003). The positive psychology of interested adolescents. *Journal of Youth and Adolescence, 32*(1), 27-35.

Johnson, L. S. (2004). *Academic engagement from the perspective of flow theory: A comparative analysis of student experience in nontraditional and traditional schools.* (Order No. 3161314, Northern Illinois University). *ProQuest Dissertations and Theses,* 155-155 p. Retrieved from http://search.proquest.com.proxy.library.ohiou.edu/docview/305135831?accountid=12954. (305135831)

Johnson, L. (2008). Relationship of instructional methods to student engagement in two public high schools. *American Secondary Education, 36*(2), 69-87.

Karahoca, A., Karahoca, D., & Yengen, I. (2010). Computer assisted active learning system development for critical thinking in history of civilization. *Cypriot Journal of Educational Sciences, 5,* 4-25.

Kerpen, C. (2013). How the internet has changed education forever. Retrieved from http://www.inc.com/carrie-kerpen/how-the-internet-has-changed-education-forever.html

Korkmaz, O., & Karakus, U. (2009). The impact of blended learning model on student attitudes towards geography course and their critical thinking dispositions and levels. *The Turkish Online Journal of Educational Technology, 8*(4), 51-63.

Koro-Llundberg, M., Bussing, R., Williamson, P., & M'Cormack-Hale, F. (2008). Reflecting on the experience sampling method in the qualitative research context: Focus on knowledge production and power during the data-collection process. *Field Methods, 20*(4), 338-355. doi: 10.1177/1525822X08320201

Lankford, H., Loeb, S., Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational Evaluation and Policy Analysis, 24*(1), 37-62.

Levin, T., & Wadmany, R. (2006). Teachers' beliefs and practices in technology-based classrooms: A developmental view. *Journal of Research on Technology in Education, 39*(2), 157-181.

Li, Q. (2007). Student and teacher views about technology: A tale of two cities? *Journal of Research on Technology and Education, 39*(4), 377-397.

Manen, M. (1990). *Researching lived experience*. Albany: State University of New York Press.

Marshall, C., & Rossman, G. (1999). *Designing qualitative research*. California: Sage.

Martinez, S. (2009). Mexican American high school students' perceived levels of challenge in school. *Hispanic Journal of Behavioral Sciences, 31*(3), 297-316.

McKnight, K. (2014). Top 12 ways technology changed learning. Retrieved from http://www.teachhub.com/how-technology-changed-learning

Moreno, M., Jelenchik, L., Koff, R., Eikoff, J., Diermyer, C., Christakis, D. (2012). Internet use and multitasking among older adolescents: An experience sampling approach. *Computers in Human Behavior, 28*, 1097-1102. doi:10.1016/j.chb.2012.01.016

Moustakas, C. (1994). *Phenomenological research methods*. California: Sage

Mueller, J., Wood, E., Willoughby, T., Ross, C., & Specht, J. (2008). Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers and Education, 51,* 1523-1537. doi: 10.1016/j.compedu.2008.02.003

National Telecommunication and Information Administration (2014). *Exploring the digital nation: Embracing the mobile internet*. US Department of Commerce, Washington, DC.

Nett, U., Goetz, T., Hall, N. (2011). Coping with boredom in school: An experience sampling perspective. *Contemporary Educational Psychology, 36*, 46-59. doi: 10.1016/j.cedpsych.2010.10.003

Nora, A., & Snyder, B. (2009). Technology and higher education: The impact of e-learning approaches on student academic achievement, perceptions and persistence. *Journal of College Student Retention, 10*(1)*,* 3-19. doi: 10.2190/CS.10.1.b

Pargas, R., Levin, A., & Austin, J. (2005). Work in progress-Providing interactivity in a technology-rich classroom. Paper presented at the 35th ASEE/IEEE Frontiers in Education Conference, Indianapolis, In. doi: 0-7803-9077-6/05

Parris, L., Varjas, K., Meyers, J. (2014). "The internet as a mask": High school students' suggestions for preventing cyberbullying. *Western Journal of Emergency Medicine, XV* (5), p. 587-592. doi: 10.581/westjem.2014.4.20725

Patton, M. (2002). *Qualitative research & evaluation methods 3rd edition*. California: Sage.

Phillip, T., & Garcia, A. (2013). The importance off still teaching the igeneration: New technologies and the centrality of pedagogy. *Harvard Educational Review, 83*(2), 300-319.

Rah, M., Walline, J., Mitchell, G., Zadnik K. (2006). Comparison of the experience sampling method and questionnaires to assess visual activities in pre-teen and adolescent children. *Ophthalmic and Physiological Optics, 26*(5), 483-489.

Reeves, E., Bylund, R. (2005). Are rural schools inferior to urban schools? A multilevel analysis of school accountability trends in Kentucky. *Rural Sociology, 70*(3), 360-386.

Salaway, G., & Caruso, J. (2007). The ECAR study of undergraduate students and information technology. *ECAR Research Study 6*. Retrieved from http://www.educause.edu/library/resources/ecar-study-undergraduate-students-and-information-technology-2007

Schmidt, J., & Shumow, L. (2011, April). *Perceived competence and subjective experience of ninth graders vs. other high school students in science*. Unpublished paper presented at American Educational Research Association, New Orleans, La.

Scollon, C., Kim-Prieto, C., Diener, E. (2003). Experience sampling: Promises and pitfalls, strengths and weaknesses. *Journal of Happiness Studies, 4*(1), 5-34.

Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In R. Andrews & C. Haythornthwaite (Eds.) *The sage handbook of e-learning research,* 221-247. California: Sage.

Shernoff, D., & Csikszentmihalyi, M. (2010). Flow in schools Cultivating engaged learners and optimal learning environments in M. Furlong, R. Gilman, E. Huebner (Eds.), *Handbook of Positive Psychology in Schools*, 131-145. New York: Routledge.

Shernoff, D. J. (2001). *The experience of student engagement in high school classrooms: A phenomenological perspective.*(Order No. 3019968, The University of Chicago). *ProQuest Dissertations and Theses,* 253-253. Retrieved from http://search.proquest.com.proxy.library.ohiou.edu/docview/304749496?accountid=12954. (304749496)

Shernoff, D., & Schmidt, J. (2008). Further evidence of an engagement-achievement paradox among U.S. high school students. *Journal of Youth & Adolescence, 37*, 564-580. doi: 10.1007/s10964-007-9241-z

Shumow, L., Schmidt, J., Kackar, H. (2008). Adolescent's experience doing homework: Associations among context, quality of experience and outcomes. The School Community Journal, 18(2), 9-27.

Skill, T., & Young, B. (2002). Embracing the hybrid model: Working at the intersections of virtual and physical learning spaces. *New Directions For Teaching and Learning, 92,* 23-32.

Smokowski, P., Cotter, K., Robertson, C., Guo, S. (2013). Demographic, psychological, and school environment correlates of bullying, victimization and school hassles in rural youth. *Journal of Criminology, 2013*, Article ID 137583. doi:10.1155/2013/137583

So, H., & Brush, T. (2007). Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment: Relationships and critical factors. *Computers & Education*, 2-19. doi:10.1016/j.compedu.2007.05.009

Southern Rural Development Center (2005). The role of education: Promoting the economic & social vitality of rural America. L. Beaulieu, R. Gibbs (Eds.). Mississippi: Mississippi State.

Strover, S. (2014). The US digital divide: A Call for a new philosophy. *Critical Studies in Media Communication*, *31*(2), 114-122. doi:10.1080/15295036.2014.922207

Truscott, D., Truscott, S. (2005). Differing circumstances, shared challenges: Finding common ground between urban and rural schools. *Phi Delta Kappan, 87* (02), 123-130.

Van Rooy, W. (2012). Using information and communication technology (ICT) to the maximum: learning and teaching biology with limited digital technologies. *Research in Science and Technological Education, 30*(1), 65-80. doi: 10.1080/02635143.2011.653877

Wang, P. (2013). Examining the digital divide between rural and urban schools: Technology availability, teachers integration level and students' perception. *Journal of Curriculum and Teaching, 2*(2), 127-139). doi:10.5430/jct.v2n2p127

Wei, K., Teo, H., Chan. H., Tan, B. (2011). Conceptualizing and testing a social cognitive model of the digital divide. *Information Systems Research, 22*(1), 170-187.

Yair, G. (2000). Educational battlefields in America: The tug-of-war over students' engagement with instruction. *Sociology of Education, 73*, 247-269.

Yapici, I., & Akbayin, H. (2012). The effect of blended learning model on high school students' biology achievement and on their attitudes towards the internet. *The Turkish Online Journal of Educational Technology, 11*(2), 228-237.

Yin, R. (2011). Qualitative research from start to finish. New York: Guilford Press.

Zandvliet, D., & Straker, L. (2001). Physical and psychosocial aspects of learning environment in information technology rich classrooms. *Ergonomics, 44*(19), 838-857. doi:. 10.1080/00140130117116

2014 U.S. Department of Health and Human Services Poverty Guidelines. (n.d.). *ASPE*. Retrieved June 19, 2014, from http://aspe.hhs.gov/poverty/14poverty.cfm

Appendix A: Pre-study Survey Questions

Pre-study Survey Questions

1. Are you male female

2. Do you have an IEP (Individualized Education Plan)? yes no don't know

3. Do you have Internet access at home? yes no

4. At home, do you have access to a (select all that apply):

computer

laptop

tablet (Ipad or similar tablet)

cell phone (without web access)

smart phone

electronic music/video device (iPod, etc)

electronic gaming device (X box, etc)

5. Can you bring your device to school to use? yes no

Comment:

6. How often do you use a computer for the following classes:

(never one time a month every other week once a week daily)

English Language Arts

Science

Math

History

7. What programs have you used for class? Check all you have used

Word processing program (Word, Open Office, etc)

Presentation software (Powerpoint, Prezi, etc.)

Spreadsheet software (Excel, Open office, etc.)

Creating graphics (Photoshop, etc.)

List other programs you have used for classes:

8. Please give us your opinion about the following statements regarding your experiences with information technology/computers in your courses.

Strongly disagree Disagree Neutral Agree Strongly agree

8.1 I am more engaged in courses that require me to use technology than in courses that do not use technology.

8.2 Overall, my instructors use information technology well in my courses.

8.3 My school needs to give me more training on the information technology that I am required to use in my courses.

9. The use of information technology/computers in my courses:

Strongly disagree Disagree Neutral Agree Strongly agree

9.1 Allows me to take greater control of my course activities than in courses that do not use technology.

9.2 Helps me do better research for my courses than in courses that do not use technology.

10. How useful do you find the following course features?

Not useful Somewhat useful Useful Very useful Extremely useful Did not use

10.1 Online syllabus

10.2 Online readings and links to other text-based course materials

10.3 Online discussion board (posting comments, questions, and responses)

10.4 Online access to sample exams and quizzes for learning purposes

10.5 Taking exams and quizzes online for grading purposes

11. How important is it for you to use computers in your classes?

not important slightly important important very important

12. Please comment in writing on the use of technology/computers in your learning:

1. Is it effective for your own learning?

A. If yes, how?

B. If no, why not?

13. How do you like to learn with technology?

No Yes Don't Know

13.1 I like to learn through text-based conversations over e-mail, IM, and text messaging.

13.2 I like to learn through programs I can control, such as video games, simulations, etc.

13.3 I like to learn through contributing to Web sites, blogs, wikis, etc.

13.4 I like to learn by running Internet searches.

14. Rank the following from most enjoyable to least enjoyable:

Not enjoyable Slightly enjoyable Enjoyable Very enjoyable

Reading text book

Creating something (poster, booklet, cartoon, podcast) online

Looking up terms in a text book

Solving problems using the text book

Looking up terms on the Internet

Reading from a website

Problem solving using the computer

Creating something (poster, booklet, cartoon) with my hands

15. Have you done lab simulations on the computer for science class? yes no

If yes, did you like them? Please tell me why or why not.

16. Rank the following classes in order of actual technology use (1=highest 5 = lowest):

Mathematics

English Language Arts

Science

History

Language (Spanish, etc.)

17. Write 3 words that describe your feelings about science classes in general.

Appendix B: Experience Sampling Form

Experience Sampling Form

ID______________ **Date_____________**

Time you were Beeped___________ **Time you answered___________**

As you were beeped…………..(be specific)

What were you thinking about?

What was the main thing you were doing?

Was the main thing you were doing…

More like work [] More like play [] Both [] Neither []

How well were you concentrating? Not at all 0 Very Much 9

Did you enjoy what you were doing? Not at all 0 Very Much 9

Were you learning something or getting better at something? Not at all 0 Very Much 9

Did you feel good about yourself? Not at all 0 Very Much 9

Did you have some choice in picking this activity? Not at all 0 Very Much 9

Were you living up to your expectations? Not at all 0 Very Much 9

Describe your mood as you were beeped:

	very	quite	some	neither	some	quite	very	
Happy								Sad
Passive								Active
Ashamed								Proud
Involved								Detached, not involved
Excited								Bored
Clear								Confused
Worried								Relaxed
Competitive								Cooperative

Were you:

working alone [] working with a partner [] working in a group[]

Tell how you felt about the main activity:

How challenging was it? Low 0 High 9

Your skills in the activity? Low 0 High 9

Did you find the activity interesting?	Not at all 0	Very Much 9
How difficult did you find this activity?	Not at all 0	Very Much
Were you succeeding at what you were doing?	Not at all 0	Very Much
How important was it to your future goals?	Not at all 0	Very Much

Any comments?

Appendix C: Post-study Interview Questions

Post-study Interview Questions used in both regular and technology rich classes

1. Share your experience using a lot of technology in class

   How was it different/similar to a regular class?

2. How do you feel about using computers in school?

3. What were some technological tools we used that you felt were helpful for you?

   Why?

   Is this different than before you participated in the study?

   Can you explain?

4. Do you feel that you have the skills to be successful in computer rich classes?

   What skills do you need?

5. Will you tell me about something you really enjoyed during the class?

   Why?

6. Can you tell me about anything you did not enjoy during the class?

   Why?

7. If you had the choice, what types of learning experiences would you want to have in science class?

   Why?

8. What about this experience was different from how you usually learn science in class? Which experience do you enjoy and why?

How is this approach different from other science classes you have taken?

9. When you were completing your experience sampling form, did you think about how you were learning? What did you think about?

10. What do you see for the future of the classroom?

What will school look like in the future?

Appendix D: Ohio University Parental Consent Form, Minor Assent Form

Title of Research: Student Engagement in a Computer Rich High School Science Class

Researcher: Jeff Hunter, MBA, PhD Candidate

You are being asked permission for your child to participate in research. For you to be able to decide whether you want your child to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your child's personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your child's participation in this study. You should receive a copy of this document to take with you.

<u>Explanation of Study</u>

This study is being done because there is a need to understand how students learn about science using computers.

If you agree to allow your child to participate, your child will fill out a science and technology interest survey. Your child will be asked to participate in a week long evaluation of their experience in a standard classroom and in the use of technology in the classroom. Several students will also be asked to participate in interviews after the evaluation has ended.

Your child's participation in the study will last approximately two weeks, during their science class. The class material will be the same as if there was not study happening.

Risks and Discomforts

No risks or discomforts are anticipated

Benefits

This study is important to science/society because it is important for our country's future to generate students who are interested and excited about science.

Your child may not benefit, personally by participating in this study.

Confidentiality and Records

Your child's study information will be kept confidential by the use of a pseudonym instead of using your child's name. Your child's name will not be connected to any data in this research. The code list relating your child's name to the pseudonyms will be maintained on a password protected computer and in a locked cabinet, and will be destroyed once the research is published.

Additionally, while every effort will be made to keep your child's study-related information confidential, there may be circumstances where this information must be shared with:

* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;

* Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU

Contact Information

If you have any questions regarding this study, please contact

Researcher: Jeff Hunter, email: jh182899@ohio.edu, hunter@claylocalschools.org, 740-354-6645, c 740-821-4014

Advisor: Dr. Krisanna Machtmes, email: machtmes@ohio.edu 740-597-1323

If you have any questions regarding your child's rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:

you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered you have been informed of potential risks to your child and they have been explained to your satisfaction.

you understand Ohio University has no funds set aside for any injuries your child might receive as a result of participating in this study

you are 18 years of age or older

your child's participation in this research is completely voluntary

your child may leave the study at any time. If your child decides to stop participating in the study, there will be no penalty to your child and he/she will not lose any benefits to which he/she is otherwise entitled.

Parent Signature________________________ Date_____________

Printed Name_________________________

Child's Name_________________________

Assent Form for Minors

I am willing to take part in the study called Student Engagement in a Computer Rich High School Science Class. I understand that the researchers from Ohio University are hoping to understand the impact computers in the classroom have on the students.

I understand that I will do an anonymous survey, complete a daily survey of what I am thinking about in science class for 1 week and I might be asked to participate in a short interview.

I will be asked about how I feel, what I am thinking about and my mood. This study will take place at X High School and should take about 4 minutes of my time per day for 1 week.

I am taking part because I want to. I have been told that I can stop at any time, and if I do not like a question, I do not have to answer it. No one will know my answers, including parents, guardians, and school officials.

Name ______________________

Signature ___________________

Date: ______________________

Age: ________

Appendix E: Random Number Generator

Random Integer Generator

This form allows you to generate random integers. The randomness comes from atmospheric noise, which for many purposes is better than the pseudo-random number algorithms typically used in computer programs.

Part 1: The Integers

Generate [45] random integers (maximum 10,000).

Each integer should have a value between [5] and [48] (both inclusive; limits ±1,000,000,000).

Format in [5] column(s).

Part 2: Go!

Be patient! It may take a little while to generate your numbers...

[Get Numbers] [Reset Form] [Switch to Advanced Mode]

Note: The numbers generated with this form will be picked independently of each other (like rolls of a die) and may therefore contain duplicates. There is also the Sequence Generator, which generates randomized sequences (like raffle tickets drawn from a hat) and where each number can only occur once.

Random Number chart #1

25	47	34	37	45
13	25	34	8	45
10	30	20	46	42
27	48	14	6	5
28	22	16	43	34
29	14	38	35	8
48	19	21	17	13
21	23	15	5	9
42	48	8	41	28

Random Number Chart #2

44	33	29	18	46
36	32	11	47	38
36	11	48	35	44
45	37	42	14	32
43	12	6	25	34
18	32	46	7	42
11	7	19	25	47
45	35	37	19	48
39	35	38	15	16

Appendix F: ECAR Survey Tool

Students and Information Technology in

Higher Education:

2007 Survey Questionnaire

Thank you for your willingness to answer this survey, which focuses on your experiences with and opinions about information technology. The information you and other undergraduate students provide will be reported in a national study that will be available to higher education institutions. We will also make available to your school's leaders data that you and your classmates give us about your school. The primary goal of the study is to better understand student experiences with information technology, which, in turn, can help your school's leadership to respond to your IT needs.

Your answers are confidential, and neither your school nor the EDUCAUSE Center for Applied Research will be able to identify you.

For the purposes of this survey, information technology refers to "personal electronic devices such as laptops and handheld computers, smart phones, and your institution's computers and associated devices."

Please submit your survey responses as soon as possible within the next two weeks. It should take you approximately 15 minutes to complete the survey. As thanks for your time and valuable input, each participant who provides an e-mail address will be entered in a drawing for one of 60 $50 and $100 gift certificates for Amazon.com.

You may print a blank copy of the survey, if you'd like, before completing it by clicking "Printable version of the survey" in the header of the Web-based survey. To print your responses after completing the survey, select the "Review" button at the end of the survey.

We appreciate your time and participation. If you have any questions or concerns, please contact the campus representative specified in the e-mail you were sent.

Click the "Next" button to begin the survey. Once again, thank you for your assistance!

Section 1. Age Verification and Consent Statement

We may only survey students age 18 or older.

1.1 I am 18 years old or older. *<Required>*

( ) No *<Go to Section 5>*

( ) Yes *<Read consent form and go to 1.2>*

I give my consent to the following:
For this survey you were selected at random from a list of students at your institution. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

Sponsored by the EDUCAUSE Center for Applied Research, this study is being conducted by Judy Caruso of the University of Wisconsin–Madison and Dr. Gail Salaway, EDUCAUSE

Center for Applied Research. EDUCAUSE is a nonprofit association whose members include information technology leaders in higher education. Its mission is to advance higher education by promoting the intelligent use of information technology.

Background Information
If you agree to be in this study, please complete and submit the following survey. The survey asks for basic background information and questions you about:

- What kinds of information technologies you use and how often.
- What your level of skill is at using different information technologies.
- How these technologies contribute to your undergraduate experience.
- What value information technologies provide in teaching and learning in higher education.

It will take about 15 minutes to complete the survey. Please answer the questions to the best of your ability. There is no right or wrong answer. You only need to fill out the survey once.

Risks and Benefits of Being in the Study
There are no physical, psychological, social, or medical risks associated with your participation in this study. The benefit of your participation is to inform school officials of the benefits of their information technology investments for students.

Compensation
We will hold a raffle for gift certificates of $50 and $100 from Amazon.com for participating in this survey. If you choose to participate in the raffle, you must include an e-mail address in the space provided at the beginning of the survey. Once the survey has closed, we will conduct a random drawing from the e-mail addresses of those who participated within four weeks of the closing of the survey.

Your e-mail address will be kept separate from the data collected in the survey. It will not be used to connect your survey responses with your name, nor will it be used for any purpose other than to contact you should you win a prize.

Confidentiality
The records of this study will be kept private. In any report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely.

Voluntary Nature of the Study
Participation in this study is voluntary. Your decision about whether to participate will not affect your current or future relations with your institution, with any of the institutions participating in this survey, or with EDUCAUSE. If you decide to participate, you are free not to answer any non-required question or withdraw at any time without affecting those relationships.

Contacts and Questions
You may direct any questions to Judy Caruso, 608-263-7318, judy.caruso@doit.wisc.edu, or to a representative of your institution's Institutional Review Board.

If you wish to print a copy of the survey before completing it online, a PDF version is available from the link in the online survey header. Once you complete and submit the survey by clicking the Finish button, a summary of your responses will be displayed with the option to print and/or save them.

Statement of Consent

1.2 I have read the above information and have had the opportunity to ask questions

and receive answers. I consent to participate in the study. <*Required*>

( ) No <*Go to Section 5*> ( ) Yes <*Go to 1.3*>

1.3 If you are interested in entering the drawing for gift certificates, please enter your e-mail address.
<*Optional*>____

Section 2. Your Use of Electronic Devices

2.1 How old is your personal desktop computer?

( ) Less than 1 year	( ) 4 years	( ) 8 years	( ) Don't own
( ) 1 year	( ) 5 years	( ) 9 years	
( ) 2 years	( ) 6 years	( ) 10 years	
( ) 3 years	( ) 7 years	( ) More than 10 years	

2.2 How old is your personal laptop computer?

( ) Less than 1 year	( ) 4 years	( ) 8 years	( ) Don't own
( ) 1 year	( ) 5 years	( ) 9 years	
( ) 2 years	( ) 6 years	( ) 10 years	
( ) 3 years	( ) 7 years	( ) More than 10 years	

2.3-2.7 Which of the following electronic devices do you own?

		No	Yes
2.3	Simple cell phone (without Web access)		
2.4	Personal digital assistant (PDA) (Palm, etc.)		
2.5	Smart phone (combination cell phone and PDA device) (BlackBerry, etc.)		
2.6	Electronic music/video device (iPod, etc.)		
2.7	Electronic game device (Game Boy, Xbox, PlayStation, etc.)		

2.8 Which e-mail account do you prefer for e-mail communication from your college or university?
( ) University account ( ) Other

2.9 If your institution could communicate with you in any form, what would your first choice be?
( ) Instant messaging ( ) E-mail
( ) Text messaging
( ) Personally authenticated Web site (portal) ( ) Paper mail
( ) No preference

2.10 How many hours each week do you normally spend doing online activities for school, work, and recreation?
( ) Less than 1 ( ) 34 ( ) 68 ( ) 102 ( ) 136

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5
( ) 6
( ) 7
( ) 8
( ) 9
( ) 10
( ) 11
( ) 12
( ) 13
( ) 14
( ) 15
( ) 16
( ) 17
( ) 18
( ) 19
( ) 20
( ) 21
( ) 22
( ) 23
( ) 24
( ) 25
( ) 26
( ) 27
( ) 28
( ) 29
( ) 30
( ) 31
( ) 32
( ) 33
( ) 35
( ) 36
( ) 37
( ) 38
( ) 39
( ) 40
( ) 41
( ) 42
( ) 43
( ) 44
( ) 45
( ) 46
( ) 47
( ) 48
( ) 49
( ) 50
( ) 51
( ) 52
( ) 53
( ) 54
( ) 55
( ) 56
( ) 57
( ) 58
( ) 59
( ) 60
( ) 61
( ) 62
( ) 63
( ) 64
( ) 65
( ) 66
( ) 67
( ) 69
( ) 70
( ) 71
( ) 72
( ) 73
( ) 74
( ) 75
( ) 76
( ) 77
( ) 78
( ) 79
( ) 80
( ) 81
( ) 82
( ) 83
( ) 84
( ) 85
( ) 86
( ) 87
( ) 88
( ) 89
( ) 90
( ) 91
( ) 92
( ) 93
( ) 94
( ) 95
( ) 96
( ) 97
( ) 98
( ) 99
( ) 100
( ) 101
( ) 103
( ) 104
( ) 105
( ) 106
( ) 107
( ) 108
( ) 109
( ) 110
( ) 111
( ) 112
( ) 113
( ) 114
( ) 115
( ) 116
( ) 117
( ) 118
( ) 119
( ) 120
( ) 121
( ) 122
( ) 123
( ) 124
( ) 125
( ) 126
( ) 127
( ) 128
( ) 129
( ) 130
( ) 131
( ) 132
( ) 133
( ) 134
( ) 135
( ) 137
( ) 138
( ) 139
( ) 140
( ) 141
( ) 142
( ) 143
( ) 144
( ) 145
( ) 146
( ) 147
( ) 148
( ) 149
( ) 150
( ) 151
( ) 152
( ) 153
( ) 154
( ) 155
( ) 156
( ) 157
( ) 158
( ) 159
( ) 160
( ) 161
( ) 162
( ) 163
( ) 164
( ) 165
( ) 166
( ) 167
( ) 168

2.11 How often do you use an electronic device to access a library resource on an official college or university library Web site?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.12 How often do you use an electronic device for writing documents for your coursework?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.13 How often do you create, read, and send e-mail?
( ) Never
( ) Once per year
( ) Once per
semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.14 How often do you create, read, and send instant messages?
( ) Never
( ) Once per year
( ) Once per
semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.15 How often do you play computer games online or offline?
( ) Never
( ) Once per year
( ) Once per
semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.16 How often do you download Web-based music or videos?
( ) Never
( ) Once per year
( ) Once per
semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.17 How often are you doing online shopping?
( ) Never
( ) Once per year
( ) Once per semester/quarter
( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.18 How often do you access or use wikis?
( ) Never
( ) Once per year
( ) Once per semester/quarter
( ) Monthly
( ) Weekly
( ) Several times per
week ( ) Daily

2.19 How often are you blogging?

( ) Never
( ) Once per year
( ) Once per semester/quarter
( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.20 How often do you participate in online social networks (facebook.com, friendster.com, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter
( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.21 How often do you use an electronic device for creating spreadsheets or charts (Excel, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter
( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.22 How often do you use an electronic device for creating presentations (PowerPoint, Keynote, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.23 How often do you use an electronic device for creating graphics (Photoshop, Flash, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.24 How often do you create audio/video (Director, iMovie, etc.)?

( ) Never
( ) Once per year

( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.25 How often do you create Web pages (Dreamweaver, FrontPage, HTML, XML, Java, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.26 How often do you access a course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)?

( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

2.27_2.33 What is your skill level using the following computer technologies and applications?

	Poor	Fair	Good	Very good	Excellent	Do not use
2.27 Spreadsheets (Excel, etc.)						
2.28 Presentation software (PowerPoint, etc.)						
2.29 Graphics software (Photoshop, Flash, etc.)						
2.30 Video/audio software (Director, iMovie, etc.)						
2.31 Online library resources						
2.32 Computer maintenance (downloading software updates, installing additional memory, organizing files, etc.)						
2.33 Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)						

2.34 Why did you learn spreadsheet software (Excel, etc.)?

( ) College or university course requirement
( ) High school or previous course requirement ( ) Personal interest
( ) Job requirement or to enhance job opportunities ( ) Other
( ) Do not use

2.35 Why did you learn presentation software (PowerPoint, Keynote, etc.)?
( ) College or university course requirement
( ) High school or previous course requirement ( ) Personal interest
( ) Job requirement or to enhance job opportunities ( ) Other
( ) Do not use

2.36 Why did you learn graphics software (Photoshop, Flash, etc.)?
( ) College or university course requirement
( ) High school or previous course requirement ( ) Personal interest
( ) Job requirement or to enhance job opportunities ( ) Other
( ) Do not use

2.37 Why did you learn video/audio software (Director, iMovie, etc.)?
( ) College or university course requirement
( ) High school or previous course requirement ( ) Personal interest
( ) Job requirement or to enhance job opportunities ( ) Other
( ) Do not use

2.38 During the academic year, what is your most frequently used method for access to the Internet?
( ) Commercial dial-up modem service (AOL, EarthLink, etc.) ( ) College- or university-operated dial-up modem service

( ) Commercial broadband service (DSL modem, cable modem, etc.) ( ) College- or university-operated wired broadband service
( ) Commercial wireless network
( ) College- or university-operated wireless network ( ) I do not access the Internet

Section 3. Your Use of Technology in Courses

3.1 Which of the following best describes your preference with regard to the use of information technology in your courses?
( ) I prefer taking courses that use *no* information technology.
( ) I prefer taking courses that use *limited* information technology.
( ) I prefer taking courses that use a *moderate* level of information technology.
( ) I prefer taking courses that use information technology *extensively.*
( ) I prefer taking courses that use information technology *exclusively*.

3.2_3.16 Are any of the following technologies used in your courses during the current semester or quarter?

	Not using this semester/quarter	Using this semester/quarter

3.2 E-mail
3.3 Instant messaging
3.4 Presentation software (PowerPoint, Keynote, etc.)
3.5 Course management system (ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass, etc.)
3.6 Course Web site
3.7 Programming languages (C++, Java, etc.)
3.8 Graphics software (Photoshop, Flash, etc.)
3.9 Video/audio software (Director, iMovie, etc.)
3.10 Podcast
3.11 Webcast
3.12 Blogs
3.13 Online social networks (facebook.com, etc.)
3.14 E-portfolios
3.15 Spreadsheets (Excel, etc.)
3.16 Discipline-specific technologies (Mathematica, Matlab, AutoCAD, Stella, etc.)

3.17_3.19 Please give us your opinion about the following statements regarding your experiences with information technology in your courses.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3.17 I am more engaged in courses that require me to use technology than in courses that do not use technology.					
3.18 Overall, my instructors use information technology well in my courses.					
3.19 My school needs to give me more training on the information technology that I am required to use in my courses.					

3.20-3.23 The use of information technology in my courses:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3.20 Helps me better communicate and collaborate with my classmates than in courses that do not use technology.					
3.21 Results in more prompt feedback from my instructor than in courses that do not use technology.					
3.22 Allows me to take greater control of my course activities than in courses that do not use technology.					
3.23 Helps me do better research for my courses than in courses that					

do not use technology.

3.24 Have you ever taken a course that used a course management system (e.g., ANGEL, WebCT, Blackboard, Desire2Learn, Moodle, Sakai, OnCourse, FirstClass)? *<Required>*
( ) No *<Go to 3.35>* ( ) Yes *<Go to 3.25>*
( ) Don't know *<Go to 3.35>*

3.25 How would you describe your own overall experience using a course management system?
( ) Very negative ( ) Negative
( ) Neutral
( ) Positive
( ) Very positive

3.26_3.34 How useful did you find the following course management system features?

	Not useful	Somewhat useful	Useful	Very useful	Extremely useful	Did not use
3.26 Online syllabus						
3.27 Online readings and links to other text-based course materials						
3.28 Online discussion board (posting comments, questions, and responses)						
3.29 Online access to sample exams and quizzes for learning purposes						
3.30 Taking exams and quizzes online for grading purposes						

3.31 Which of the following benefits from using information technology in your courses was the most valuable to you?

( ) Improved my learning
( ) Convenience
( ) Helped me manage my course activities (planning, apportioning time, noting success and failure, etc.)
( ) Helped me communicate with my classmates and instructors ( ) No benefits
( ) Other

3.32 The use of information technology in my courses has improved my learning.
( ) Strongly disagree ( ) Disagree ( ) Neutral ( ) Agree ( ) Strongly agree

3.31 Turning in assignments online

3.32 Getting assignments back online from instructors with comments and grades
3.33 Online sharing of materials among students
3.34 Keeping track of grades on assignments and tests online

3.37 How often do you bring your laptop to class?
( ) Never
( ) Once per year
( ) Once per semester/quarter ( ) Monthly
( ) Weekly
( ) Several times per week ( ) Daily

3.38 Which of the following best describes you?
( ) I love new technologies and am among the first to experiment with and use them. ( ) I like new technologies and use them before most people I know.
( ) I usually use new technologies when most people I know do.
( ) I am usually one of the last people I know to use new technologies.
( ) I am skeptical of new technologies and use them only when I have to.

3.39. How do you learn best?
( ) I learn best working alone.
( ) I learn best working with others.
( ) I learn equally well working alone or working with others. ( ) Don't know

3.40-3.43 How do you like to learn?
3.40 I like to learn through text-based conversations over e-mail, IM, and text messaging.
3.41 I like to learn through programs I can control, such as video games, simulations, etc.
3.42 I like to learn through contributing to Web sites, blogs, wikis, etc.
3.43 I like to learn by running Internet searches

4.3 What is your cumulative grade point average (GPA)?

4.4 What is your class standing?
( ) Senior at a four-year institution
( ) Freshman at a four-year institution
( ) Student at a two-year institution
( ) Other

4.5 Are you currently a full-time or part-time student? <Part time is fewer than 12 credit hours per semester/quarter.>
( ) Full-time ( ) Part-time

4.6 Do you reside on campus or off campus?

( ) On
campus ( )
Off
campus

4.7_4.16 What disciplines are you majoring in? Check all that apply.
[ ] 4.7 Social
sciences [ ] 4.8
Humanities
[ ] 4.9 Fine arts
[ ] 4.10 Life sciences, including agriculture and health
sciences [ ] 4.11 Physical sciences
[ ] 4.12 Education, including physical
education [ ] 4.13 Engineering
[ ] 4.14
Business [ ]
4.15 Other
[ ] 4.16 Undecided

4.17 For calendar year 2006, what was your total family income from all sources, before taxes?
( ) Less than
$30,000
( ) $30,000 to
$74,999
( ) $75,000 to
$149,999
( ) $150,000 or
more
( ) Decline to
answer
( ) Don't know

Which institution are you attending? <Required> <Drop-down list of institutions>

Before proceeding, please confirm that the name of your institution appears in box 4.18.

4.19 If you have any other comments or insights about your information technology use and skills or about how IT has helped or not helped your undergraduate experience, please feel free to share them with us.____

Section 5. Thank You

You have reached the end of the survey. Thank you! Please submit the survey by clicking the

Finish button now, or if you wish to review, print, or save your responses, click “Review.”

– END SURVEY –

Appendix G: IRB Exemption

OHIO UNIVERSITY
Office of the Vice President for Research

Office of Research Compliance
RTEC 117
Athens, OH 45701-2979

T: 740.593.0664
F: 740.593.9838
www.research.ohiou.edu

14E137

A determination has been made that the following research study is exempt from IRB review because it involves:

Category 1 - research conducted in established or commonly accepted educational settings, involving normal educational practices

Project Title: Student Engagement in a Technology Rich High School Science Class

Primary Investigator: Jeffrey C. Hunter

Co-Investigator(s):

Advisor: Krisanna Machtmes
(if applicable)

Department: Education

Rebecca Cale 4/28/14

Rebecca Cale, AAB, CIP
Office of Research Compliance

Date

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.

Appendix H: Collaborative Institutional Training Initiative (CITI)

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

HUMAN RESEARCH CURRICULUM COMPLETION REPORT

Printed on 02/13/2014

LEARNER	Jeffrey Hunter (ID: 2730933) 1914 Baird Ave. Portsmouth ohio 45662 USA
DEPARTMENT	teacher education
PHONE	7403546644
EMAIL	jh182899@ohio.edu
INSTITUTION	Ohio University
EXPIRATION DATE	03/26/2015

GROUP 2.SOCIAL AND BEHAVIORAL INVESTIGATORS AND KEY PERSONNEL.

COURSE/STAGE:	Basic Course/1
PASSED ON:	03/26/2012
REFERENCE ID:	7551037

REQUIRED MODULES	DATE COMPLETED
Introduction	03/22/12
History and Ethical Principles - SBE	03/22/12
Defining Research with Human Subjects - SBE	03/26/12
The Regulations - SBE	03/26/12
Assessing Risk - SBE	03/26/12
Informed Consent - SBE	03/26/12
Ohio University	03/26/12

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid Independent Learner. Falsified information and unauthorized use of the CITI Progam course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Jeffrey Hunter (ID: 2730933)
- **Email:** jh182899@ohio.edu
- **Institution Affiliation:** Ohio University (ID: 533)
- **Institution Unit:** teacher education
- **Phone:** 7403546644

- **Curriculum Group:** Human Research
- **Course Learner Group:** Group 2.Social and Behavioral Investigators and Key Personnel.
- **Stage:** Stage 2 - Refresher Course

- **Report ID:** 14835585
- **Completion Date:** 12/26/2014
- **Expiration Date:** 12/25/2017
- **Minimum Passing:** 80
- **Reported Score*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED
SBE Refresher 1 – Instructions	12/26/14
SBE Refresher 1 – Defining Research with Human Subjects	12/26/14
SBE Refresher 1 – Assessing Risk	12/26/14
SBE Refresher 1 – History and Ethical Principles	12/26/14
SBE Refresher 1 – Federal Regulations for Protecting Research Subjects	12/26/14
SBE Refresher 1 – Informed Consent	12/26/14

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK TRANSCRIPT REPORT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Jeffrey Hunter (ID: 2730933)
- **Email:** jh182899@ohio.edu
- **Institution Affiliation:** Ohio University (ID: 533)
- **Institution Unit:** teacher education
- **Phone:** 7403546644

- **Curriculum Group:** Human Research
- **Course Learner Group:** Group 2.Social and Behavioral Investigators and Key Personnel.
- **Stage:** Stage 2 - Refresher Course

- **Report ID:** 14835585
- **Report Date:** 12/26/2014
- **Current Score**:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT
SBE Refresher 1 – History and Ethical Principles	12/26/14
SBE Refresher 1 – Federal Regulations for Protecting Research Subjects	12/26/14
SBE Refresher 1 – Informed Consent	12/26/14
SBE Refresher 1 – Instructions	12/26/14
SBE Refresher 1 – Defining Research with Human Subjects	12/26/14
SBE Refresher 1 – Assessing Risk	12/26/14

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

Appendix I: Traditional Setting

Classrooms are very bright with natural light and designed to eliminate overcrowding in the classroom. Photographs (below) are provided to add richness to the location description. In the classroom utilized for this study, students were seated in rows in freestanding desk-tables and chairs. The seating area was arranged in three rows of six desk-tables and two rows of five desk-tables. Students faced (east) the white boards and smart boards. To their right (south) were display cases with books, samples (bones, fossils, minerals) and lab materials. The north side of the classroom was separated to provide for lab work. The lab area was divided into six stations with air, gas, computer and water with sinks. Each lab station had storage in drawers and cabinets underneath. A lab station was ADA accessible. The north wall above the lab stations had windows that looked out over the gym and to the hills and river valley to the north and west.

(Hunter, 2014, COHS)

(Hunter, 2014, COHS)

(Hunter, 2014, COHS)

Appendix J: Computer Rich Setting

The computer classroom or lab was located four classrooms east of the students' usual classroom. Photographs (below) are provided to add richness to the location description. The classroom was set up to provide each student access to a computer, common software, and the Internet. Tables with computers lined the north, east, and south walls. The classroom was arranged to include open table areas for workspace or for students who brought their own device to class. The open tables were located in the center of the classroom. The teacher work area and white boards were located on the west wall of the classroom. The south wall consisted primarily of windows with a view of the southern hills.

(Hunter, 2014, COHS)

(Hunter, 2014, COHS)