2016

The Development and Validation of an Instrument to Measure Teachers' Perceptions of the Effect of Mobile Technology Initiatives on Classroom Climate

Carol Wyatt

The Development and Validation of an Instrument to Measure Teachers' Perceptions of the Effect of Mobile Technology Initiatives on Classroom Climate

by

Carol Wyatt

A dissertation submitted in partial fulfillment of
the requirements for the degree of

Doctor of Education
in
Learning and Leading

University of Portland
School of Education

Abstract

The purpose of this study was to develop and validate an instrument to measure teacher's perceptions of the effect of mobile technology initiatives on classroom climate. The process proposed by Benson and Clark (1982) was used to develop the instrument in four phases: planning, item construction, quantitative evaluations, and validation. A 115-item pool was constructed and tested on a pool of K-12 educators ($N=334$) in mobile technology teaching environments. The pool was refined through a principal axis factor analysis to create a 35-item instrument. The Mobile Technology Classroom Climate Survey (MTCCS) was developed with four factors: Student Centered Innovation (α = 0.88), Challenges (α = 0.87), Policies and Support (α = 0.76), and Technical Skills (α = 0.76). The instrument domains are consistent with the literature that suggests mobile technology has increased student engagement (Argueta et al., 2011; Bebell & O'Dwyer, 2010; McLester, 2011; Rosen, 2011), teacher concerns about student distraction (Shieh, 2012) and shallow thinking (Bauerlein, 2011), and the importance of professional development (Cuban, 2009; Overbay, Mollette, & Vasu, 2011). Implications for future research include a need to explore associations between MTCSS results and student or teacher outcomes and a study of potential a relationships between the MTCCS and other classroom climate instruments, in an effort understand the impact of technology rich environments on classroom climate and to establish concurrent validity of the instrument.

Acknowledgments

I wish to express sincere appreciation to my chair Dr. James Carroll, whose critical eye, vast knowledge, and enlightened mentoring were instrumental and inspiring. In addition, special thanks are due to my committee members, Dr. Nicole Ralston and Dr. Jacqueline M. Waggoner whose valuable input, enthusiasm for this project, and encouragement were of immense help.

I am very grateful for the members of the first doctoral cohort at the University of Portland. It has been an honor to learn with you, and blaze a new trail over the course of the last three years. In particular, I would like to thank Chris Smart and David Exley who have shared countless car pools, participated in comprehensive exam study sessions and dissertation writing sessions every weekend.

In addition, I could not have done this work without the APA tutoring and research help from my good friend and amazing librarian Laura Schick, whose intelligence, wisdom and boundless energy is incredible. I would also like to thank my Principal Paul Hogan, administrative team members Elaine Forde and Khalid Maxie, and Linda Pieratt for supporting me through this process.

And to my husband, Todd Wyatt, and my children, Jessica and Paul, and my parents, Janice and Leo Pelster, thank you for your patience, love, and support. I would not be here without the foundation of my family.

Table of Contents

Page

List of Tables

Chapter One: Introduction

Classrooms are inherently human organizations and thus social structures worthy of study. Classrooms are one of the most influential and important social structures in the lives of students (Lippitt & Gold, 1959). Because of the influence of the school environment in students' lives, it is important to understand its structure. Perry (1908) first wrote about school atmosphere and its importance in what would later be researched extensively under the category of classroom climate. Terms such as atmosphere, mood, ambience, ecology and personality have been used to define classroom climate (Adelman & Taylor, 2005; Halpin & Croft, 1962). While there is not consensus on a definitive set of domains to describe school climate, Thapa, Cohen, Guffey, and Higgins-Dealessandro's (2013) review of the literature found agreement that the following four domains encapsulate the major elements of school climate: Safety, Relationships, Teaching and Learning, and the External Environment.

Many things can form and shape the adults that students will ultimately become. These things include: moments from school experiences, times a student felt particularly connected or disconnected to an adult or their peers, the norms and values of the school community, and academic lessons taught in the classroom. Likewise, Norton (1999) found that for teachers the social structures and climate established in a building are directly associated with job satisfaction and teacher retention. Given this importance to both students and teachers, school and classroom climate has been an area of much research (Anderson, 1982; Fraser, 1989; Freiberg & Freiberg, 1999; Thapa et al., 2013).

School climate has been associated with many important and beneficial school outcomes. Angell (1991) suggested that positive classroom climate is associated with developing civic virtues in students. Schools with better student perceptions of the teaching climate were correlated with lower student dropout rates by students in their senior year (Barile et al., 2012). Brackett, Reyes, Rivers, Elbertson, and Salovey, (2011) found that student conduct and teacher affiliation were better in schools that scored higher in perceived classroom emotional climate. School climate, specifically school connectedness, is a predictor of adolescent health and academic outcomes, violence prevention, student risk behaviors, including sex, violence, and drug use (Cohen, McCabe, Michelli, & Pickeral, 2009). Zullig, Huebner, and Patton (2011) found that school climate was positively associated with student statisfaction and school safety.

Most significantly, school climate is positively correlated with student learning and student motivation to learn, which is ultimately a primary mission for any school (Cohen, McCabe, Michelli, & Pickeral, 2009). Decades of research have clearly established that classroom climate is a predictive variable for student achievement (Arter, 1989; Fraser, 1991; Thapa et al., 2013). Establishing and maintaining a positive classroom climate is basic to improving schools (Adelman & Taylor, 2005).

There are many elements that affect classroom climate; a few examples of these elements are societal norms, cohesion, power, control, classroom management (Gottfredson, Gottfredson, Payne, & Gottfredson, 2005), human relationships (Schaps, 2005), staff and student morale, support, and evaluation structures (Thapa et al., 2013). Technology is also an element that affects classroom climate. Technology is an element in each of the identified classroom and school climate domains of safety, relationships, teaching and learning, and the external environment (Thapa et al., 2013).

Technology has added a new complexity in student safety. For example, issues of safety arise with technology in the form of online bullying and online sexual predators. Wachs, Junger, and Sittichai (2015) found that online bullying continues to rise in frequency at a level that rivals traditional bullying, particularly in western cultures. Schools are implementing a wide range of anti-bullying curricula to insure student safety and ultimately improve school climate (Lee, Kim, & Kim, 2015).

Technology has provided multiple ways to communicate both in and outside of the classroom, influencing the relationship domain. As Hakkarainen, Muukonen, and Lipponen (2001) state, “Relationships in modern societies are transformed by emerging new means of creating, processing, accessing, and transferring information” (p. 182). This transformation is changing student access to teachers, how students converse with faculty and their peers, and how faculty members collaborate.

Perhaps the domain most heavily impacted by technology is the teaching and learning domain. The most consistent finding in the area of technology and classroom climate is increased student engagement. In the ten-year study of Apple Classrooms of Tomorrow, Fisher (1996) attributed increased student enthusiasm and student initiated projects to having computers in the classroom. Technology is not only influencing how students are taught, but also what skills are being taught. In response to the increasing availability of information technology to students and teachers, a set of digital literacies has emerged (Hockly, 2012).

The external environment domain of school and classroom climate is also influenced by developments in technology. The boundaries of the external environment have expanded globally as the use of the Internet can allow for international collaborations between students and faculty (Maguth, 2012). The physical walls of the classroom have also been redefined as online discussion boards have provided a method to have class discussions beyond the time and physical space of the traditional classroom (Ruday, 2011). Further, students have access to a wealth of information and learning experience beyond the school curriculum. Buckingham (2007) believes that by building connections between school use of technology and students' out of school experiences schools can capitalize on the benefits of informal learning.

The ubiquitous use of technology has changed how people work, play, and experience human interaction. The population trend continues towards increased ownership of mobile technology, with over two-thirds of Americans owning a smart phone (Smith, Rainie, McGeeney, Keeter, & Duggan, 2015). For teens, ages 13-17, this percentage increases as 73% reported to have or have access to a smartphone (Lenhart, 2015). The use of these devices is changing how people accomplish tasks, gather and disseminate information, and acquire knowledge. Unique in human history is the rapid nature of this change. What would have been considered too expensive, unavailable or impractical in the recent past has now become commonplace. Examples of these innovations include interactive touch eBooks, real-time collaboration on documents, wide spread free cloud storage and mobile productivity applications. Further, these changes are widespread and pervasive across all different types of human organizations and, in particular, the classroom social structure.

Over the last several decades, computers in the classroom have become a reality for many. However, the idea of having a mobile computing device for every student has shifted from a far-fetched ideal to a key context for educational innovation (Lei & Zhao, 2008). The ratio of the number of students to the number of computers in the building has dropped. For example, the national ratio of students to computers has dropped from 125:1 in 1983 to 4:1 in 2002 (Russell, Bebell, & Higgins, 2004), and currently 1:1 and even 1:X (Herold, 2013) ratios are being implemented. Several states and large city districts, such as Chester, Pennsylvania, the Department of Education for the State of Maine, and Los Angeles Unified School District, (Sincar, Richardson, Flora, & Sauers, 2013; Svensson, 2013), have implemented large-scale 1:1 technology initiatives, the vast majority using mobile devices. And while the issues related to technology and education are not dependent on the form of integration, the student to device ratio, the particular device, the mobility of the current devices has shifted the context of these issues in an important way. Traditional computer technology could be analyzed as an extension of the classroom, while current mobile devices are essentially extensions of the student.

Problem Statement

Since mobile technology is changing the context of the human interaction, and because classroom climate is a predictive factor on student achievement (Thapa et al., 2013), it would be prudent to gain additional knowledge on the effect of mobile technology on classroom climate. While there is a wide body of research on classroom climate instruments (Fraser, 1998) and there are emerging valid instruments on the use of technology in the classroom (Gibson et al., 2014; Vannatta & Nancy, 2004), none of these instruments addresses the complexities of the impact of technology on school climate. There does not appear to be a valid and reliable instrument that measures the effect of technology on classroom climate. There is a need for an instrument that illuminates how technology is affecting classroom climate from the teacher perceptive.

Purpose

The purpose of this study was to create and validate an instrument designed to measure teachers' perceptions of the effect of one-to-one mobile technology on the climate of the classroom. Literature from instrument development and validation, classroom climate, and the use of mobile technology in classroom was synthesized to form the foundation for the domains and constructs the instrument strives to measure. Since the instrument's intent is to measure the teachers' perception of the effect of mobile technology on classroom climate, the developed instrument was named *The Mobile Technology Classroom Climate Survey* (MTCCS). The theoretical constructs that describe the classroom climate were modified with the lens of mobile technology to form the foundation of the empirical instrument. The instrument was validated using classic instrument construction techniques organized into a four-phase process as proposed by Benson and Clark (1982). The four phases are 1) planning, 2) construction, 3) quantitative evaluations, and 4) validation. Using this four phase process of instrument development, this study investigated the goals, objectives and potential purposes of such an instrument. Further, the instrument was refined from a broad item pool through statistical analysis.

Significance

The goals for the use of this instrument are twofold. The initial goal that inspired this study and the creation of the instrument was to better elucidate the influence of technology on the classroom climate. This instrument provides researchers a better understanding of how teachers perceive the changes that mobile devices have effected in the classroom. The second goal was a purpose that emerged from the process of planning and creating the instrument. This goal is to use the instrument as a tool for building administrators to plan and direct professional development. By analyzing the combined results of each factor on the instrument, administrators will have better clarity in areas in which their teachers need additional support and growth. Both of these goals will provide a significant contribution to the education of our students: first, by providing a contribution to the research, which is still sparse in this area, and secondly by providing directed professional development that will aid teaching and learning.

Summary of chapter

Classroom climate is an essential social structure that correlates to many positive outcomes for teaching and learning (Thapa et al, 2013). Technology has had an increasingly dominant presence in the classroom over the last 30 years (Bebell & Kay, 2010). As technology becomes more mobile and as the student to device ratio drops to 1:1, the impact of these changes on the social structure of classroom needs to be studied. The purpose of this study was to develop a reliable and valid instrument to measure the teachers' perception of the effect of mobile devices on the classroom climate. This instrument contributes to researchers' understanding of the role technology is playing in the climate of the classroom, and provides building administers direction for the professional development needs of their staff. The next chapter reviewed the current literature in three areas: instrument development, school and classroom climate, and technology in the classroom.

Chapter Two: Review of the Literature

This chapter is organized into three sections. The first section is a summary of the classical methods of survey instrument development and validation relevant to this study. The second section is a review of the literature on Classroom Climate Instruments. The third section is a review of the literature on the effect of mobile technology in the classroom.

Instrument Development and Validation

This section gives a brief history of instrument development and validation in the social sciences, and then it provides the theoretical support for each of the steps of instrument development and validation relevant to this study.

A brief history of instrument development. The historical genesis of instrument development parallels the growth of the two closely related disciplines: statistics and psychology (Crocker & Algina, 1986; Salsburg, 2001). Beginning in the mid-1800's psychologists began to recognize the importance of obtaining psychological measurements and employing the then emerging quantitative methods. Cocker and Algina (1986) describe that in 1869, Sir Francis Galton began to demonstrate that mental abilities might be distributed in accordance to the normal curve, and later suggested a procedure for examining the covariance of two variables. Based on Galton's suggestion, Karl Pearson began his foundational work on correlation coefficients, followed by Charles Spearman whose work on the theory of intelligence gave birth to the correlational procedure known as factor analysis. The procedures of Pearson and Spearman are still commonly used today, as are the correlation coefficients that bear their names.

In the early 1900's, two French psychologists, Alfred Binet and Theophile Simon, propelled the construction, validation, and methodology of instrument development from *armchair logic* to scientific method (Crocker & Algina, 1986). During this same time period American scholars were also developing procedures for mental testing and psychological measurement; most notable is the work of James McKeen Cattell and E. L. Thorndike. Beginning in 1917, and continuing through two world wars, the war department funded and explored the application of intelligence and psychological testing on military personnel. Since that time, psychological testing has branched considerably into other fields and vocations, most notably education. The application of psychological measurement, intelligence testing, and standardized testing in American education has exploded since the 1930s into a multi-billion dollar industry and continues to be the subject of much research and critical debate (Chingos, 2012; Taubman, 2009).

Instrument development. While there is no universally accepted step-by-step standard specifically for instrument development and validation, Benson and Clark (1982) propose a four-phase development process. This four-phase model was modified slightly to serve as the conceptual framework for the instrument development and validation in this study. The four phases are 1) planning, 2) construction, 3) quantitative evaluations, and 4) validation. The planning phase includes identifying the purpose and goals of the instrument, and a review of the literature specifically targeting extant instruments that measure similar domains. The construction phase involves developing a large item pool. The quantitative methods phase occurs with the data obtained from the first pilot of the item pool. In this stage, statistical techniques are used to refine the item pool and group items into appropriate construct domains. The final phase is validation. In this stage a second pilot using the refined instrument is administered and qualitative techniques are used with content experts and target subjects to further validate and refine the survey. Phases three and four may be repeated several times as necessary to finalize the survey instrument (Benson & Clark, 1982). A comprehensive literature review of each of these four phases follows.

Phase one: Planning. The American Association for Public Opinion Research (AAPOR) established 12 guiding principles for the development of research; the first one is "Have specific goals" (The American Association for Public Opinion Research, 2016). Phase one is the planning phase and is considered to be the most important stage in development (Gable & Wolf, 1993; Schmeiser & Welch, 2006). The purpose of this phase is to fully develop the research questions, goals, and objectives. Further, this phase includes a review of existing research and evaluation of similar or related survey instruments. A deep understanding of the constructs being measured, clarifying the purpose for which the instrument will be used, and establishing priorities for probable future uses of the instrument, greatly increases the likelihood of a successful final form (Crocker & Algina, 1986).

The planning stage is also the appropriate time to distinguish the population of interest and establish the sampling frame. A well-defined target population and a sampling frame that closely mimics the population is essential in reducing and quantifying sampling error and bias (Dillman, Smyth, & Christian, 2014; Fowler, 2008). In the planning phase it is prudent to identify underlying assumptions, both in construct and in methodology, including the process of giving a survey at all. There are several alternative methodologies to obtain information that may provide more accurate or comprehensive data than are available by survey (Draugalis, Coons, & Plaza, 2008).

A well-defined purpose, plan, and methodology are critical to the success of the instrument. Researchers that neglect the planning phase produce poor results (Gable & Wolf, 1993). Often in these cases, the methodology or items on the survey do not measure the intended construct. Throughout the process of the instrument development decisions will be made based on the judgment of the researcher; thus a purposeful understanding of the constructs being measured is required to limit bias (Dillman et al., 2014). Hence, the lack of familiarity with the literature or not having established contextual frameworks corrupts item selection or development (Kelley, Clark, Brown, & Sitzia, 2003).

Phase two: Construction. Phase Two involves the construction and review of a large item pool. Historically, the test or instrument developer will conceptualize one or more domains consistent with his or her understanding of the constructs and try to think up items or behaviors he or she believes represent or manifest the construct in question. However, this methodology invites an added element of subjectivity, possible omission of relevant domains and an unquantifiable bias to the instrument in development (Crocker & Algina, 1986). As such, in Phase Two the objective is to create a more systematic approach to item development to limit possible researcher bias. Crocker and Algina (1986) note that complete eradication of this bias is not possible. Instrument development can be seen as a delicate balance between art and science, as wisdom, experience, and subjectivity of the content experts must lie in balance with the scientific and statistical methods that, incidentally, are also subject to interpretation (Schmeiser & Welch, 2006).

Consistent with *Standards for Educational and Psychological Testing*, the item pool consists of more questions or tasks than are needed to populate the instrument (American Educational Research Association, 2014). The creation of the item pool, as stated above, is reliant on the researcher's experience. To broaden, refine, or verify the researcher's view of the construct, Crocker and Algina (1986) suggest engagement in one or more of the following activities: content analysis, review of the research, critical incidents, direct observations, expert judgment, and instruction objectives. The following list describes each of these activities.

- *Content analysis* is a qualitative approach that involves posing open-ended questions to subjects in the target population regarding the construct of interest. These responses are then coded into topical categories, and used to develop items.

- *Review of the research* entails a study of how past researchers have envisioned the construct. The value of this activity is echoed by Gable and Wolf (1993) when they state, "A well-done literature review will be a rich source of content" (p. 33).
- *Critical incidents* are a list of anecdotes or behaviors relevant to the construct, compiled either by subjects or the researcher, and helpful to identify extremes on the continuum of the construct.
- *Direct observations* of the subjects or environment by the researcher help identify potential domains of the construct.
- *Expert judgment* is obtained when the researcher gathers more information on the construct by collecting input from individuals with first-hand experience of the construct.
- *Instruction objectives* are developed when the researcher provides material to the experts in the field and requests that objectives are derived from the material given. This approach is more appropriate to test development of skills or knowledge than a survey instrument of perception. (Crocker & Algina, 1986).

Once the pool of questions is compiled, it is refined in Phase Three through a review process for content validity and further pruned through the statistical methods. Before the item pool can be tested and refined in Phase Three, the researcher must decide upon the response format and size of the scale.

Response Format. The construction of an item pool requires the researcher to determine the appropriate response format for the instrument. An instrument in the affective domain is typically concerned with locating individuals at different points on the continuum of the constructs in question; as such, a subject-centered approach is appropriate (Crocker & Algina, 1986). When subject-centered, a perception-based approach is taken with the goal to rank the respondent's perceptions on a bi-polar (negative to positive) continuum. A Likert (1936) scale response format is appropriate. There is no consensus among researchers on the number of steps or amount of gradation to use in the Likert response format. The decision is left to the researcher with the critical understanding being that too few steps will fail to illicit discriminations of which the respondent is capable, while too many will create confusion and response fatigue among respondents (Cohen, Manion, & Morrison, 2000; Gable & Wolf, 1993; Gilbert, 2001). Several researchers have evaluated response scale steps empirically, and the general consensus is that reliability and validity issues seem best served on a five- to seven-step response scale (Dillman et al., 2014; Gable & Wolf, 1993).

The other noteworthy issue of selecting an even or odd number of scale steps in a Likert type scale provides ample issues for debate, as even scales force respondents to take a side allowing binary interpretation of the responses. Likewise odd scales provide a neutral or *undecided* response that may also be seen as valuable data to the researcher (Gable & Wolf, 1993). An odd numbered scale provides a trichotomous format: negative, neutral, or positive. The neutral option can be interpreted by some respondents as well, thus, providing a choice for the apathetic or indifferent (Kulas & Stachowski, 2009). Krosnick and Fabrigar (1997) found a disproportionate number of respondents default to the middle, with no indication if the overall tendency is negative or positive.

Phase three: Quantitative evaluation. Phase Three involves administration of the item pool in a first pilot to a large representative sample, and then conducting an item analysis and factor analysis to inform construct domains and to refine item selection. The following gives a brief overview of factor analysis and delineates the critical decisions that are incumbent on the researcher throughout the process.

Factor analysis. Building on the foundational correlational theories of Spearman (1904) and Pearson (1895), factor analysis has been commonly used in the fields of psychology and education. Factor analysis, a multivariate statistical procedure, can be classified into two types: Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). EFA strives to develop the main dimensions from a large set of items intended on revealing unknown constructs. CFA, on the other hand, assumes the dimensions of the construct a priori, and seeks to test the assumed structural model (Williams, Brown, & Onsman, 2012). There are a variety of procedures for fitting data to a common model. These procedures like: Maximum Likelihood, Principle Component Analysis (PCA), and Principal Axis Factoring (PAF), vary slightly in the assumptions made and in the methodical extraction (Kaplan, 1995). Gabel and Wolf (1993) define the purpose of factor analysis as "to examine empirically the interrelationships among the items and to identify or verify clusters of items that share sufficient variation to justify their existence as a factor or construct to be measured by the instrument" (p. 108).

While the popularity of factor analysis as a method of analyzing self-reporting survey data continues to grow (Williams et al., 2012), both CFA and EFA procedures have aspects that are criticized. CFA is often criticized because the analysis is only as good as the a priori domains that are being tested, meaning that latent variables, outside the a priori domains, are likely to be missed. For example, if a researcher intends to confirm four known domains, a fifth equally important domain could be missed. EFA, on the other hand, is described as taking a *shotgun* approach, and letting random efforts to relate domains misguide theory (Crocker & Algina, 1986; Fabrigar, Wegener, MacCallum, & Strahan, 1999; Gable & Wolf, 1993; Nunnally & Bernstein, 1994). However, decisions made throughout the implementation process can maximize the strengths of these procedures (Fabrigar et al., 1999). These decisions include insuring a large sample size from whom to gather data, that at least some of the correlational matrix elements exceed .3, and the use of tests, such as Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity, to confirm the suitability of the data for a factor analysis. Sample sizes of 100-200 are acceptable if the factors are well determined (Tabachnick & Fidell, 2013). Sample sizes of at least 300 are needed with low commonalities (shared item variance), a small number of factors, or three to four indicators for each factor. In the worst cases of low commonalities and large number of weakly determined factors, sample sizes of well over 500 are required.

Sample size can be reduced if consistently high commonalities exist (Tabachnick & Fidell, 2013).

The labeling of factors is subjective, based on the researcher's theoretical perspectives, and represents an area where the importance of the researcher's understanding of the construct is critical. Henson and Roberts (2006) note "the meaningfulness of latent factors is ultimately dependent on researcher definition" (p. 396). The strength of systematic factor analysis is to isolate items with strong correlations in responses, referred to as high loadings, and find those factors that together explain the majority of the responses in the context of the construct (Williams et al., 2012). Once this process has been conducted and analyzed, the researcher then examines items and makes a decision whether the items should be discarded. For example, the item might load on several factors, not load on any factors, or mathematically load by random chance, but conceptually not fit any logical factor structure. Traditionally, at least two or three variables must load on a factor so it can be given a meaningful interpretation (Tabachnick & Fidell, 2013).

Phase four: Validation. Validity is defined as the overall evaluative judgment of how well experimental data and theoretical constructs support the appropriateness of interpretations of the instrument results. "Validity is not a property of the test or assessment as such, but rather of the meaning of the test scores" (Messick, 1995, p. 741). Messick (1989) includes not only the meaning of the test scores in the broad concept of validity, but also includes the interpretation, use, and potential consequences (both intended and unintended) of the instrument as evidence for or against validity. However, the role that interpretation and consequences should play in the study of validation is disputed both theoretically and in terms of practical application (Kane, 2006). To ignore purpose in defining validity is tantamount to defining validity for a *useless* instrument. The current definition of validity stipulated in the 2014 version of the Standards for Educational and Psychological Testing describes validity in terms of both interpretations and uses, and provides a sufficient starting point for validation (Sireci, 2015). Therefore, while Benson and Clark (1982) titled the fourth phase validation, it is misleading as the total process of validation as defined is embedded in all four phases. Since the instrument is not validated independent of the purpose—for example, establishing purpose in phase one is part of the validation process—validation appears in all phases.

Initially validity was developed as a correlational statistic between the test score and later performance of the criterion being measured (Nunnally & Bernstein, 1994). As instruments became more widely implemented, concurrent correlational statistics were used as a measure of how accurate an instrument was relative to like instruments, in addition to the predictive criterion correlations (Lissitz & Samuelsen, 2007). Chronologically, content validity was developed next in educational environments as an alternative to criterion based validity (Lissitz & Samuelsen, 2007). In educational testing, content validity is defined as how well a test measures the content that was taught (Morrell & Carroll, 2010). Cronbach and Meehl (1955) introduced Construct Validity as a fourth type of validity, the other three being predictive, concurrent, and content. Construct validity was defined as how well the assessment tool was aligned and measured the domains and nomological networks of the intended construct, particularly when no defined criterion exists (Cronbach & Meehl, 1955). Over the years, several other forms and models of validation have been defined and developed to include: criterion validity, concurrent validity, construct validity, content validity, consequential, positivism, face validity, internal validity, and external validity (Kane, 2006). However, many researchers have opted to adopt Messick's unified approach, studying validity not as distinct types but taken together as evidence towards validation of the whole (Brualdi, 1999; Messick, 1989; Moss, 1992).

As validation theory has developed, there has been much dialogue on the best process of establishing validity (Borsboom, 2015). The history of this debate has been characterized in four approximate chronological periods: the genesis of validity theory (before 1951), the fragmentation of validity (1952-1974), the (re)unification of validity (1975-1999), and the deconstruction of validity (2000-2012) (Newton, 2014). The genesis period denotes the initial development of the concept of validity, the fragmentation period refers to the development of the different types of validity, the (re)unification period refers to Messick's widely adopted unified approach. The deconstruction period refers to the most recent debates on the practical use of Messick's unified approach. Messick's unified approach includes Messick's progressive matrix of construct validity, a matrix that details the intersection of the use and interpretation of the test with the evidential and consequential basis, as a framework for organizing validity evidence (Hamavandy & Kiany, 2014). Critics, such as Kane (2012), argue that while Messick's theories are rich and have been influential to the field, they are not practical in practice and he proposes a more argument-based approach to establishing validity.

Classroom Climate Instruments

This section gives a brief definition of classroom climate and history of the development of instruments to measure classroom climate and is followed by a review of the implications of classroom climate surveys.

Definition of classroom climate. Like so many constructs in education there is not a universally agreed upon definition of school or classroom climate. Terms used to describe school and classroom climate include: learning environment, atmosphere, ambience, ecology, milieu, feelings, tone, and setting (Cohen et al., 2000). Halpin and Croft (1962) described school climate as the personality of the school. Building from organizational research, climate was defined as a set of characteristics having three factors: distinguishing one organization from another, relatively enduring over time, and influential to the behavior of people within the organization (Johnson, 1990). The school climate is the school's personality analogy and definition of climate has been refined to distinguish climate and culture, changing the school climate analogy to climate being the attitude of the school, while regarding the school's culture as the personality (Gruenert & Whitaker, 2015). School climate is generally considered a fluid byproduct of many immediate environmental factors including; social, physical, emotional, and organizational structures. Further, it is a reflection of the school's culture, which is a stable entity derived from the institution's underlying beliefs, values, traditions, history, and broader community context (Adelman & Taylor, 2005). School climate cannot be studied independent of class discipline, level of class, demographics of students and teachers, and cultural values and norms. Some researchers question if these factors are so essential to the study of school climate that classical theories cannot be applied to non-western dominant cultures (Zedan, 2010).

The primary difference between school and classroom climate is the unit of study. The National Council of School Climate (2007) has the following definition for school climate: "School climate is based on patterns of people's experiences of school life and reflects norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures" (para. 3). The term classroom climate has been defined as the sum total of all group processes that take place during teacher-to-student and student-to-student interactions (Zedan, 2010).

Historical background. Educators have researched the concept of classroom climate for over 100 years, starting when Perry (1908) first wrote explicitly about the impact of atmosphere and what he termed *esprit de corps* on student learning. Perry (1908) wrote about both the physical and emotional climate of the classroom and encouraged educators to decorate in an effort to "reduce the ill effects of a cheerless classroom" (p. 141) and suggested that school atmosphere was "the teacher's strongest lever in promoting efficiency and good government among the boys and girls" (p. 304). Empirically grounded school research began in the 1950s when Halpin and Croft (1963) initiated systematic studies of the impact of the school climate on student learning using their Organizational Climate Description Questionnaire (OCDQ).

In 1968, classroom environment assessments were used in the evaluation of the Harvard Project Physics. Through that study The Learning Environment Inventory (LEI) for secondary students was developed by Walberg (1969) building from the Classroom Climate Questionnaire (CCQ) that was linked to earlier business organizational studies. A parallel instrument, My Class Inventory (MCI), was developed for elementary students (Anderson, 1982). During the same time period, Moos and Trickett (1987) developed the Classroom Environment Scale (CES) used in junior and high school classrooms with forms for both teachers and students. In the years that followed a rich diversity of questionnaires and classroom environment instruments have been developed and become a hallmark of the field (Thapa, Cohen, Guffey, & Higgins-Dealessandro, 2013).

Analyzing teacher and student perceptions is one method that has developed to study classroom environments. Other methods, including external observer's direct observation, systematic coding of classroom communication and events, case studies, and applications of ethnography, have also been developed to study classroom environment (Fraser, 1998).

Dimensions of school and classroom climate. The elements of all human environments, including the classroom, are broadly classified by Moos' (1980) social climate dimensions: Relationships, Personal Development, and System Maintenance and System Change. The Relationship Dimension pertains to the nature and intensity of inter-personal relationships within the classroom. This category includes such things as a teacher's relationship with students, students' relationship with one another, and the degree to which individuals feel supported and free to express themselves. The Personal Development Dimension pertains to the degree to which personal growth and self-enhancement tends to occur. In the classroom this dimension includes both teacher and student autonomy, expectations of excellence, and the varying degrees to which students feel competition. The final dimension is the System Maintenance and System Change; this involves the extent to which expectations are clearly stated and fairly enforced. This dimension also includes how control is maintained and how responsive members are to change. In the classroom, this dimension would encompass classroom management, class policies and procedures, teacher consistency, and how changes occur in the rules, policies or curriculum (Arter, 1989; Fraser, 1998).

Fraser (1998) has deferred to Moos' dimensions for climate classifications when reviewing school and classroom climate instruments. Anderson (1982) compares Moos' categorization with that of Tagiuri (1968). According to Tagiuri, there are four dimensions of climate. The first is ecology, which includes all of the physical and material aspects of the environment. The second dimension is named milieu and encompasses the presence of people and groups in the organization. Milieu includes the variables that represent the characteristics and demographics of individuals in the school. The third dimension is denoted as social system and is concerned with the relationships of persons and groups. The fourth dimension is culture, and is defines as shared beliefs and norms of the organization. Anderson (1982) prefers Tagiuri's taxonomy in what she dubs the *dimension debate* because it includes a more comprehensive picture of the complete environmental quality in a school building. However, later reviews conducted by Fraser (199) and Arter (1989) use Moos' classifications. It is notable that Arter adds a fourth dimension to Moos' framework entitled Physical environment. This dimension, similar to Taguiri's ecology, includes the physical surroundings and resource availability.

Cohen, Mccabe, Michelli, and Pickeral (1989) state that there are four essential dimensions of school climate and argue that "virtually all researchers agree that there are four major areas that clearly shape school climate: safety, relationships, teaching and learning, and the (external) environment" (p. 182). The first dimension is safety. This dimension includes physical safety as well as the social emotional safety. Physical safety includes elements like having a school crisis plan, clear and consistent violation response, the school communities' attitudes towards violence, and people in the school feeling physically safe. Social and emotional safety includes cultural inclusiveness, attitudes and responses to bullying, conflict resolution, and the belief in maintaining school rules. Since the escalation in school shootings and mass school violence, this dimension of school climate is increasingly important. The second dimension of the school climate is broadly categorized as teaching and learning. This dimension includes the quality of instruction, the curriculum, community held expectations for student achievement, professional development for educators, and the quality of leadership. The third dimension is relationships. This includes positive adult-adult relationships, teacher-student relationships, valuing diversity, collaboration towards learning, morale and connectedness, and the participation of parents and others and the school community. The fourth dimension is the environmental–structural. This dimension includes all of the elements of the physical space, including: school cleanliness, having adequate space and materials, school aesthetic, and curricular and co-curricular offerings.

Zedan (2010) found five factors of classroom climate. These factors were satisfaction and enjoyment, teacher-student relationships, gender iniquity intention, student-student relationships, and competitiveness. The first factor, satisfaction and enjoyment, encompasses the students' enjoyment of the discipline and satisfaction of the rules and regulations and classroom organization established by the instructor. The second factor, teacher-student relationships, examines the extent the teacher's emotional and academic support for the student, and to what extent the student success is dependent on the teacher. The third factor, gender inequity and tension, specifically looks at gender discrimination and student anxiety about the discipline. The fourth factor, student-student relationships, details the quality of the social interactions among the students and group cohesion. Factor five, competitiveness, assesses the level of competition between students and their concern for higher achievement relative to their classmates.

The National Council of School Climate (2010) defines five dimensions of school climate. The first four are the same as Cohen, Mccabe, Michelli, and Pickeral (2007): safety, relationships, teaching and learning, and the (external) environment. The fifth additional dimension is called the school improvement process and entails measuring the implementation of evidence based programs. The United States

Department of Education (2009) includes three interrelated domains in their safe and supportive schools models: engagement (including relationships, respect for diversity and school participation), safety (including emotional and physical safety, substance abuse) and environment (including physical environment, academic environment, wellness, and discipline environment). Table 1 summarizes each of these models by listing domains.

Professional development and teacher belief are relevant to the study of classroom climate as associations have been found between teacher belief and classroom climate and between teacher training and classroom climate. Van der Sijde and Tomic, (1992) found that involvment in training on classroom climate of pre-service teachers was associated more positive student perceptions of classroom climate. Likewise, Benninga, Guskey, and Thornburg (1981) found association with certain teacher attitudes and elementary student preceptions of classroom climate. A similar association was found between teacher preceptions, particularly in the areas of empathy and willingness to accomodate for learning differences, and undergraduate students perspection of classroom climate (Rowbotham, 2010).

Table 1

Summary of Climate Domains by Author

Moos	Tagiuri	Cohen, Mccabe, Michelli and Pickeral	Zedan	National Council of School Climate	United States Department of Education
Relationships	Ecology	Safety	Satisfaction and Enjoyment	Safety	Engagement
Personal Development	Milieu	Relationships	Teacher-Student Relationships	Relationships	Safety
System Maintenance and System Change	Social System	Teaching and Learning	Gender Iniquity Intention	Teaching and Learning	Environment
	Culture	External Environment	Student-Student Relationships	External Environment	
			Competitiveness	School Improvement Process	

The importance of school and classroom climate. Consistent throughout decades of research is the positive correlation between healthy climate and desirable educational outcomes. A positive school climate fosters youth development and learning (Cohen et al., 2009). The ecological model of child development maintains the quality of the child’s environment and emotional support influences developmental outcomes (Reyes, Brackett, Rivers, White, & Salovey, 2012). Improving school climate has been identified as a sound strategy for dropout prevention (Thapa et al., 2013).

Cohen et al. (2009) found school climate to have an impact on individual experience. Their findings included an association between school climate and student self-concept, levels of absenteeism, and rate of student suspension. They also found that school climate, specifically school connectedness, is a predictor of adolescent health and academic outcomes, violence prevention, student risk behaviors, including sex, violence, and drug use. Most significantly, school climate is correlated to student learning and student motivation to learn. For example, one multilevel, multiple method study deployed the Classroom Emotional Climate (CEC) survey to 63 classrooms and found positive correlations between classroom climate scores and student grades, and classroom observations of student engagement (Reyes et al., 2012).

Likewise, Zedan (2010) found classroom climate affects students' behaviors, level of knowledge, scholastic achievements, motivation, self-image and attitudes towards a certain discipline, the class and the school, and schooling and education as a whole. Conversely, negative school climates can lead to feelings of unease, anxiety, and skepticism contributing to intellectual and cognitive depression.

Mobile Technology in the Classroom

This section gives a brief review of the literature on the effect of mobile technologies in the classroom, and one-to-one computing initiatives.

21st century learning skills. As with research and organizational skills, measuring the impact of one-to-one initiatives on 21st century learning skills is a nebulous task. These skills, a blend of critical thinking skills, literacy, technology skills, and content knowledge, are difficult to measure in a multiple choice standardized format. However, some trends and discussion has emerged as researchers examine the results of one-to-one initiatives. The summary of laptop initiatives across six states indicated students tend to develop 21st century skills after one-to-one implementation. The students felt better prepared for the future. Technology skills improved for both teacher and students. Students also showed improvement in their internet research skills, and demonstrated increased internet and presentation software ability than matched control students (Argueta et al., 2011).

One-to-one programs improved students' general technology skills (Goodwin, 2011). Technology training or skill development for students is more important than new, more, or better technology. Students want more technology use assigned that is relevant to coursework, and they want training to be more *on-demand* rather than in the form of a stand-alone course (Dahlstrom et al., 2014). Hence, it is difficult to discuss successful implementation of one-to-one programs without discussing the tie to project-based learning. Project-based learning and technology go hand in hand, and together are the foundation of the 21st century skills set (McLester, 2011). For example, Crompton and Keane (2012) found in the middle school iPod implementation that when assigned to develop and make math movies students were more engaged and reported deeper understanding. Teachers reported new perspectives on student learning. Another example of project-based learning and technology working in concert is the promising research emerging that game-based learning might hold the key to closing the achievement gap (Dahlstrom et al., 2014).

The specific set of 21st century learning skills is changing as one-to-one implementation becomes more mainstream. The National Council for Teachers of

English (NCTE) has redefined the term literacy to include "proficiency with the tools of technology" (National Council of Teachers of English, 2008). Richardson (2013) considers other literacies being defined. *Attention literacy* is the ability for a student to focus in a digital environment without the multiple distractions from multi-tasking and machine notifications. *Transmedia literacy* is defined as a person's ability to appropriately navigate the waters of social media (Richardson, 2013).

The effect of one-to-one computing on student engagement. The current generation of students was born into a world rich with mobile technology. And, while there is debate about students' natural proficiency with technology, the fact that they have not lived in a world without it cannot be disputed (Bradshaw, Waasdorp, Debnam, & Johnson, 2014). Some researchers argue that for them it is an unnatural experience to have the classroom be the one place in students' lives void of technology (Bennett, Maton, & Kervin, 2008). The image of the always connected "digital native", (Prensky, 2001) or "millennial student", (Newton, 2000) or the terms "net generation" (Tapscott, 1998) and "iGeneration" (Rosen, 2011) are familiar to today's educators. Expectations are made about the ability of these students, born after 1980 into a world of expanding digital technologies, which are, for good and ill, currently driving school policy, curriculum development, and academic discourse (Rosen, 2011). Students are also projecting these expectations into the classroom. Students expect their instructors to use technology to engage them in the learning process; they believe technology is critical to their academic success and future accomplishments (Watulak, 2012). Part of the current debate is discussing whether or not these types of expectations and assumptions are valid. According to Lohnes and Kinzer (2007), assumptions regarding the net generations are pervasive throughout our culture and have led educators to presume a common set of experiences among students. However, not all students value or use technology to the same extent as their peers.

One-to-one technology initiatives have expanded throughout school districts worldwide (Dahlstrom, et al., 2014). The overall impact of these programs is unclear, as data specifically tied to student outcomes remains elusive even after almost three decades of research. The rapidly changing form and function of technology has impacted the ability for researchers to conduct relevant studies. For the iPad specifically, the lack of empirical research and assessment speaks to the notion that the examination and determination of the iPad effectiveness is still in its infancy (Bebell & O'Dwyer, 2010; Johnson, Adams-Becker, Estrada, & Freeman, 2014; Sincar, Richardson, Flora, & Sauers, 2013). Early reports indicate an improvement in student engagement and fewer discipline issues. While a few schools report increase in student achievement data, the results are generally inconsistent and clear evidence of results is rare (Bebell & Kay, 2010). McLester (2011) summarized four empirical studies on one-to-one environments and found evidence of increased teacher and student engagement and modest student achievement. Likewise, a white paper produced for the North Carolina State University that summarized six statewide one-to-one initiatives found that teachers and students generally agreed that laptops increased student engagement (Bebell & O'Dwyer, 2010). For example, Manuguerra and

Petocz's (2011) classroom case study found the use of the iPad increased student reported engagement.

Student engagement remains a powerful predictor of student success and high school completion. One consistent result from studies on the technology enriched classroom is increased student engagement (Argueta, Huff, Tingen, & Corn, 2011). An early 2009 study of Pocket PC handheld devices employed in primary classrooms reported increased engagement and found students with low literacy levels benefitted the most (Scherer, 2011). Another study from Taiwan in 2011 on the impact of Technology-Enabled Active Learning (TEAL) in a high school context also found increased student engagement.

> The TEAL students showed more positive attitudes towards going to physics class because they said it was fun. "Fun" to them meant that the instructor provided them with demonstration and hands-on activities along with lectures in a high-tech studio, which they stated was rather different from other courses they had experienced previously. (Shieh, 2012, p. 210)

A four year study of middle school students in Texas found that one-to-one laptop programs had more engaged learners and less disciplinary problems (Goodwin, 2011). While technology is not a magic cure for raising standardized test scores, the research consistently supports it as a critical component to student engagement.

> Technology is all about engagement. Watching the intense looks on our children's faces as they play video games, text all day long, Skype, Facebook,

> watch YouTube videos, and juggle a dozen websites at a time, we can clearly see that they are engaged. (Rosen, 2011, p. 15)

Despite the emerging evidence of improved student engagement, as the discussion that follows about teacher anxiety in a one-to-one environment demonstrates, classroom management and concerns of student distraction remain high for educators.

The effect of one-to-one computing on student organizational and research skills. Since organizational and research skills are difficult to measure on a standardized exam and therefore difficult to quantify, few studies have addressed if being in a one-to-one computing environment improves these skills. As such, qualitative data must suffice; unfortunately it is varied and greatly contested. An initial study from Maine, that initiated a one-to-one iPad pilot, found through student survey that 83% of the student body felt more interested and 86% said it was easier to gather information when researching (Ion, 2012). Another study reviewing Michigan's Freedom to Learn one-to-one initiative found that students reported working with the laptops improved their learning, research skills, and study skills (Lowther, Inan, Strahl, & Ross, 2012). Those educators that believe in digital native model of our students have also entered into this debate. They argue that for students born into this technological world, the technology has become an extension of the brain itself. Their environment has forced students to adapt to new ways of thinking, managing complex and vast quantities of data in every form of media. For this group of educators, there can be no question whether the technology improves organizational and research skills, as it is their belief that, for this generation, technology itself is foundational to these skills (Prensky, 2013). However there is a lack of empirical evidence to support or refute these beliefs.

Another contingent in the debate are those that believe digital media are creating a generation of shallow thinkers, so used to a constant barrage of digital messages that they can no longer engage with content at a deeper level (Bauerlein, 2011). These educators are concerned that students are not able to read complex text, which requires focused attention which is contrary to our multi-tasking use of technology. Bauerlein (2011) contends that a major distinction between those who are college ready and those who are not is the ability to comprehend complex text. He advocates for an hour of slow reading every day, and occasionally assigning research papers without online tools. He believes this will slow down learning and allow for deeper thinking. Further, tension exists with the ease of online publishing. Digital tools have now cluttered the files of academic discourse with too many opinions, and not enough objective summaries that lead to well-reasoned argument. Prensky (2013) has an opinion on this advice, “anyone who maintains that we should continue to teach and use both the old ways and the new is suggesting that we maintain an expensive horse in the barn in case our car breaks down” (p. 24). More study on both sides of this debate is warranted.

Professional development in a one-to-one environment. By far the most consistent result in the studies reviewed, was the need for a well thought out and planned professional development program. A strong professional development program correlated to more teacher buy-in, support and leadership from the administration, and a successful implementation. Likewise, in schools where there was little to no professional development, implementation was less effective. “Across the four empirical studies, it is evident that teachers play an essential role in the effective implementation of 1:1 initiatives and that the onus of responsibility for implementation often falls to the teacher” (Bebell & O'Dwyer, 2010, p. 8). In their study of one-to-one programs across five middle schools, Bebell and Kay (2010) attributed the poor implementation to lack of teacher knowledge and buy-in, concluding “It is impossible to overstate the power of individual teachers in the success or failure of 1:1 computing” (p. 47).

Through these studies, some best practices, including: funding, product choice, teacher buy-in, and instructional practices have emerged for developing a professional development program to support one-to-one implementation. Professional development programs need to be funded. In a study across 45 schools in North Carolina, successful schools reserved 25% of their technology budgets for professional development (Overbay, Mollette, & Vasu, 2011). The choice of product was also a factor. If the device was too complex, requiring several sessions before adequate implementation could occur, it was less likely to be used by teachers (Scherer, 2011). Professional development needs to focus on implementation into the classroom rather than proficiency with a particular product (Argueta et al., 2011).

Teacher buy-in and a focus on instructional practices are both key factors (Spires, Oliver, & Corn, 2012). Teacher attitudes are critical to success. Time on job is not as important as perception of change and being active and persistent in confronting the challenge of implementing technologies in the classroom. Successful innovation has a wide base of teacher buy-in, and motivates the teacher to participate in professional development (Shieh, 2012). The time training was offered and the type of training offered played a role in teacher's willingness to participate. Well-planned and sustained professional development is more effective than sporadic training (Argueta et al., 2011). Teacher input is important to planning training; allowing a variety of types of sessions and tailoring sessions to teachers' specific needs (Overbay et al., 2011).

When it comes to instructional practices with technology there are two schools of thought, change everything versus good teaching practice regardless of tools. Postman (1998) states, "Technological change is not additive, it is ecological, which means, it changes everything" (p. 1). Many critics of one-to-one initiatives are more critical of the lack of change than the proposed change itself. Norris and Soloway (2010) argue that schools are using the devices as little more than glorified pencils. Far too often technology is viewed as an add-on and not central to the instructional process. The concern is that technology lessons are "old wine in new bottles" (Richardson, 2013) and investments are wasted on classrooms that fail to implement them in a new and engaging manner. Cuban (2009) and Richardson (2013) argue that the billions of dollars spent of technology initiatives have largely been a waste of money, showing no student gains in achievement. Richardson (2013) states, "we've spent millions of dollars on iPads and interactive whiteboards in schools that do little more than deliver digitalized worksheets or teacher-directed content to students" (p.

12). While digitalized worksheets and teacher-centered classrooms are not ideal, they are equally lacking in a non-technology rich classroom (Motschnig-Pitrik & Holzinger, 2002).

Johnson (2013) argues that good teaching practice should drive the use of technology and not the other way around.

> Because effective technology practices are not yet part of the culture of education, teachers and those who evaluate teachers do not understand technology use as well as they understand traditional teaching practices. Thus, our simple guide—which starts with effective teaching instead of technology—might be useful to both assessing teacher performance and those being assessed. Using such a guide is one way to ensure that the benefits students receive from technology do not depend on the individual teacher's level of personal commitment to technology use. (p. 84)

Ferriter (2011) argues that he could successfully prepare his students without any technology in the classroom. While he is not arguing for the latter, his point is that good teaching trumps good tools and "focusing on specific digital tools instead of instructional skills they're designed to support often leads to poor technology integration" (p. 84). According to Mclester (2011), establishing common rubrics across grade levels and a shared language of learning is critical to success in implementing a one-to-one initiative; many would call this just good teaching regardless of one-to-one programs. Irrespective of teacher or administrator stances on the changes required in instructional practice, a well-planned professional development program remains essential; otherwise we run the risk that technology will be oversold and underused (Cuban, 2009).

Also crucial to successful implementation was aligning the perceptions of both classroom teachers in school and district in terms of what type of professional development is called for and needed (Penuel, 2006). Teachers identified very specific aspects of professional development such as instructional integration and ongoing support as crucial. Additionally, emphasis on how to use the iPad in their classroom with their own specific subjects was sought by teachers.

A content analysis study that characterized common opinions expressed in 362 student blog posts on the one-to-one program in their schools included more efficient and productive learning, tools for better writing, the ability to access information, engagement with new media, relevancy in a technological world, collaboration with peers, and individualized and differentiated instruction (Zheng, Arada, Niiya, & Warschauer, 2014). The most frequently mentioned theme was increase in efficiency and productivity in learning. More than 55% of the student blog posts mentioned that laptops helped them create a learning environment that was more efficient and productive. The ability to instantaneously communicate this information accelerated learning for students. In addition to increasing productivity, students frequently blogged about how their writing improved. Forty-six percent of students indicated that an individualized laptop provided them with better tools for writing. They also preferred laptops to traditional pen and paper when editing their work stating their physical ability to write improved by fostering creativity in their overall approach to the writing process (Zheng et al. 2014)

Teacher's attitudes and beliefs about one-to-one environments. As discussed, professional development is critical to the success of one-to-one initiatives. This is less about technology training and more about teachers' buy-in, their attitude, and beliefs. Scherer (2011) writes that teachers are using technology in their personal lives. She notes that middle-aged women make up the largest demographic for both teaching and online social media-based games. The belief that using this technology in the classroom is value-added and makes a richer more diverse experience for students is what schools need to cultivate in all of their instructors. The teachers' attitude towards the implementation will be directly related to the students' attitude (Crompton & Keane, 2012).

Teachers are concerned that there is not enough time allotted for professional development and that the devices pose new difficulties with classroom management. Ion (2012) points out that in the same studies that teachers are concerned about student distraction, they are also reporting increased student engagement. Student distraction, defined as off-task behavior, seems to be the opposite of student engagement. The study of technology-enriched classrooms (TEAL) conducted in Taiwan found that certain teacher attitudes had become obstacles to successful implementation in their classrooms. One teacher in the study reported not to believe that the technology would help students learn. "She thought technology would distract students' attention, and as she stated before, she emphasized again that oral explanation was the best approach to helping students learn physics” (Shieh, 2012, p. 211).

Technology and climate. Since computers first entered the classroom in the mid-1980s, educational researchers have been studying their impact (Fisher, Dwyer, & Yocam, 1996; Schofield, 1995; Walser, 2011; White & Hubbard, 1988; Zucker, 2008). The focus of this research has been primarily in the teaching and learning domain. The early studies primarily considered artificial intelligence and adaptive learning (Scofield 1995), redefining curriculum to include computer skills (White & Hubbard, 1988) and general technology use (Zucker, 2008). Only in a few studies did authors mention the other aspects of climate.

Schofield (1995) did discuss findings that suggested changes in peer interaction patterns; an increase in peer tutoring was found during class but a decrease in peer socialization at the beginning and end of the class periods. Mucherah (2002) modified Computer Environment Scale (Moos & Tricket, 1995) to include some technology-based questions. The results of this study found that six factors emerged from the modified instrument that were different than Moos and Tricket’s (1995) original instrument that had nine factors. In the implications of this study, Mucherah (2002) indicates the importance in differentiating between student computer use and watching the teacher display information with the technology.

Another modified environment scale that attempts to incorporate technology as an addition scale is the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Fraser & Aldridge, 2003). This instrument added three additional scale items to the seven scaled survey called What is Happening in this Class (WIHIC) instrument (Fraser, McRobbie, & Fisher, 1996). Two of the scales were added to measure the extent differentiation of instruction and student autonomy occurred in the class. The third additional scale was on computer use. This computer use scale did not address how technology was impacting climate, but rather what types of software programs were being used. In the findings, Dorman (2009) states very little association between computer usage and classroom climate, noting that few studies have investigated the psychosocial dimensions of computer classroom environments. And as the research is still sparse it is not clear if those dimensions are the same for computer classroom environments and classrooms deploying mobile devices.

Summary of the Chapter

This review examined three areas: instrument development, classroom climate and mobile technology in the classroom. The review of instrument development found support for Benson and Clark's (1982) four-phase process for instrument development. As validation is not independent of purpose (Messick, 1989), the importance of planning in phase-one emerged from the research (Gable & Wolf, 1993; Schmeiser & Welch, 2006). Best practices for construction of the item pool in phase two, and quantitative evaluation in phase three were also reviewed. Testing the refined instrument was detailed in the review of phase four.

The domains of classroom climate were reviewed. Several models of classroom climate were explored and summarized. Moos (1980) described three dimensions of all human social structures: Relationships, Personal Development, and System Maintenance and System Change. Cohen et al. (2009) suggest four school specific domains: Teaching and Learning, Safety, Relationships, and External Environment. The importance of classroom climate emerged from the research showing correlations between classroom climate and several student outcomes (Cohen et al, 2009; Thapa et al, 2013).

Current research on mobile technology suggests more engaged learners (Argueta et al, 2011; Bebell & O'Dwyer, 2010; Scherer 2011) in technology rich classrooms. Challenges to mobile technology in the classroom also emerged including student distractions and increased difficulty of reading complex texts (Bauerlein, 2011). The importance of professional development in the successful implementation of technology in the classroom surfaced as well in the literature (Bebell & Kay, 2010; Penuel, 2006).

There did not appear to be much research on the effect of mobile technology on the classroom climate. Given the importance of classroom climate and the increasing use of mobile technology it is imperative that studies, such as this one, provide additional understanding.

Chapter Three: Methodology

The purpose of this study was to build a valid survey instrument that measures teachers' perception on the effect of one-to-one mobile technology on the climate of the classroom. This study implements a four-phase instrument development process: 1) planning, 2) construction, 3) quantitative evaluations, and 4) validation (Benson & Clark, 1982). The methods for each phase are delineated.

Phase One Methodology: Planning

The purpose of this phase is to fully develop the research questions, goals, and objectives targeted by the instrument. The research question in this phase was:

1.1 What are the goals, objectives and potential purposes of the instrument?

Methodology for research question 1.1. The methodology was two pronged. The first prong was a review of existing research and evaluation of similar or related survey instruments. The purpose of this approach was to understand and define the current state of research and identify research gaps that could potentially be covered by the instrument (Gable & Wolf, 1993). The literature review for this study, detailed previously in Chapter Two, included a review of research on classroom climate, mobile technology in the classroom, and eighteen instruments developed to measure classroom climate and eight instruments developed to measure technology use in the classroom. The results of this search and the details of these instruments are listed in Table 2 and Table 3 in Chapter 4. The items on each of these twenty-six instruments were grouped for commonality and sorted based on Moos' (1980) three dimensions of human organizations: relationships, personal development, and systems management and change. If instrument items were obviously outside of these three dimensions, they were placed in a fourth: miscellaneous category, and further examined for commonality.

The second prong of phase one was a study of current practitioners to examine the perceptions or behaviors of a person with high to low levels of the characteristics the instrument intends to measure (Gable & Wolf, 1993, p. 30). In the case of the Mobile Technology Classroom Climate Survey (MTCCS), the area of interest is the effect of mobile technology on the social climate of the classroom. This investigation employed face-to-face interviews of six teachers selected through a purposeful and stratified design. The interviews were conducted at a private parochial high school in the Pacific Northwest, selected because of the school's full school one-to-one initiative, and an existing relationship with the researcher. The school was in the second year of a transition to a one-to-one learning environment. This high school benefitted from a veteran faculty, with the average length of teaching experience being 18 years.

The teachers were disaggregated by gender and then rated by their technology use and their technical competence in the classroom as perceived by the Information Technology Director, whose responsibility it is to provide technical support to all teachers. A male and female teacher from each technology use and competency level: high, average, and low were then selected by computerized randomization and invited to participate in the study.

The six teachers were interviewed for 30 to 45 minutes in September of 2015. Interview content was chosen to provide insight and depth of meaning through acquiring rich data critical to understanding the perceptions of these individuals (Gillman, 2000; Ritchie & Lewis, 2003), and to further refine the understanding of potential instrument domains identified from the literature. Questions focused on what the teachers saw as the effects of the one-to-one initiative on classroom climate. They were asked to describe specific elements of their classroom climate within each dimension, and then asked how the implementation of a one-to-one environment had changed those elements, both positively and negatively.

Each teacher was asked five open-ended questions about classroom climate and technology: 1) Describe your ideal classroom environment. 2) How do you characterize the different elements of classroom climate? 3) How has technology changed the elementary classroom climate? 4) In what ways has technology improved any of these elements of classroom climate? 5) In what ways has technology created challenges in any of these elements of classroom climate? Follow-up questions were asked to elucidate the teacher's perspective on technology and climate. Each interview was recorded and transcribed for analysis. Each interview was read and coded for emergent themes consistent among the six teachers, and then re-read and responses coded if the answer fell into one of the following four classroom climate domains that emerged from the literature: Teaching and Learning, External Environment, Relationships, and Safety.

Open coding was conducted line-by-line, followed by a process of focused coding (Flick, 2014). A constant comparative approach (Glaser, 1999) led to emerging themes that informed subsequent interviews and served as the basis for the results of the study. These themes were then compared to the themes that emerged from the literature, and established instruments. Goals and objectives of the instrument were written based on the themes that surfaced, and a list of potential purposes of the instrument was compiled.

Phase Two Methodology: Construction

The purpose of phase two was to construct an item pool and compare the constructed pool against existing research for construct validity. The two research questions in this phase were:

2.1 What are the necessary items to be used in the development of a survey instrument to measure the perceptions of teachers of the effect of one-to-one mobile technology on the climate of the classroom?

2.2 Does the instrument item pool have construct validity as demonstrated by a comparison with the research?

Methodology for research question 2.1. Consistent with the Standards for Educational and Psychological Testing (2014), an item pool of a minimum of 10 questions/statements for each domain was developed from two sources. The first source was questions that arose from a review of the existing instruments surrounding classroom climate and educational mobile technologies.

The second source for developing the item pool was content analysis. *Content analysis* is a qualitative approach that involves posing open-ended questions to subjects in the target population regarding the construct of interest (Crocker & Algina, 1986). This information was gathered from practitioners in the field through a simple survey. The survey was distributed to 50 in-service teachers recruited from graduate level continuing education courses and through the local professional network of educational technologists. The survey contained three questions: two multiple-choice demographic questions and one free response. Teachers were asked to classify their teaching experience in one of three categories: 1-5 years, 6-15 years, over 15 years. They were also asked to classify the use of mobile technology in their classroom into one of the following categories: every student has access to a mobile device, most students have access to mobile devices, few students have access to mobile devices, and no students have access to mobile devices. Finally, teachers were asked to respond to the following free response prompt:

> As classroom technologies continue to evolve, several classrooms and buildings are moving to a one device for every student model. Please list questions that you would like pose to other teachers about the effects of these technologies on the climate of the classroom. Classroom climate includes the relationships you form with students, or students form with each other. It also includes the feelings of growth or achievement in the classroom, as well as classroom management systems or policies. Please list as many questions as

you can think of in the box provided below. These questions will inform future research and the author of these questions will remain anonymous.

Summaries of the teachers' expertise, classified by their years of experience were calculated. The percent of return was also reported.

The survey responses were coded and then grouped by the researcher into one of three dimensions of societal context of the classroom: relationships, personal development, and systematic control and change (Moos, 1980). As with phase one, a fourth miscellaneous category was used to classify any responses that fell outside of the three categories. Like responses were grouped within Moos' three categories, and item statements developed. Items similar to an item from the existing literature were reworded using a technology lens. Items that were redundant or irrelevant to the study were eliminated, with only one item retained.

Once the item pool had been classified in the contextual areas surrounding classroom climate, the researcher edited the tense and sentence structure of each item for consistency. Following the guidelines for constructing good questions as proposed by Dillman, Smyth, and Christian (2008), each item was checked for relevance, language simplicity, technical accuracy, and proper sentence structure. A standard six-step Likert-type scale was developed to use for all test items. For each test item respondents were asked to respond by choosing one of the following scale options: Strongly Disagree, Disagree, Somewhat Disagree, Somewhat Agree, Agree, Strongly Agree.

The item pool was read by three people for clarity and face validity (Dillman et al., 2008). These readers were selected because they were not practitioners, nor experts in the field, and instructed to proof for grammatical correctness, any confusing sentence structure, unfamiliar or undefined words. The purpose of this initial proofing was to help limit construct-irrelevant bias and to insure the linguistic load was appropriate (American Educational Research, 2014).

The edited and revised item pool was then entered into Qualtrics (Qualtrics, 2005) survey software. Guidelines were followed for designing web based surveys as proposed by Dillman et al. (2008). Specific care was given to layout and the order each item was asked.

Methodology for research question 2.2. The final step in phase two was to compare the instrument item pool to existing research. A robust item pool was created.

Phase Three Methodology: Quantitative Evaluation

Phase three involves administration of the item pool in a first pilot to a large representative sample, and then conducting an item analysis to inform construct domains and to refine item selection. There were two research questions in phase three:

3.1 What are the appropriate number of factors in the instrument based on Exploratory Factor Analysis?

3.2 Which questions in the item pool can be eliminated from the instrument pool to create a refined instrument based on the loadings of the exploratory factor analysis (EFA)?

Methodology for research question 3.1. The complete item pool survey was distributed to 300 in-service teachers through a national network of parochial schools, all in a variety of stages of implementing one-to-one initiatives. Respondents to the survey were also recruited from graduate schools, conferences, and the researcher's personal professional network to assure the maximum number of respondents possible. Factor analysis requires a large sample size (Tabachnick & Fidell, 2013). In addition to the complete item pool, the survey also gathered basic non-identifying demographic information, including gender, race, years of experience teaching, and years teaching in a one-to-one environment. The data were imported from Qualtrics into SPSS, where a factorial analysis was conducted. Both a Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity, were calculated and interpreted to ensure minimum standards were met to conduct a factor analysis. The correlation matrix and Eigenvalues for each item were reported using a Principal Axis Extraction and Varimax rotation. A scree graph was completed and interpreted to consider the appropriate number of factors. Correlations were reproduced with extracted factors and compared to original correlation matrix for congruency to indicate if the extracted factors represented the original data. A rotated factor matrix was constructed to demonstrate the load on each of the factors requested. Factors were given appropriate names based on the item content.

Methodology for research question 3.2. The variance of the raw data was again analyzed using Principal Axis Factoring (PAF). The goal of PAF is to reduce a large number of variables down to a smaller number; it is a method of data reduction

(Tabachnick & Fidell, 2013). The first step in this process is to analyze the item correlation matrix. If any of the correlations are above .9 or below .1, items will be noted and the potential effectiveness of PAF evaluated. The PAF process was conducted using SPSS and a table was generated that included the total variance explained, eigenvalues, and extraction sums of squared loadings. Factors with eigenvalues greater than 1 were retained. A scree graph was completed and interpreted to consider the appropriate number of factors. Correlations were reproduced with extracted factors and compared to original correlation matrix for congruency to indicate if the extracted factors represent the original data. A rotated factor matrix was constructed to demonstrate the load on each of the factors extracted. Items that did not load into a factor were reconsidered for appropriateness and possible elimination. Several models and factor group sizes were explored and compared for consistency. The instrument was refined and reorganized, eliminating redundant or irrelevant items and regrouped into appropriate factors.

Phase Four Methodology: Validation

The purpose of phase four is to study the validity and reliability of the refined instrument. There are four research questions associated with phase four.

4.1. Does the refined instrument have face validity as demonstrated by the judgment of subjects?

4.2. Does the refined instrument have internal reliability as demonstrated by acceptable values for Cronbach's alpha?

Methodology for research question 4.1. Face validity simply asks the question if the items make sense or apparent relevance to the respondents (Kane, 2006). To insure face validity the refined instrument was given to a graduate level class of pre-service teachers for review. Items that were confusing or seemed out of place to the respondents were noted and edited or reconsidered.

Methodology for research question 4.2. The data from the informational pilot were analyzed using the Reliability Statistics package in SPSS. The Cronbach's alpha was reported and interpreted. Likewise an Item-Total Statistics Table was constructed with the Cronbach's alpha statistics if an item was deleted. Items whose removal increased the Cronbach's alpha score, or whose corrected item correlation was low, were considered for removal from the instrument.

Summary of the Chapter

The methodology of this study reflects Benson and Clark's (1982) four phase process for developing an instrument. The first phase, planning, consisted of reviewing existing literature and interviewing teachers to verify existing constructs and to define the purpose. The second phase consisted of creating an item pool by adapting items from existing instruments to fit the construct intended for measurement and through a process of content analysis. The third phase refined the item pool by using exploratory factor analysis. The fourth phase checked the reliability of the refined instrument by calculating Cronbach alpha coefficients. The results of this process and the refined MTCCS follow in Chapter 4.

Chapter Four: Results

This chapter details the results and findings in the development of the MTCCS instrument. This chapter details the results of each of the four-phase instrument development process (Benson & Clark, 1982).

Phase One Results: Planning

The purpose of this phase was to fully develop the research questions, goals, and objectives targeted by the instrument. The research question in this phase was:

1.1 What are the goals, objectives and potential purposes of the instrument?

Results for research question 1.1. The research was two pronged. The first prong was a review of existing research and evaluation of similar or related survey instruments. The review for this study, detailed previously in Chapter Two, included a review of research on classroom climate and mobile technology in the classroom. Then the items on eight instruments developed to measure either classroom climate and two instruments for technology use in the classroom were reviewed for commonality. To find these instruments a key word search was done in the PyschTests database; the key words used were “class* climate” or “class* environment.” The search returned 88 potential instruments. Survey instruments in written in the English language with the teacher as the intended audience were retained. From the results 18 of these instruments were considered as appropriate for this study and retained for further analysis. These 18 instruments are listed in Table 2. The questions on these instruments were sorted into the different dimensions of social climate that emerged from the literature review, and then modified with a technology lens for generating items in the pool. For, example an item on the “School Experiences Questionnaire” (Noack, Kracke, Gniewosz, & Dietrich, 2010) reads “Students in our class are encouraged to develop their own views on problems.” was sorted into the personal development dimension and written for the initial pool as “The use of technology in my class encourages students to develop their own views on problems.”

Similarly, a second search was done on the PyschTests database using the keyword search “Technology in the classroom.” This search yielded 19 results. Ten of these instruments were considered, while the remaining nine were eliminated because they had a different intended audience or were focused outside the constructs of study. Items on the retained instruments were again sorted for the appropriateness of the construct and into one of the three dimensions of social climate. For example, item 8 on the Teacher Attitudes towards Classroom Computing Scale (Gibson et al., 2014) states “My students work together more frequently in classes that use computers” and was sorted into the Relationship domain. This question was modified for the initial pool as “My students collaborate more frequently in classes that use mobile technology.” Table 3 lists these instruments.

Many items on the instruments reviewed were not within the construct of classroom climate or could not be modified in a meaningful way to include technology. For example the item “I help students find and navigate available digital media and resources” in the Teachers' Perceived Support Toward Technology Integration Scale (Blackwell, Lauricella, & Wartella, 2014) was more about how the technology was used than the climate of the classroom and not included in further analysis. Many items were similar across several different surveys, these items were grouped together and represented by a single item that best encapsulated the idea. Through this process a compilation and review of the existing instruments was completed.

Table 2

Classroom and School Climate Instruments

Instrument Title	Citation	Items
Perceptions of Students Questionnaire	Ardaiz-Villanueva, Nicuesa-Chacón, Brene-Artazcoz, Lizarraga, and Baquedano (2011)	36
Class Scales	Wandt and Ostreicher (1954)	14*
Cognitive Holding Power Questionnaire (CHPQ)	Stevenson (1990)	30
Classroom Environment Scale (CES)	Moos and Trickett (1974)	90
Classroom Assessment Scoring System (CLASS)	La Paro and Pianta (2003)	9
Early Childhood Ecology Scale--Revised; Reflection Form (ECES-R, ECES)	Flores, Casebeer, and Riojas-Cortez (2011)	30
Teacher Classroom Environment Measure (TCEM)	Feldlaufer, Midgley, and Eccles (1988)	11*
Classroom Ecology Checklist	Reinke and Lewis-Palmer (2005)	20
Engagement Versus Disaffection with Learning: Teacher Report	Skinner, Kindermann and Furrer (2009)	27
Classroom Rating Scale	Maxwell (2007)	37
Teacher Attitudes toward Mobile Phones Survey	O’Bannon and Thomas (2014)	53
Classroom Assessment Practices Questionnaire (CAP-Q)	Gonzales and Fuggan (2012)	56
Teacher Attitudes toward Classroom Computing Scale	Gibson, Stringer, Cotten, Simoni, O’Neal, and Howell-Moroney (2014)	11*
Teachers' Classroom Environment and Voice Problems Questionnaire	Åhlander, Rydell, and Löfqvist (2011)	52
Classroom Practice Inventory (CPI)	Reszka, Hume, Sperry, Boyd, and McBee (2014)	24
Student Personal Perception of Classroom Climate (SPPCC)	Rowe, Kim, Baker, Kamphaus, and Horne (2010)	26
What is Happening in this Class (WIHIC)	Fraser (1998)	56*
Teacher and Classmate Support Scale (TCMS)	Torsheim, Wold, and Samdal (2000)	8*

*These instruments’ response format are scale items, instead of a standard Likert-type response scale.

Table 3

Technology Use Instruments

Instrument Title	Citation	Items
Cyber-Slacking in the Classroom Questionnaire	Taneja, Fiore and Fischer (2015)	41
Teachers' Influence on Learners' Self-Directed Use of Technology Survey	Lai (2015)	28
Teachers' Perceptions of Classroom Technology Use	Hogarty, Lang, and Kromrey (2003)	83
Teachers' Perceived Support Toward Technology Integration Scale	Blackwell, Lauricella, and Wartella (2014)	12
Technology Acceptance Measure for Preservice Teachers (TAMPST)	Teo (2010)	16
P-Map Teacher Survey	Pierce and Stacey (2013)	35
Teacher Beliefs Questionnaire (TBQ)	Nishino (2012)	56
Belief and Experience Questionnaire (BEQ)	Qu, Ling, Heynderickx, and Brinkman (2015)	16

The stated purpose of each of these surveys was also compiled and analyzed. The 18 that emerged from the initial search stated purposes centered on the measurement of teacher perceptions and beliefs of the classroom climate. The ten instruments found in the second search generally had one of three purposes. The first purpose was measuring teacher perceptions of use of technology in classroom. The second purpose among these instruments was measuring the perceived success of implementation of the technology. The third purpose was measuring the perceived support for the implementation of new technologies. None of the instruments reviewed stated a purpose that measured the teacher's perceptions of the effect technology had on classroom climate.

The second prong of phase one was a study of current practitioners to examine the perceptions or behaviors of a person with high to low levels of the characteristics the instrument intends to measure. In the case of the Mobile Technology Classroom Climate Survey (MTCCS), the area of interest is the effect of mobile technology on the social climate of the classroom. Six face-to-face interviews were conducted. The interviews lasted between 30 to 45 minutes each. The following paragraphs detail the results of the interviews. The entire teaching faculty (*N* = 84) from a school in the second year of a mobile technology initiative was stratified in 6 groups. First they were stratified by gender, with 38 females and 46 males. Each of the 2 gender groups were divided into one of three computer proficiency rankings: the lowest group was defined by those people who were identified as weak computer skills and low interest in technology integration, the middle group was defined as weak computer skills but an open or eager interest in technology integration, and the high group had proficient or greater technology skills and a high interest in integration. Each member of faculty was rated by a media specialist, whose job responsibilities included technology integration and support for all faculty. The females were rated as follows: 15 in the low group, 14 in the middle group, and 9 in the high group. The males had 12 in the low group, 21 in the middle group, and 14 in the high group. The names of the faculty were put into one of six columns of a spreadsheet based on their ranking and the computer randomly generated one name from each column.

One teacher from each of the six groups was randomly selected and invited to participate in an interview. It was made clear that participation was completely voluntary. The male faculty member in the low group opted out. Another male faculty member from that group was randomly selected. He and the other initial selections all consented to be interviewed. Of the six teachers interviewed, three were humanities teachers, two were math or science teachers, and one was a Physical Education teacher. Each had a minimum of seven years of teaching experience, with teaching experience at this particular school ranging from 3 to 31 years. All six had been at the school for at least 3 years, and thus present through the lifespan of the mobile technology implementation.

When asked to describe the ideal classroom climate five of the six teachers referred to the ideal classroom climate as safe. Each of these five teachers mentioned the word safe or safety in reference to either physical or emotional safety. Teacher #1 (a high level user) describes his ideal climate as “An environment in which they [the students] feel safe, important and they can share their ideas without being shot down.” Four of these instructors also mentioned student comfort as being an important element. Students felt comfortable to ask questions, share different opinions or ideas and not have to worry about how the teacher or peers would respond. The teacher that did not mention safety in his description of the ideal classroom climate focused on student attention and engagement. This teacher (Teacher #4, a medium level user) stated his ideal classroom climate as one where students are paying attention, focused on the lecture, and are making eye contact.

When asked to characterize the different elements of classroom climate, four of the teachers again used words or phrases similar to that of their ideal climate. These words and phrases were: trust, being comfortable, growth mindset, comfort, humor, respect, being focused, paying attention, not daydreaming, volunteering to participate, creative, thoughtful, challenge ideas, and no distractions. One teacher asked for clarification of what elements of classroom climate were. When examples of relationships, teaching and learning, and safety where given, she replied that most things probably fall into those categories.

Each teacher was asked how the classroom climate had changed since going one-to-one. The first teacher said it was a huge distraction, and lamented it being more difficult to build rapport with students. He also felt the need to re-learn how to teach. He said, “It’s changing how we deliver instruction.” The second teacher, a low level user, echoed the sentiment of the technology being a distraction, stating “I think the biggest difference is that I have to police in a different way.” She expressed annoyance with the additional supervision required. The third teacher, a high level user, did not feel the technology had changed her environment. She discussed some of the different things the device could do, but stated “as far as classroom environment goes, I don’t find that my classroom is different.” In contrast, Teacher #4 felt the iPads were a big change. He stated “It was hard to get eye contact, as they [the students] just want to look at the screen. He also stated that he stopped posting his lecture notes online before class, as he felt it was a disincentive for students to pay attention. He also noted “Lab behavior hasn’t changed.” The fifth teacher, a medium level user, liked that students could research in class very easily. She appreciated the convenience of having the devices instantly accessible, and able to look things up on the fly. She stated that she sets the students a task, and asks that they not get distracted. She tells her class "That will also distract the people around you and it will affect our environment of trust and respect." The sixth teacher, a low level, did not feel like it changed the environment of the Physical Education classes that he taught. He said the only change was the physical care that the devices required. He needed to have a place for students to put the iPad when it was raining outside, so they did not get stepped on or damaged.

When discussing the improvements teachers has seen since implementing the technology, four of the teachers mentioned that it was easier to communicate with individual students through email. In the past, students were not as good about seeing and responding to their emails, but with every student having a device with them this has improved. These three also mentioned an increased ability to have students collaborate in a more meaningful way. Programs, like Google Docs, allow multiple students to share their ideas. Two teachers thought the devices made the students more organized, and liked that they had all their materials and notes in one place. A teacher expressed appreciation for the flexibility having the device on hand provided. She stated that she especially liked how much easier it was for students to look things up during discussion.

The conversations about the challenges centered on three themes; distractions in class, a loss of face-to-face communication, and maintaining a level of trust. Throughout the interviews, each teacher mentioned that he or she felt the device provided students with too many possible ways to be distracted. Teacher #3 felt that a proportion of students have always found ways to be distracted, whether it was their own thoughts, doodling, or doing other homework. However, the rest of those interviewed felt the distraction of the technology was more insipid and constant than in the past.

Teachers felt the use of mobile technology in the classroom was not ideal for building either student-student or teacher-student relationships. Two teachers cited that students seemed to choose to interact with their devices during free time and passing periods over talking to their peers in the class. This was also a concern with teacher-student relations. Teacher #1 stated, “It’s hard to develop rapport and relationships between students and teachers when they are paying attention to Pinterest or something that is going on their iPads.”

The issue of trust came up frequently in the interviews. This issue dovetailed into the discussion of both distractions and teacher-student relationships. Teachers felt compelled to supervise, manage, and discipline student distraction. The word *police* came up in three teachers’ interviews. They also felt this heightened level of supervision had a negative impact on their relationships. Teacher #5 had the following anecdote.

> Last year when I attempted to find out ways if they were messing around on their iPad or not, like hands up. It shows I do not really trust you. One day I tried it and I didn’t like it. The dynamic was that I didn’t trust them. It was like a judging thing. I found out a way I liked a lot better. I would just walk back and stand by Jake because I don’t think he was paying attention. He would immediately push a button. I would make it more funny, slap Jake on the back

> so that he knows that I like him. With me being suspicious I felt it affected the trust in the classroom.

The idea that teachers felt they could trust students to do things like: to pay attention, to come up with their own ideas or to be on task, was less when the mobile devices were present came up in four of the six interviews.

These six interviews addressed the perception that technology is influencing the climate of the classroom. The interviews talked about the shift teachers are realizing in how the technology is impacting the relationships they have with students, how it is changing the communication they have with students, and how it is affecting issues of trust and control in the classroom. The interviews indicated a need for an instrument to better understand the dynamic of technology in the classroom specifically with regards to classroom climate. The purpose of this instrument to be used as a tool for professional development was surfaced through these interviews, and was expressed as valuable.

Phase Two Results: Construction

The purpose of phase two was to construct an item pool and compare the constructed pool against existing research for construct validity. The two research questions in this phase were:

2.1 What are the necessary items to be used in the development of a survey instrument to measure the perceptions of teachers of the effect of one-to-one mobile technology on the climate of the classroom?

2.2 Does the instrument item pool have construct validity as demonstrated by a comparison with the research?

Results for research question 2.1 and 2.2. The first source was questions that arose from a review of the existing instruments surrounding classroom climate and educational mobile technologies in phase one. The initial pool was constructed from modified item statements from the instruments in the review; 51 items were generated in this manner. As each item was initially sorted by construct dimension the representation was quantifiable by the following distribution: 23 were in the relationship category, 18 were in the personal development category which represented primarily questions on teaching and learning, and 10 were in the System Maintenance and System Change category primarily dealing with school policies and teacher support.

The second source for developing the item pool was content analysis. The content analysis was distributed to a subset of the target audience. Seventy-two teachers responded; 19% having 1 to 5 years of teaching experience, 35% between 6 to15 years of experience and the remaining 46% had over 15 years of experience. The majority of respondents were teaching in a one-to-one environment, with 90% reporting that every student had access to a device at their schools. The remaining 10% were distributed as follows: 6% stated most students had access to a device, 3% stated few students had access to a device, and 1% stated that no students had access to a mobile device. Given the teaching experience on the sample and the availability of mobile devices in the schools represented, it can be concluded that the teachers participating have adequate experience to generate a wide breadth of questions around the construct of technology's effect on classroom climate.

From these 72 respondents, 168 questions were generated (see Appendix B). These questions were grouped together, sorted by construct, and modified if necessary, in a similar manner as the items from the instrument review. Items that may have been considered outside the scope of the construct, but were mentioned by two or more respondents, were included in the item pool to mediate against possible underrepresentation. A pilot item pool was completed with a total of 115 items. The items were read by two people, one middle school teacher and one high school teacher both teaching in one-to-one environments, to proof grammar and look at content validity. Three non-practitioners also read the item pool looking for grammar and any uncommon educational-specific language that could be deemed ambiguous or confusing. Many changes in grammar, punctuation, and wording occurred to refine the item pool.

Phase Three Results: Quantitative Evaluation

Phase three involved administration of the item pool in a first pilot to a large representative sample, and then conducting an item analysis to inform construct domains and to refine item selection. There were two research questions in phase three:

3.1 What are the appropriate number of factors in the instrument based on Exploratory Factor Analysis?

3.2 Which questions in the item pool can be eliminated from the instrument pool to create a refined instrument?

Results for research question 3.1 and 3.2. The survey was initially administered during a professional development meeting required for all Pre-Kindergarten through Eighth Grade teachers in a large Catholic archdiocese in the Pacific Northwest. It was subsequently administered during faculty meetings at two high schools in the same archdiocese. In addition, the survey was distributed to other high school teachers via an email listserv. The total estimated population was 635, and the response rate was 62%. The survey was distributed using Qualtrics (2015) online survey software and open to responses for a period of three weeks. The first survey was taken on October 8, 2015 and the last on October 28, 2015.

Three hundred and thirty-seven out of the 398 people that began the survey completed the survey. A total of 41 different schools are represented among the survey responders. There were 36 K-8 schools represented, 4 high schools, and 1 respondent at the district level.

Three hundred and thirty-two people reported their gender, 32% male and 68% female. The respondents reported a teaching experience that ranged from 1 to 40 years of service, with a mean of 12.42 years and a standard deviation of 8.60 years (N = 188). The median years of teaching experience from the sample was 10 years, with quartiles at 5.25 (Q1) and 17.00 (Q3) years. Respondents were also asked to classify their current assignment into one of the following categories: Elementary K-5 Teacher, Middle School Humanities Teacher, Middle School Math and/or Science

Teacher, High School Humanities Teacher, High School Math and/or Science Teacher, High School Language Teacher, Administrator or Other. Table 4 denotes the results.

Table 4

Demographic of Current Teaching Assignment (n=353)

Current Assignment	*n*	%
Elementary K-5 Teacher	114	32%
Middle School Humanities Teacher	32	9%
Middle School Math and/or Science Teacher	34	10%
High School Humanities Teacher	53	15%
High School Math and/or Science Teacher	37	10%
High School Language Teacher	19	5%
Administrator	10	3%
Other	54	15%

Those that selected the *Other* category reported their current assignments to include: Librarians, Health and Physical Education, Music, Band, Art, Elementary World Language Teachers, Technology Specialist and Reading Specialist. The current grade level assignment for 329 respondents were classified as follows: 57 Prekindergarten to Grade 2 Teachers (17%), 66 Grade 3 to Grade 5 Teachers (20%), 68 Middle School Grades 6-8 Teachers (21%), 138 High School Teachers (42%). Respondents were also asked to classify the technology model in their building. They were asked to select the qualifier that best described their classroom. One hundred sixty-two (48%) teachers reported that every student had access to a mobile device and took that device home as well. Eighty-two (24%) teachers reported that every student had access to a mobile device, but they did not take the device home. Fifty-two (16%) teachers reported that most students had access to mobile devices. Twenty-eight (8%) teachers reported that a few students had access to mobile devices. Eleven (3%) teachers reported that none of their students had access to mobile devices.

The item pool consisted of 115 questions; each question was on a six-point scale from strongly disagree to strongly agree. Appendix A denotes the descriptive statistics for all 115 items. The following items in the item pool are notable because of their high or low medians: medians at the endpoints of the scale of 1 or 6. Four questions pertaining to cyber-bullying had medians of 1: Item #11- I have felt cyber-bullied by an administrator, Item #29- I have sent a digital communication that was intended to bully or intimidate a student, Item #31- I have felt cyber-bullied by a student. Item #57- I have felt cyber-bullied by another teacher. Two questions had medians of 6: Item #17- Ensuring students have time away from technology is valuable, Item #100-I use technology to find instructional materials used in my class. These items are also notable for their high kurtosis, also suggesting a small variance in responses. Table 5 shows all of the items whose kurtosis is greater than 3.

Table 5

Survey Items with Kurtosis Greater than 3

Item #	*Statement*	*n*	*MD*	*Kurtosis*
54	The administration in my school is supportive of technological innovation.	344	5	3.04
57	I have felt cyber-bullied by another teacher.	340	1	3.09
100	I use technology to find instructional materials used in my class.	347	6	3.91
96	Students currently have too little technology in their lives.	342	1.5	4.10
11	I have felt cyber-bullied by an administrator.	342	1	4.55
49	I care about how my students are using their mobile device.	345	5	4.77
31	I have felt cyber-bullied by a student.	343	1	4.99
17	Ensuring students have time away from technology is valuable.	343	6	7.43
29	I have sent a digital communication that was intended to bully or intimidate a student.	343	1	27.33

These eight items were eliminated from the item pool before the factor analysis was conducted, as the homogeneity in response could result in undue leverage in the correlational statistics (Tabachnick & Fidell, 2013). Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was calculated on the full data set a value of .88, exceeding the suggested minimum of .60. Further a Bartlett's Test of Sphericity was conducted indicating that correlation matrix significantly differs from the identity matrix (χ^2(5565, *N*=215) = 12875, p <.001). Results from KMO and Bartlett's test suggest a factor analysis is appropriate (Osborne, 2014).

Several extraction methods were explored: Principal Axis Factoring (PAF), Maximum Likelihood (ML), and Principal Component Analysis (PCA). Each of the communalities tables were calculated and compared, and found to be congruent for the ML and PAF extractions, and similar to the PCA extraction. Therefore, it was determined the PAF extraction would be the most appropriate (Osborn, 2014).

An initial PAF was conducted, with a Varimax rotation, 28 factors with an eigenvalue of 1 were extracted. The total percent of variance explained in these 28 factors was 70%. Half of the items, 53, cross-loaded on two or more factors, with 39 cross loading on two factors and 14 cross loading on two or more factors. Given the large number of cross loadings, an oblique rotation was tested to see if that rotation produced a better model. An oblique rotation is preferred when factors are correlated at a .30 level or above (Osborne, 2014). The oblimin process, an oblique rotation, was conducted with SPSS (IBM Corp., 2013) statistical software. The factor analysis extracted 28 factors, similar to the Varimax results. The factor correlation matrix showed no factors correlations were above .30, suggesting the Varimax rotation would be appropriate.

The scree plot from the Varimax rotation showed an inflection point between components 4 and 5, suggesting 5 dimensions are present. These five factors explain 37% of the variance present in the data set. The model was reconsidered four separate times extracting a fixed number of factors: four, five, six and then 7, to see which model would minimize cross loadings and maximize the number of questions that successfully loaded on the factors. Table 6 displays the number of items that failed to load on any factor, loaded on a single factor, loaded on two factors, or loaded on three factor using .3 as the threshold for loadings.

Table 6

Number of Cross Loading Items Per Model

Cross Loadings	4 Factor Model	5 Factor Model	6 Factor Model	7 Factor Model
0	5	4	2	1
1	78	74	65	64
2	22	24	35	34
3	1	3	3	6

Before the appropriate model was selected, a detailed review of the items in each factor was conducted. Beginning with factor 1, items 76, 88, 43, 36 and 63 were among the highest loading items in all four models. These items were the 5 highest loading items in the four and five factor models. Although, item 76 loaded higher than 88 in the four factor model and this order was switched in the five factor model. In the six and seven factor models, there were two additional items that loaded at this level. Item 83 loaded higher than item 36 in the six factor model and items 79 and 83 loaded higher than both items 43 and 63 in the seven factor model. Since both items 79 and 83 cross-loaded to other factors, they were not considered in the initial analysis of factor one. Table 7 shows these 5 items with the highest loading values.

Table 7

Highest Loading Values for Factor 1

Item	Question
76	Students work together more frequently when using their mobile devices.
88	The technology encourages a student-centered classroom environment.
43	Having mobile devices in the classroom encourages me to be creative in my lesson planning.
36	Having a device in class encourages students to be creative.
63	I believe that technology enhances innovation in my classroom

A similar process was used to develop item groupings in each successive factor. The highest loading items for factor two were items 8, 72, 18, 46 94. Item 8 loads the highest in all four models, but the order of the other four permutes between the models. Table 8 shows these five questions.

Table 8

Highest Loading Values for Factor 2

Item	Question
8	Students rely too much on technology to complete academic tasks.
72	Technology makes it difficult for students think deeply.
18	Mobile devices have changed the teacher-student relationships.
46	The physical barrier of the device between the students and the teacher has a negative impact on the classroom climate.
94	Students' eye focus on the screen, instead of looking towards the front, changes my ability to connect with students in class.

In regards to factor one and two, there were no structural differences in models with regards to the highest loading items. However, there were structural differences in the models for the next two factors. The question set in model six and seven for factor 3 had more high loading items in common with fourth identified factor of models four and five. These common questions were items, 61, 90, 25, 80 and 7. These questions had the high loadings in factor three for the six and seven factor models and have high loadings in factor four in the four and five factor model. These questions are listed in Table 9.

Table 9

Highest Loading Values for Factor 3

Item	Question
61	Understanding technology is an essential life skill for students.
90	Students are enthusiastic about using technology in class.
25	Students prefer using pen and paper to write.
80	The use of technology for grading is efficient.
7	The parents of our students are supportive of our technology initiatives.

The next common grouping of high loading items, 55, 58, 47, 37, 111, was extracted as factor three in the four and five factor models. This question group is extracted as factor five in the six-factor model, and it was extracted as factor four in the seven-factor model. Table 10 details these items.

Table 10

Highest Loading Values for Factor 4

Item	Question
55	The administration has clearly articulated the role of technology in our building.
47	The school has established school-wide student use policies for mobile devices.
58	Colleagues provide assistance for the use of mobile device in the class.
37	Professional development has adequately prepared me for using mobile devices in the classroom.
111	Students have ample resources to study using technology.

There were discrepancies in the structure for the fifth grouping of questions. Items numbers 84, 109, 1, 64, 82, and 86 represented the highest loadings for factor five of the five-factor model, and factor six for the six-factor model. These six items were also the only items that loaded on those components. However, in the seven-factor model, only three of these items loaded together, 84, 109, and 86. Table 11 shows those three items.

Table 11

Highest Loading Values for Factor 5

Item	Question
109	Lack of technological skills limits my work.
84	Lack of technological skills makes me feel incompetent as a teacher.
86	Mobile devices have changed the way I plan for my classes.

The six-factor model and seven-factor model had several high loading items in common extracted from the fourth and fifth factors respectively. This question group includes items 27, 52, 40, 59, 103 and 15. Table 12 details these items.

Table 12

Highest Loading Values for Factor 6

Item	Question
52	Students are allowed to use on their mobile device during lecture or direct instruction.
40	Students are allowed to use their mobile device during individual work time.
27	Students are allowed to use on their mobile device during group work time.
59	Students use their mobile devices for student– initiated learning in my classroom.
103	The use of mobile devices provides a way for me to make connections with my students.
15	Students have sufficient space on their desks for the use of their mobile devices.

The final factor of the seven-factor model included items 19, 65, 89, 34 and 30. These items are listed below in Table 13.

Table 13

Highest Loading Values for Factor 7

Item	Question
19	I have felt cyber-bullied by a parent.
65	Internet access is required to be an effective teacher.
89	Digital citizenship is explicitly taught in my classroom.
34	I have used technology to teach students global awareness.
30	Students are less formal in their written communication when using mobile devices.

Table 14 summarizes these high loading question groupings and how they correspond to the factors extracted in is each of the different models

Table 14

Summary of Question Groupings by Model

	Question Groupings						
Factor model	1	2	3	4	5	6	7
4	1	2	4	3	X	X	X
5	1	2	4	3	5	X	X
6	1	2	3	5	6	4	X
7	1	2	3	4	6	5	7

As considerations for the correct number of factors were made, those items that did not load in the various models were examined. Items 42 and 69 did not load in any model. Items 19, 33, and 109 did not load in the four-factor model. While, items 32 and 114 did not load on the five-factor model. Item 42 reads "Being connected is very important to my students." and item 69 reads "I am able to manage the device in my classes." In the original 28-factor model, item 42 loads onto factor 5. This factor also contained items 78, 48, 98, 51 and 1. In each of the other 4 models 78, 48, 98 and 51 all loaded into factor 2, given this commonality there was no evidence that item 42 not loading on these models represented a loss of an independent factor. Further, the respondents may have interpreted the use of the word connected in several different ways. Item 1 loaded into a variety of components for the various models and was often cross-loaded, and was analyzed further.

Item 69 loaded with only one other item, item 66, in the 27th factor of the original 28-factor model. Item 66 cross-loaded with a higher loading factor on Factor 1 at -0.56 than on factor 27 at -0.31. While it is possible for single factor components to be indicators of factors that were underrepresented in the item pool, that did not appear to be the case with Item 69. Item 69 also had some ambiguity in the language, as the word manage maybe interpreted differently by respondents. For example, it could be understood as managing the technical aspects of the device, or it could be interpreted to mean classroom management or discipline. It was therefore determined that Item 69 and Item 42 should be eliminated from the item pool.

After considering the factor groupings that would be present in the different models, and consistent with the suggestion of the scree plot, the four-factor model was deemed the most appropriate for this instrument. The items were then analyzed for reduction; the goal was to have between 35 to 50 items total in the refined instrument.

First, all items that cross-loaded on three factors were eliminated. The items that cross-loaded on two factors were set aside for further analysis. Then the remaining items in each factor were grouped together for analysis. A correlation process was run and a Cronbach's alpha was calculated. The bivariate correlation matrix was constructed, but found no two questions were highly correlated. A table was created that had each item number, the question, the loading number, and Cronbach's alpha if deleted. The questions in the grouping were then eliminated based on lower loadings and higher alpha scores, they were also considered in light of the item's congruency with the construct. This process was iterated several times to refine the factor to a reasonable size question set.

Ten questions were retained in Factor 1. The item retained with the lowest loading was .50 and the factor's Cronbach's alpha was .87. Ten questions were retained on Factor 2. The item retained with the lowest loading was .49 and the factor's Cronbach's alpha was .87. The third factor also had ten items retained. The lowest item loading coefficient was .41 and Cronbach's alpha for this factor was .76.

The fourth factor only had four items that did not cross load. When these items were tested for reliability the Cronbach's alpha was exceedingly low at .02. Therefore, items that cross loaded on Factor 4 and one other factor were reconsidered to increase reliability, increasing the item pool for factor four to 14. The Cronbach's alpha was again calculated for the new grouping and the items refined. This process was repeated until items fit a common construct and the Cronbach's alpha improved. Factor four was refined to five items with a Cronbach's alpha of .74. The lowest item loading for this factor was .31. It is possible that this factor was not significantly different than factor one. Once the refined instrument was selected, a PAF factor matrix will be recalculated to see if factor four is a true factor or an echo of factor 1, as all but one of the five items cross loaded on factor 1.

Factor five had four items load and one item cross-loading to another factor. The Cronbach alpha for this scale was .57 with the single load items and .59 for all five items. This indicator can be maximized to .76, when the subgroup was limited to the two items 84: Lack of technological skills makes me feel incompetent as a teacher and 109: Lack of technological skills limits my work. While these questions provide interesting data, it is debatable if these questions are part of the construct of classroom climate. As the exploration continued, these questions were deemed appropriate for the final instrument.

The initial instrument was tested for stability. Several exploratory factor analysis processes were conducted to test the stability of the structure. It was clear through the process that the factor group 4 is superfluous, as four of those items factor into factor one when the process is reconstructed. The remaining 3 factors remained stable throughout the several different factoring extractions. The 15 items now represented in factor 1 were reconsidered to make sure that each of those items belongs in that factoring, and Cronbach's alpha was recalculated and refined. Factor 1 retained 13 items with the lowest loading being .496 and Cronbach's Alpha at .888. With the fourth factor removed, only four factors remained. The refined pilot instrument follows in Table 21.

Factor naming. Factor 1 contained 13 items. These items could all be grouped into the broad category of Teaching and Learning, however there was a more precise and consistent theme among these items. Each of these items spoke to either innovation and creativity in the classroom, or student learning and autonomy. To encapsulate this sentiment, Factor 1 was named Student-Centered Innovation. Factor 2 spoke to the negative aspects that are often associated technology: over reliance, distraction, and off task behavior. As such, Factor 2 was named Challenges. The third factor contained items that spoke to the logistics of having the devices in the classroom and how to support them. These items included mentions of discipline procedures, clearly articulated technology goals, classroom management, and professional development. Factor 3 was named Policies and Resources. The final factor only had two questions and acknowledges the need for some technical skills. As both questions are stated from the perspective of need, Factor 4 was named Technical Limitations. The complete refined instrument follows in Table 15.

Table 15

Mobile Technology Classroom Climate Survey

Student Centered Innovation

1. Having mobile devices in the classroom encourages me to be creative in my lesson planning (Item 43)
2. I believe that technology enhances innovation in my classroom (Item 63)
3. Having a device in class encourages students to be creative (Item 36)
4. Students work together more frequently when using their mobile devices (Item 76)

5. The technology encourages a student-centered classroom environment (Item 88)
6. Technology enhances student-to-teacher communication (Item 113)
7. Mobile devices can help struggling students learn (Item 26)
8. The use of mobile devices provides a way for me to make connections with my students (Item 103)
9. In the future, technology will likely play a more prevalent role in my classroom (Item 39)
10. I use technology to quickly assess students' understanding (Item 21)
11. Technology enhances student-to-student communication (Item 110)
12. Technology allows students to have more autonomy over their learning (Item 22)
13. I would like to learn ways of further integrating technology into my lessons (Item 60)

Challenges

1. Students rely too much on technology to complete academic tasks (Item 8)
2. The physical barrier of the device between the students and the teacher has a negative impact on the classroom climate (Item 45)
3. Students use technology to cheat by inappropriately sharing work (Item 50)
4. Technology inhibits students' ability to communicate (Item 68)
5. Technology makes it difficult for students to think deeply (Item 72)
6. Technology has limited our students' ability to reflect on their learning in meaningful ways (Item 91)
7. Technology has decreased students' intrinsic motivation to learn (Item 93)
8. Students' eye focus on the screen, instead of looking towards the front, changes my ability to connect with my students (Item 94)

9. Many students are regularly off-task on their mobile device (Item 101)
10. Using technology erodes basic academic skills (Item 106)

Policies and Resources

1. Parents of students should be able to access their child's current grade information at anytime (Item 2)
2. Discipline procedures are in place for students who are off task on their mobile device (Item 5)
3. Students have sufficient space on their desks for the use of their mobile devices (Item 15)
4. Professional development has adequately prepared me for using mobile devices in the classroom (Item 37)
5. The school has established school-wide student use policies for mobile devices (Item 47)
6. The administration has clearly articulated the role of technology in our building (Item 55)
7. Colleagues provide assistance for the use of mobile device in the class (Item 58)
8. Students should be able to access their current grade information at anytime (Item 71)
9. Classroom policies for the use of mobile devices are clearly defined for students (Item 73)
10. Students have ample resources to study using technology (Item 111)

Technical Limitations

1. Lack of technological skills makes me feel incompetent as a teacher (Item 84)
2. Lack of technological skills limits my work (Item 109)

Phase Four Results: Validation

The purpose of phase four is to study the validity and reliability of the refined instrument. There are four research questions associated with phase four.

4.1 Does the refined instrument have face validity as demonstrated by the judgment of subjects?

4.2 Does the refined instrument have internal reliability as demonstrated by acceptable values for Cronbach's alpha?

Results for research question 4.1 and 4.2. An English teacher proofed the refined instrument for clarity and grammar. The data from the item pool pilot were analyzed using the Reliability Statistics package in SPSS. The follow table details each scale constructed from the final factor analysis and the corresponding internal consistency (coefficient alpha) reliability of each scale. Reliability estimates ranged from 0.76-0.88. The overall Cronbach's alpha is acceptable at 0.70.

Table 16

Details of Scales Constructed from the Factor Analysis

Factor Scale	No. of Items	Eigenvalue	Cumulative % variance	Alpha reliability
1. Student Centered Innovation	13	8.45	24.86	0.88
2. Challenges	10	3.07	33.38	0.87
3. Policies and Support	10	2.41	40.07	0.76
4. Technical Skills	2	1.90	45.36	0.76

As demonstrated by Table 16, the instrument has good-to-excellent reliability ratings, indicating it is ready for additional testing in the field.

Summary of the Chapter

In this chapter results from each of the four phases were presented. In the results from the phase one, the planning stage, two purposes for the instrument emerged. As validation is not independent of purpose (Messick, 1989), these two purposes are critical for evaluation of the instrument. The first purpose was to gather data to better understand the effect of technology on classroom climate. The second purpose was to provide building administrators direction for faculty professional development. Phase two yielded 115 questions in an item pool, through a process of former instrument evaluation and content analysis. The item pool was tested on a sample of 398 K-12 educators. A refined instrument was developed in phase four, and 35 items were retained in four domains. The Cronbach's alpha coefficients were calculated in phase four, with an acceptable overall alpha coefficient of .70, and domain scale alphas ranging from .76-.88.

Chapter Five: Conclusions

The purpose of this study was to create and validate an instrument designed to measure teachers' perceptions of the effect of one-to-one mobile technology on the climate of the classroom. The instrument was developed in a four-phase process (Benson & Clark, 1982) and found to have four factors. The following chapter discusses the development of this instrument in relationship to the literature.

Discussion of Findings

The instrument was developed in four phases, each phase with individual research questions. The discussion that follows considers each phase.

Phase one discussion: planning. The purpose of this phase was to fully develop the research questions, goals, and objectives targeted by the instrument. The results of this phase confirmed the need to produce an instrument that measured the effect of technology on classroom climate. The review of existing instruments found many established classroom climate surveys (Fraser, 1998; Arter, 1989). There were also several surveys that measured technology use (Gibson et al., 2014; Blackwell, Lauricella & Wartella, 2014). The few instruments found that did measure both technology and climate were hybrids of existing classroom climate surveys and technology use surveys (Fraser & Aldridge, 2003; Mucherah, 2002). These hybrids instruments took some questions from each, but did not create new questions that spoke specifically to the influence of technology on the classroom climate. This review established a need for a new integrated instrument, which considered the domains of climate through the lens of technology.

Through the teacher interviews the purposes of the instrument emerged. The teachers indicated a need to better understand how technology was influencing the classroom climate. The results of the completed instrument would be used to direct professional development efforts. If, for example, schools found high average scores on the *Challenges* scale, perhaps that would be an indicator that more professional development was needed in how to limit class time distractions.

Phase two discussion: Construction. The purpose of phase two was to construct an item pool and compare the constructed pool against existing research for construct validity. The item pool consisted of 115 questions. The strength of the item pool was that every question was focused on both climate issues and technology. Further, there was a wide breadth of questions. The pool was generated both from rewording existing survey items and from in-service educators. One limitation was that the content analysis was conducted with secondary teachers, and a broader perspective might have strengthened the item pool.

Phase three discussion: Quantitative evaluation. Phase three involved refining the item pool into the resulting instrument. The first step of the process was to discard several items that had very high kurtosis. This means that the respondents answered these questions with such consistency that the items would add little value to the instrument (Tabachnick & Fidell, 2013). Some of these items are not surprising. For example item 29, “I have sent a digital communication that was intended to bully or intimidate a student,” had a mean of 1.18 (Strongly Disagree) and a kurtosis of

27.33. It would be expected that few teachers perceive their digital communication was intended to intimidate.

However, two of these items are particularly interesting. Item number 54 “The administration in my school is supportive of technological innovation” had unexpected consistency in response. Teachers having strong agreement of administrative support of technological innovation with a mean score of 5.11 (Agree – Strongly Agree) suggests a perceived importance and perhaps a top-down implementation of technology in the classroom. Likewise the high mean of 5.27 (Agree – Strongly Agree) and low variance of item 100, “I use technology to find instructional materials used in my class” was also unexpected. This suggests that even if teachers are low implementation users in using technology in the classroom, they are using it to find instructional materials themselves; indicating a move away from long standing reliance on established print items.

The next step of this process was factor analysis. The initial 28 factors from the exploratory factorial analysis were reduced to four, and then high loading representative questions were selected for each domain. Of statistical interest is that when bivariate correlations were calculated, no two items were strongly correlated; this may indicate a good diversity in the item pool (Costello & Osborne, 2005).

Four factors emerged in the final instrument (Table 17). Each of these factors has strong implications for professional development when building leaders consider overall summary statistics. A school building leader that finds lower averages on *Student Centered Innovation* might wonder if more support is needed for teachers to use mobile devices in more creative and innovative ways. Likewise, higher averages on *Challenges* might suggest instruction in new classroom management techniques might be warranted. Low average scores on *Policies and Resources* might suggest a review in the systematic school policies might be in order. Low averages on *Technical Limitations* might suggest a need for more training and time learning the technology.

Table 17

MTCCS Factor Descriptions

Factor Scale	No. of Items	Descriptions
1. Student Centered Innovation	13	The extent to which teachers perceive the technology increases student autonomy, innovation and communication.
2. Challenges	10	The extent to which teachers perceive the technology increases student autonomy, innovation and communication.
3. Policies and Support	10	The extent to which teachers perceives the systems, administration, and professional development support the technology initiatives.
4. Technical Skills	2	The extent to which a teacher perceives technical skills play a role in their technology innovations.

Phase four discussion: Validation. The purpose of phase four is to study the validity and reliability of the refined instrument. The instrument has good-to-excellent reliability ratings, indicating it is ready for additional testing in the field.

Discussion of Findings as they Relates to the Literature

The literature review was organized in three parts: instrument construction, classroom and school climate research, and mobile technology in education. The development of the MTCCS is discussed in each of these areas.

Instrument development and validation. Using the four-phase process described by Benson and Clark (1982) did produce an instrument. The elimination of items 42 and 69 are an example of importance of clarity in item wording (Dillman, Smyth & Christina, 2014). The items that loaded onto the four factors that remained on the instrument fit a logical structure. To continue to test the validity of the MTCCS refined instrument, additional evidence will need to be collected (Brualdi, 1999; Messick, 1989; Moss, 1992). The MTCCS should be deployed in its refined form to a large sample and the structure confirmed by confirmatory factor analysis. This process, followed by focus group or interview sessions of educators to verify the results of the survey are consistent with the perceived needs of the school would validate the proposed purpose of the MTCCS.

Classroom and school climate. Fraser (1989) reviewed six classroom environment instruments by classifying each subscale into Moos' (1980) three social climate dimensions. Each of the subscales were able to be classified into one of Moos' broad dimensions. When reviewing the four factors and items on the MTCCS it is interesting that they do not discretely fit into the three social climate dimensions.

The *Student Centered Innovation* factor would be classified into Moos' personal development dimension, except for four items in the scale that relate directly to communication and collaboration. Communication and collaboration would be more appropriately classified in the relationship dimension. This may indicate a shift in our understanding of the social nature of learning and personal development.

The items of the *Challenges* factor also would be classified in each of the Moos' dimensions. For example, the item "Technology inhibits students' ability to communicate" would be appropriately classified in the relationship dimension. Likewise the item "Technology has decreased students' intrinsic motivation to learn" would be classified in the personal development dimension. Finally, the item "Many students are regularly off-task on their mobile device" would be classified in the systems management and system change dimension.

The majority of the items of the *Polices and Resources* would be classified in the systems management and system change dimension. However, the item regarding professional development would be more appropriately classified in the personal development dimension. Both items of the *Technical Limitations* are classified in the personal development dimension. Interestingly, the items in the Mucherah (2003) study using a hybrid technology and climate questionnaire also factored slightly differently, into six factors, than the nine-factor structure of the original climate instrument. This suggests that technology is influencing the structure of classroom climate.

Cohen, McCabe, Michelli, and Pickeral (2009) state that there are four essential dimensions of school climate: safety, relationships, teaching and learning, and the (external) environment. The four factors of the MTCCS do not fit discretely into these domains either. While each of the items can be individually classified into these domains, the overall factors cannot. This suggests teachers might be thinking of these concepts differently.

Mobile technology in education. While future use of the MTCCS is needed to understand how the instrument will contribute to the literature, the development of the instrument and the refinement of the domains have some interesting connections to the literature. There were a few themes that have emerged from the research of mobile technology in the classroom: increased student engagement (Argueta et al., 2011; Bebell & O'Dwyer, 2010; McLester, 2011; Rosen, 2011), teacher concerns about student distraction (Shieh, 2012) and shallow thinking (Bauerlein, 2011), and the importance of professional development (Cuban, 2009; Overbay, Mollette, & Vasu, 2011). The factors that emerged on the MTCCS mirror these themes from the current literature. The *Student Centered Innovation* mirrors the research that found students are more engaged in one-to-one environments (Argueta et al., 2011; Bebell & O'Dwyer, 2010; McLester, 2011; Rosen, 2011), increased collaboration and better communication (Zheng et al., 2014). The *Challenges* factor is consistent with teacher concerns about student distraction (Shieh, 2012) and concerns shallow thinking (Bauerlein, 2011). And the final two factors, *Policies and Resources* and *Technical Limitations*, confirm the need for well-thought out and planned professional development (Bebell & Kay, 2010).

Limitations of the Study

Although a refined instrument has emerged from this study, there were a few limitations. First, the sample for the factor analysis was drawn from a limited subset of all educators. Respondents were all teachers in parochial schools, the sample tended towards more veteran educators, and the majority of respondents were within two years of a one-to-one initiative. It is possible a more diverse sample, with younger teachers and teachers that experience a diversity of social economic status in the classroom would have responded differently. Additional testing of the refined instrument in more diverse educational settings would be prudent.

The second limitation of the study was the homogenous sample for the phase one and two of the item pool. The interview subjects and content analysis respondents were all secondary teachers. It is possible that the item pool had a more secondary perspective, and potentially could have been less relatable for primary grade teachers. Future study should continue to test the refined instrument at all grade levels to verify the validity of a K-12 instrument.

A third limitation for consideration is the need for more data to further understand how the factors of the instrument relate to the domains of classroom climate as defined by the literature. The instrument intends to measure the teacher's perspective of the effect of mobile technologies on the climate of the classroom. Even as this refined instrument has been developed through a methodical process, more study is needed to confirm that the instrument is measuring the intended construct.

Further factorial analysis would verify that latent factors were not missed in the data reduction process, and construction of the instrument.

Implications for Future Research

There is a wealth of possibilities for future research. As mentioned in the limitations section above, the refined model should be tested further to confirm the stability of the factors and to ensure the generalizability. This study indicates that the MTCCS is a potential tool to direct professional development efforts. However, other purposes might be considered and validated. The literature clearly indicates that classroom climate is associated with several positive student outcomes. Research to explore associations between MTCSS results and students or teacher outcomes would also be insightful.

Future research will include a study of potential relationships between the MTCCS and other classroom climate instruments, in an effort to understand differences inspired by technology rich environments and to establish concurrent validity. It would be of interest to do a pairwise comparison of the MTCCS with an established classroom climate instrument measured from the teacher's perspective. Each teacher would be given the MTCCS and also another established traditional instrument that measures classroom climate. The points of convergence and item-by-item correlations would provide interesting data on further understanding the teacher's perspective of the effect of mobile technology on the classroom climate.

As the instrument is further tested and developed, it would be valuable to study if the demographic of the instructors are correlated to trends in responses. These demographics of interest include: age, years of teaching experience, discipline taught, grade level taught, type of pre-service program, gender or ethnicity. In the same way, it would be equally as valuable to distribute the survey to variety of school demographics to see if trends or responses differed significantly by school setting. The school demographics for comparison would include: rural vs. urban, private school vs. public, low socio-economic status schools vs. high socio-economic schools, and schools in the beginning stages of technology implementations vs. schools with a long standing one-to-one programs. Finally, the development and validation of a companion MTCCS from the student's perspective would provide a way to consider how educators and students could be approaching mobile technologies differently.

In terms of professional development, the MTCCS survey is intended to inform administration on areas where the collective faculty have areas of strength, as well as growth opportunities. The averages would be reported for each item, as well as an overall factor average. The overall factor averages would be considered. For example, an average score above a 4 in factor one, Student Centered Innovation, might suggest a faculty whose strengths include innovation and a willingness to explore relationships in a digital reality. An average score less than 4 might suggest professional development on specific ways to build digital communication and innovation into the classroom could be an area of growth. Further, deploying the MTCCS over the course of several years would be one measurement of how the faculty is growing and changing as they become more experienced in one-to-one learning environments.

Summary of the Chapter

The purpose of this study was to create an instrument that measured the teachers' perspective of the effect of mobile technology on the classroom climate. The four-phase process developed by Benson and Clark (1982) proved effective in the construction of a refined instrument ready for piloting. Through the process of planning, the purpose was well defined, a critical element towards establishing validity (Messick, 1989). The process of item creation created a robust pool for testing. The quantitative evaluations built a 35-item instrument in a four factor structure. A strict adherence to the process and established guidelines limited researcher bias.

The social structure of the classroom is as complex and unique and the members that inhabit it. Having a positive classroom climate has consistently been correlated to positive student outcomes (Thapa et al., 2013). The introduction of mobile technology to the classroom, as an extension of the student, as well as the classroom, has added another layer of complexity to this social structure. Schools and classrooms will be better places as the MTCCS instrument helps us better understand exactly what is going on in an increasingly complex pedagogical world with constant advances in the technologies.

References

Adelman, H. S., & Taylor, L. (2005). Classroom climate. In S. W. Lee, P. A. Lowe, & E. Robinson (Eds.), *Encyclopedia of school psychology* (pp. 89-91). Thousand Oaks, CA: Sage.

Åhlander, V. L., Rydell, R., & Löfqvist, A. (2011). *Teachers' Classroom Environment and Voice Problems Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t31897-000

Aldridge, J. M., & Fraser, B. J. (2003). Effectiveness of a technology-rich and outcomes-focused learning environment. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 41-69). Singapore: World Scientific.

Aldridge, J. M., Fraser, B. J., & Huang, T. I. (1999). Investigating classroom environments in Taiwan and Australia with multiple research methods. *The Journal of Educational Research*, *93,* 48-62. http://dx.doi.org/10.1080/00220679909597628

American Association for Public Opinion Research. (2016). *Best practices for research*. Retrieved from http://www.aapor.org/Standards-Ethics/Best-Practices.aspx

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.

Anderson, C. S. (1982). The search for school climate: A review of the research. *Review of Educational Research, 52*, 368-420. http://dx.doi.org/10.2307/1170423

Anderson, G. J., & Walberg, H. J. (1967, May). Classroom climate and individual learning. *Resources in Education*, 1-16. Retrieved from ERIC database. (ED015153)

Angell, A. V. (1991). Democratic climates in elementary classrooms: A review of theory and research. *Theory & Research in Social Education, 19*, 241-263. http://dx.doi.org/10.1080/00933104.1991.10505640

Ardaiz-Villanueva, O., Nicuesa-Chacón, X., Brene-Artazcoz, O., Lizarraga, M. A., & Baquedano, M. A. (2011). *Perceptions of Students Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t14057-000

Argueta, R., Huff, D. J., Tingen, J., & Corn, J. O. (2011). *Laptop initiatives: Summary of research across six states* (Friday Institute White Paper Series No. 4). Retrieved from The William & Ida Friday Institute for Educational Innovation, North Carolina State University College of Education website: https://www.fi.ncsu.edu/wp-content/uploads/2013/05/laptop-initiatives-summary-of-research-across-seven-states.pdf

Arter, J. A. (1987, April). Assessing school and classroom climate: A consumer's guide. *Resources in Education,* 1-80. Retrieved from ERIC database. (ED295301)

Bailey, E. K., & Cotlar, M. (1994). Teaching via the internet. *Communication Education*, *43*, 184-193. http://dx.doi.org/10.1080/03634529409378975

Barile, J., Donohue, D., Anthony, E., Baker, A., Weaver, S., & Henrich, C. (2012). Teacher-student relationship climate and school outcomes: Implications for educational policy initiatives. *Journal Of Youth and Adolescence*, *41*, 256-267. http://dx.doi.org/10.1007/s10964-011-9652-8

Bauerlein, M. (2011, February). Too dumb for complex texts? *Educational Leadership*, *68*(5), 28-33. Retrieved from http://www.ascd.org/publications/educational-leadership/feb11/vol68/num05/Too-Dumb-for-Complex-Texts%C2%A2.aspx

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire Wireless Learning Initiative. *The Journal of Technology, Learning, and Assessment*, *9*(2), 1-60. Retrieved from http://ejournals.bc.edu/ojs/index.php/jtla/article/view/1607

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning, and Assessment, 9*(1), 1-16. Retrieved from http://ejournals.bc.edu/ojs/index.php/jtla/article/view/1606

Bennett, S., Maton, K., & Kervin, L. (2008). The "digital natives" debate: A critical review of the evidence. *British Journal of Educational Technology*, *39*, 775-786. http://dx.doi.org/10.1111/j.1467-8535.2007.00793.x

Benninga, J. S., Guskey, T. R., & Thornburg, K. R. (1981). The relationship between teacher attitudes and student perceptions of classroom climate. *The Elementary School Journal*, *82*, 66–75. http://dx.doi.org/10.1086/461242

Benson, J., & Clark, F. (1982). A guide for instrument development and validation. *The American Journal of Occupational Therapy, 36*, 789-800. http://dx.doi.org/10.5014/ajot.36.12.789

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2014). *Teachers' Perceived Support Toward Technology Integration Scale* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t35314-000

Borsboom, D. (2015). Zen and the art of validity theory. *Assessment in Education: Principles, Policy & Practice*, 1-7. http://dx.doi.org/10.1080/0969594X.2015.1073479

Brackett, M., Reyes, M., Rivers, S., Elbertson, N., & Salovey, P. (2011). Classroom emotional climate, teacher affiliation, and student conduct. *The Journal of Classroom Interaction, 46*, 27-36. Retrieved from http://ei.yale.edu/publication/classroom-emotional-climate-teacher-affiliation-and-student-conduct/

Bradshaw, C. P., Waasdorp, T. E., Debnam, K. J., & Johnson, S. L. (2014). Measuring school climate in high schools: A focus on safety, engagement, and the environment. *Journal of School Health, 84,* 593-604. http://dx.doi.org/10.1111/josh.12186

Brualdi, A. (1999, December). Traditional and modern concepts of validity. *ERIC/AE Digest*, 1-6. Retrieved from ERIC database. (ED435714)

Buckingham, D. (2007). *Beyond technology: Children's learning in the age of digital culture*. Cambridge, England: Polity.

Chingos, M. M. (2012). *Strength in numbers: State spending on K-12 assessment systems.* Retrieved from The Brookings Institution website: http://www.brookings.edu/~/media/research/files/reports/2012/11/29-cost-of-assessment-chingos/11_assessment_chingos_final_new.pdf

Cohen, J., McCabe, L., Michelli, N., & Pickeral, T. (2009). School climate: Research, policy, practice, and teacher education. *Teachers College Record, 111*, 180-213. Retrieved from http://www.tcrecord.org/Content.asp?ContentId=15220

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London, England: RoutledgeFalmer.

Costello, A. B. & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*, 1-9. Retrieved from http://pareonline.net/getvn.asp?v=10&n=7

Crocker, L. M., & Algina, J. (1986). *Introduction to classical and modern test theory*. New York, NY: Holt, Rinehart, and Winston.

Crompton, H., & Keane, J. (2012). Implementation of a one-to-one iPod Touch program in a middle school. *Journal of Interactive Online Learning, 11*, 1-18. Retrieved from http://www.ncolr.org/jiol/issues/pdf/11.1.1.pdf

Cronbach, L. J., & Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin, 52*, 281-302. http://dx.doi.org/10.1037/h0040957

Cuban, L. (2009). *Oversold and underused: Computers in the classroom*. Boston, MA: Harvard University Press.

Dahlstrom, E., Walker, J., & Dziuban, C. (2014). *ECAR study of undergraduate students and information technology*. Retrieved from the Educause website: https://library.educause.edu/~/media/files/library/2014/10/ers1406.pdf

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). Hoboken, NJ: John Wiley & Sons.

Dorman, J. P. (2009). Associations between psychosocial environment and outcomes in technology-rich classrooms in Australian secondary schools. *Research in Education*, *82*, 69-84. http://dx.doi.org/10.7227/RIE.82.6

Draugalis, J., Coons, S., & Plaza, C. (2008). Best practices for survey research reports: A synopsis for authors and reviewers. *American Journal of Pharmaceutical Education, 72*(1), 1-6. Retrieved from http://www.ajpe.org/doi/pdf/10.5688/aj720111

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research.

Psychological Methods, *4*, 272-299. http://dx.doi.org/10.1037/1082-989X.4.3.272

Feldlaufer, H., Midgley, C., & Eccles, J. S. (1988). *Teacher Classroom Environment Measure* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t19137-000

Ferriter, W. (2011, February). Digitally speaking: Good teaching trumps good tools. *Educational Leadership, 68*(5), 84-85. Retrieved from http://www.ascd.org/publications/educational-leadership/feb11/vol68/num05/Good-Teaching-Trumps-Good-Tools.aspx

Fisher, C. (1996). Learning to compute and computing to learn. In C. Fisher, D. C. Dwyer, & K. Yocam (Eds.). *Education and technology: Reflections on computing in classrooms* (pp.109-128). San Francisco, CA: Jossey-Bass.

Fisher, C., Dwyer, D. C., & Yocam, K. (1996). *Education and technology: Reflections on computing in classrooms*. San Francisco: Jossey-Bass.

Flores, B. B., Casebeer, C. M., & Riojas-Cortez, M. (2011). *Early Childhood Ecology Scale--Revised; Reflection Form* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t38357-000

Fowler, F. J. (2008). *Survey research methods* (4th ed.). Los Angeles, CA: Sage.

Fraser, B. J. (1989). Twenty years of classroom climate work: Progress and prospect. *Journal of Curriculum Studies, 21*, 307-327. http://dx.doi.org/10.1080/0022027890210402

Fraser, B. J. (1991). Two decades of classroom environment research. In B. J. Fraser & H. J. Walberg (Eds.), *Educational environments*: *Evaluation, antecedents and consequences* (pp. 3-27). Elmsford, NY: Pergamon Press.

Fraser, B. J. (1998). Classroom environment instruments: Development, validity and applications. *Learning Environments Research, 1*, 7-34. http://dx.doi.org/10.1023/A:1009932514731

Fraser, B. J., Fisher, D. L., & McRobbie, C. J. (1996, April). *Development, validation, and use of personal and class forms of the new environment instrument*. Paper presented at the annual meeting of the American Educational Research Association, New York, NY.

Freiberg, H. J. (1999). *School climate: Measuring, improving and sustaining healthy learning environments*. London, England: RoutledgeFalmer.

Gable, R. K., & Wolf, M. B. (1993). *Instrument development in the affective domain: Measuring attitudes and values in corporate and school settings* (2nd ed.). Boston, MA: Kluwer Academic Publishers.

Gibson, P. A., Stringer, K., Cotten, S. R., Simoni, Z., O'Neal, L. J., & Howell-Moroney, M. (2014). *Teacher Attitudes toward Classroom Computing Scale* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t29836-000

Gilbert, G. N. (2001). *Researching social life* (2nd ed.). Thousand Oaks, CA: Sage.

Gonzales, R. C., & Fuggan, C. G. (2012). *Classroom Assessment Practices Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t29887-000

Goodwin, B. (2011, February). Research says: One-to-one laptop programs are no silver bullet. *Educational Leadership, 68*(5), 78-79. Retrieved from http://www.ascd.org/publications/educational_leadership/feb11/vol68/num05/One-to-One_Laptop_Programs_Are_No_Silver_Bullet.aspx

Gottfredson, G. D., Gottfredson, D. C., Payne, A., & Gottfredson, N. C. (2005). School climate predictors of school disorder: Results from national delinquency prevention in school. *Journal of Research in Crime and Delinquency, 42*, 412-444. http://dx.doi.org/10.1177/0022427804271931

Gruenert, S., & Whitaker, T. (2015). *School culture rewired: How to define, assess, and transform it*. Alexandria, VA: Association for Supervision & Curriculum Development.

Hakkarainen, K., Muukonen, H., & Lipponen, L. (2001). Teachers' information and communication technology (ICT) skills and practices of using ICT. *Journal Of Technology & Teacher Education*, *9*, 181-197.

Halpin, A. W., & Croft, D. B. (1963). *The organizational climate of schools*. Chicago, IL: Midwest Administration Center, University of Chicago.

Hamavandy, M., & Kiany, G. R. (2014). A historical overview on the concept of validity in language testing. *Advances in Language and Literary Studies, 5*(4), 86-91. Retrieved from http://www.journals.aiac.org.au/index.php/alls/article/view/435/372

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. *Educational and Psychological Measurement*, *66*, 393-416. http://dx.doi.org/10.1177/0013164405282485

Herold, Benjamin. (2013, September 30). “1:X computing” aims to tailor digital tools to learning tasks. *Education Week*, *33*(6), s2-s7. Retrieved from http://www.edweek.org/ew/articles/2013/10/02/06el-1x.h33.html

Hockly, N. (2012). Digital literacies. *ELT Journal*, *66*, 108-112. http://dx.doi.org/10.1093/elt/ccr077

Hogarty, K. Y., Lang, T. R., & Kromrey, J. D. (2003). *Teachers' Perceptions of Classroom Technology Use* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t06010-000

Ion, F. (2012, April 18). iPads in the classroom are changing the face of education. *MacLife*. Retrieved from http://www.maclife.com/article/features/ipads_classroom_are_changing_face_education

Jamieson, S. (2004). Likert scales: How to (ab)use them. *Medical Education*, *38*, 1217-1218. http://dx.doi.org/10.1111/j.1365-2929.2004.02012.x

Johnson, D. (2013, March). Power up! Technology skills every teacher needs. *Educational Leadership*, *70*(6), 84-85. Retrieved from http://www.ascd.org/publications/educational-leadership/mar13/vol70/num06/Technology-Skills-Every-Teacher-Needs.aspx

Johnson, L., Adams-Becker, S., Estrada, V., & Freeman, A. (2014). *NMC horizon report: 2014 K-12 edition*. Retrieved from The New Media Consortium website: http://www.nmc.org/pdf/2013-horizon-report-k12.pdf

Johnson, W. L. (1990). Factorial structure of the Charles F. Kettering Climate Profile. *Psychological Reports, 67*, 67-74. http://dx.doi.org/10.2466/pr0.1990.67.1.67

Kane, M. (2012). Validating score interpretations and uses. *Language Testing, 29*, 3-17. http://dx.doi.org/10.1177/0265532211417210

Kane, M. T. (2006). Validation. In R. L. Brennan (Ed.), *Educational measurement* (4th ed., pp. 17-64). Westport, CT: Praeger.

Kaplan, D. (2004). *The Sage handbook of quantitative methodology for the social sciences*. Thousand Oaks, CA: Sage.

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care, 15*, 261-266. http://dx.doi.org/10.1093/intqhc/mzg031

Krosnick, J. A., & Fabrigar, L. R. (1997). Designing rating scales for effective measurement in surveys. In L. Lyberg, P. Biemer, M. Collins, E. De Leeuw, C. Dippo, N. Schwarz and D. Trewin (Eds.), *Survey measurement and process quality* (pp. 141-164). Hoboken, NJ: John Wiley & Sons.

Kulas, J. T., & Stachowski, A. A. (2009). Middle category endorsement in odd-numbered Likert response scales: Associated item characteristics, cognitive demands, and preferred meanings. *Journal of Research in Personality, 43*, 489-493. http://dx.doi.org/10.1016/j.jrp.2008.12.005

Lai, C. (2015). *Teachers' Influence on Learners' Self-Directed Use of Technology Survey* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t40262-000

La Paro, K. M., & Pianta, R. C. (2003). *Classroom Assessment Scoring System* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t08945-000

Lee, S., Kim, C. J., & Kim, D. H. (2015). A meta-analysis of the effect of school-based anti-bullying programs. *Journal of Child Health Care, 19*, 136-153. http://dx.doi.org/10.1177/1367493513503581

Lei, J., & Zhao, Y. (2008). One-to-one computing: What does it bring to schools? *Journal of Educational Computing Research, 39*, 97-122. http://dx.doi.org/10.2190/EC.39.2.a

Lenhart, A. (2015). *Teens, social media and technology overview 2015*. Retrieved from the Pew Research Center website: http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology*, 140, 1–55.

Lippitt, R., & Gold, M. (1959). Classroom social structure as a mental health problem. *Journal of Social Issues, 15*(1), 40-49. http://dx.doi.org/10.1111/j.1540-4560.1959.tb01434.x

Lissitz, R. W., & Samuelsen, K. (2007). A suggested change in terminology and emphasis regarding validity and education. *Educational Researcher, 36*, 437-448. http://dx.doi.org/10.3102/0013189x07311286

Lowther, D. L., Inan, F. A., Strahl, J. D., & Ross, S. M. (2012). Do one-to-one initiatives bridge the way to 21st century knowledge and skills? *Journal of Educational Computing Research, 46*, 1-30. http://dx.doi.org/10.2190/EC.46.1.a

Maguth, B. (2012). Investigating student use of technology for engaged citizenship in a global age. *Education Sciences*, *2*, 57-76. http://dx.doi.org/10.3390/educsci2020057

Manuguerra, M., & Petocz, P. (2011). Promoting student engagement by integrating new technology into tertiary education: The role of the iPad. *Asian Social Science, 7*(11), 61-65. Retrieved from https://login.ezproxyeres.up.edu/login?url=http://search.proquest.com/docview/906290204?accountid=14703

Maxwell, L. E. (2007). *Classroom Rating Scale* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t23285-000

McLester, S. (2011, June). Lessons learned from one-to-one. *District Administration, 47*, 34-39. Retrieved from http://www.districtadministration.com/issue/district-administration-june-2011

Messick, S. (1989). Meaning and values in test validation: The science and ethics of assessment. *Educational Researcher, 18*, 5-11. http://dx.doi.org/10.3102/0013189X018002005

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist, 50*, 741-749. http://dx.doi.org/10.1037/0003-066X.50.9.741

Moos, R. H. (1980). *The social climate scales: An overview*. Palo Alto, CA: Consulting Psychologists Press.

Moos, R. H., & Trickett, E. (1974). *Classroom Environment Scale* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t06449-000

Moos, R. H., & Trickett, E. J. (1987). *Classroom environment scale manual*. Palo Alto, CA: Consulting Psychologists Press.

Morrell, P. D., & Carroll, J. B. (2010). *Conducting educational research: A primer for teachers and administrators*. Rotterdam, The Netherlands: Sense Publishers.

Moss, P. A. (1992). Shifting conceptions of validity in educational measurement: Implications for performance assessment. *Review of Educational Research, 62*, 229-258. http://dx.doi.org/10.3102/00346543062003229

Motschnig-Pitrik, R. & Holzinger, A.. (2002). Student-Centered Teaching Meets New Media: Concept and Case Study. *Journal of Educational Technology & Society, 5*(4), 160–172. Retrieved from http://www.jstor.org/stable/jeductechsoci.5.4.160

National Council of Teachers of English. (2008). *The NCTE definition of 21st century literacies*. Retrieved from the NCTE website: http://www.ncte.org/positions/statements/21stcentdefinition

National School Climate Council (2007). *The school climate challenge: Narrowing the gap between school climate research and school climate policy, practice guidelines and teacher education policy*. Retrieved from the National School Climate Center website: http://www.schoolclimate.org

Newton, F. B. (2000). The new student. *About Campus, 5*(5), 8-15.

Newton, P. E. (2014). *Validity in educational and psychological assessment*. Thousand Oaks, CA: Sage.

Nishino, T. (2012). *Teacher Beliefs Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t39968-000

Noack, P., Kracke, B., Gniewosz, B., & Dietrich, J. (2010). *School Experiences Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t11096-000

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education, 15*, 625-632. http://dx.doi.org/10.1007/s10459-010-9222-y

Norris, C. A., & Soloway, E. (2010, May). One-to-one computing has failed our expectations. *District Administration, 46,* 58. Retrieved from http://www.districtadministration.com/issue/district-administration-may-2010

Norton, M. S. (1999). Teacher retention: Reducing costly teacher turnover. *Contemporary Education, 70*(3), 52-55.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York, NY: McGraw-Hill.

O'Bannon, B. W., & Thomas, K. (2014). *Teacher Attitudes Toward Mobile Phones Survey* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t32417-000

Osborne, J.W. (2014). *Best practices in exploratory analysis.* [Kindle Version] Retrieved from Amazon.com

Overbay, A., Mollette, M., & Vasu, E. S. (2011, February). A technology plan that works. *Educational Leadership, 68*(5), 56-59. Retrieved from http://www.ascd.org/publications/educational-leadership/feb11/vol68/num05/A-Technology-Plan-That-Works.aspx

Pearson, K. (1895). Note on regression and inheritance in the case of two parents. *Proceedings of the Royal Society of London, 58*, 240-242. http://dx.doi.org/10.1098/rspl.1895.0041

Penuel, W. R. (2006). Implementation and effects of one-to-one computing initiatives: A research synthesis. *Journal of Research on Technology in Education, 38*, 329-348. http://dx.doi.org/10.1080/15391523.2006.10782463

Perry, A. C. (1908). *The management of a city school*. New York, NY: The Macmillan Company.

Pierce, R., & Stacey, K. (2013). *P-Map Teacher Survey* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t31829-000

Postman, N. (1998). *Five things we need to know about technological change*. Retrieved from http://web.calstatela.edu/faculty/jgarret/102/fivethings.pdf

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon, 9*, 1-6. http://dx.doi.org/10.1108/10748120110424816

Prensky, M. (2013, March). Our brains extended. *Educational Leadership, 70*(6), 22-27. Retrieved from http://www.ascd.org/publications/educational-leadership/mar13/vol70/num06/Our-Brains-Extended.aspx

Qu, C., Ling, Y., Heynderickx, I., & Brinkman, W. (2015). *Belief and Experience Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t44474-000

Qualtrics. (2005). Qualtrics [Computer software]. Provo, UT: Qualtrics.

Reinke, W. M., & Lewis-Palmer, T. (2005). *Classroom Ecology Checklist* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t18771-000

Reszka, S. S., Hume, K. A., Sperry, L., Boyd, B. A., & McBee, M. T. (2014). *Classroom Practice Inventory* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t32453-000

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of Educational Psychology, 104*, 700-712. http://dx.doi.org/10.1037/a0027268

Richardson, J. W., Scott, M., Flora, K., Sauers, N. J., Kannan, S., & Sincar, M. (2013). Large-scale 1:1 computing initiatives: An open access database. *International Journal of Education and Development using Information and Communication Technology*, *9*(1), 4-18. Retrieved from http://ijedict.dec.uwi.edu/viewarticle.php?id=1584

Richardson, W. (2013, March). Students first, not stuff. *Educational Leadership, 70*(6), 10-14. Retrieved from http://www.ascd.org/publications/educational-leadership/mar13/vol70/num06/Students-First,-Not-Stuff.aspx

Rosen, L. D. (2011, February). Teaching the iGeneration. *Educational Leadership, 68*(5), 10-15. Retrieved from http://www.ascd.org/publications/educational-leadership/feb11/vol68/num05/Teaching-the-iGeneration.aspx

Rowbotham, M. (2010). Teacher perspectives and the psychosocial climate of the classroom in a traditional BSN program. *International Journal Of Nursing Education Scholarship*, *7*, 1-14. http://dx.doi.org/10.2202/1548-923X.1808

Rowe, E. W., Kim, S., Baker, J. A., Kamphaus, R. W., & Horne, A. M. (2010). *Student Personal Perception of Classroom Climate* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t05481-000

Ruday, S. (2011). Expanding the possibilities of discussion: A strategic approach to using online discussion boards in the middle and high school English classroom. *Contemporary Issues in Technology and Teacher Education, 11*, 350-361. Retrieved from http://www.citejournal.org/vol11/iss4/languagearts/article2.cfm

Russell, M., Bebell, D., & Higgins, J. (2004). Laptop learning: A comparison of teaching and learning in upper elementary equipped with shared carts of laptops and permanent 1:1 laptops. *Journal of Educational Computing Research, 30*, 313-330. http://dx.doi.org/10.2190/6E7K-F57M-6UY6-QAJJ

Salsburg, D. (2001). *The lady tasting tea: How statistics revolutionized science in the twentieth century*. New York, NY: W. H. Freeman.

Schaps, E. (2005). *The role of supportive school environments in promoting academic success*. Retrieved from The Center for the Collaborative Classroom website: https://www.collaborativeclassroom.org/research-articles-and-papers-the-role-of-supportive-school-environments-in-promoting-academic-success

Scherer, M. (2011, February). Transforming education with technology. *Educational Leadership, 68*(5), 16-21. Retrieved from http://www.ascd.org/publications/educational-leadership/feb11/vol68/num05/Transforming-Education-with-Technology.aspx

Schmeiser, C. B., & Welch, C. J. (2006). Test development. In R. L. Brennan (Ed.), *Educational measurement* (4th ed., pp. 307-353). Westport, CT: Praeger.

Schofield, J. W. (1995). *Computers and classroom culture*. Cambridge, England: Cambridge University Press.

Shieh, R. S. (2012). The impact of Technology-Enabled Active Learning (TEAL) implementation on student performance and teachers' teaching in a high school context. *Computers and Education, 59*, 206-214. http://dx.doi.org/10.1016/j.compedu.2012.01.016

Sireci, S. G. (2015). On the validity of useless tests. *Assessment in Education: Principles, Policy & Practice*, 1-10. http://dx.doi.org/10.1080/0969594X.2015.1072084

Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). *Engagement Versus Disaffection with Learning: Teacher Report* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t05757-000

Smith, A., Rainie, L., McGeeney, K., Keeter, S., & Duggan, M. (2015). *The smartphone difference*. Retrieved from the Pew Research Center website: http://www.pewinternet.org/files/2015/03/PI_Smartphones_0401151.pdf

Spearman, C. (1904). The proof and measurement of association between two things. *The American Journal of Psychology*, *15*, 72-101. http://dx.doi.org/10.2307/1412159

Spires, H. A., Oliver, K., & Corn, J. (2012). The new learning ecology of one-to-one computing environments: Preparing teachers for shifting dynamics and relationships. *Journal of Digital Learning in Teacher Education*, *28*, 63-72. http://dx.doi.org/10.1080/21532974.2011.10784682

SPSS Statistics for Macintosh (Version 22.0) [Computer software]. Armonk, NY: IBM Corporation.

Stevenson, J. C. (1990). *Cognitive Holding Power Questionnaire* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t17624-000

Svensson, P. (2013, June 20). LAUSD students to get iPad, expenditure will cost school district $30 million. *Huffington Post*. Retrieved from http://www.huffingtonpost.com/2013/06/20/lausd-students-ipad_n_3472714.html

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson Education.

Taneja, A., Fiore, V., & Fischer, B. (2015). Cyber-Slacking in the Classroom Questionnaire [Database record]. Retrieved from PsycTESTS. doi: http://dx.doi.org/10.1037/t40260-000

Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York, NY: McGraw-Hill.

Taubman, P. M. (2009). *Teaching by numbers: Deconstructing the discourse of standards and accountability in education*. New York, NY: Routledge.

Teo, T. (2010). *Technology Acceptance Measure for Preservice Teachers* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t03017-000

Thapa, A., Cohen, J., Guffey, S., & Higgins-D'Alessandro, A. (2013). A review of school climate research. *Review of Educational Research, 83*, 357-385. http://dx.doi.org/10.3102/0034654313483907

Torsheim, T., Wold, B., & Samdal, O. (2000). *Teacher and Classmate Support Scale* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t32293-000

van der Sijde, P. C., & Tomic, W. (1992). The influence of a teacher training program on student perception of classroom climate. *Journal of Education for*

Teaching: International research and pedagogy 18, 287-295. http://dx.doi.org/10.1080/0260747920180306

Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education*, *36*, 253-271. http://dx.doi.org/10.1080/15391523.2004.10782415

Wachs, S., Junger, M., & Sittichai, R. (2015). Traditional, cyber and combined bullying roles: Differences in risky online and offline activities. *Societies, 5*, 109-135. http://dx.doi.org/10.3390/soc5010109

Walberg, H. J. (1969). Predicting class learning: An approach to the class as a social system. *American Educational Research Journal*, *6*, 529-542. http://dx.doi.org/10.3102/00028312006004529

Walser, N. (2011). *Spotlight on technology in education*. Cambridge, MA: Harvard Education Press.

Wandt, E., & Ostreicher, L. M. (1954). *Class Scales* [Database record]. Retrieved from PsycTESTS. http://dx.doi.org/10.1037/t14023-000

Watulak, S. L. (2012). I am not a computer person: Negotiating participation in academic discourses. *British Journal of Educational Technology, 43*, 109-118. http://dx.doi.org/10.1111/j.1467-8535.2010.01162.x

White, C. S., & Hubbard, G. (1988). *Computers and education*. New York, NY: Macmillan.

Williams, B., Brown, T., & Onsman, A. (2012). Exploratory factor analysis: A five-step guide for novices. *Australasian Journal of Paramedicine, 8*(3), 1-13. Retrieved from http://ro.ecu.edu.au/jephc/vol8/iss3/1/

Zedan, R. (2010). New dimensions in the classroom climate. *Learning Environments Research, 13*, 75-88. http://dx.doi.org/10.1007/s10984-009-9068-5

Zheng, B., Arada, K., Niiya, M., & Warschauer, M. (2014). One-to-one laptops in K-12 classrooms: Voices of students. *Pedagogies: An International Journal, 9*, 279-299. http://dx.doi.org/ 10.1080/1554480X.2014.955499

Zucker, A. A. (2008). *Transforming schools with technology: How smart use of digital tools helps achieve six key education goals*. Cambridge, MA: Harvard Education Press.

Zullig, K. J., Huebner, E. S., & Patton, J. M. (2011). Relationships among school climate domains and school satisfaction. *Psychology in the Schools, 48*, 133-145. http://dx.doi.org/10.1002/pits.20532

Appendix A

Item Pool Descriptive Statistics

APPENDIX A

Item Pool Descriptive Statistics

		N	*Median*	*Mean*	*Std. Deviation*	*Kurtosis*
1	Students prefer reading on their mobile devices.	339	3	3.38	1.125	-0.639
2	Parents of students should be able to access their child's current grade information at anytime.	348	5	4.48	1.37	-0.277
3	Technology is negatively impacting students' sleep cycles.	344	5	4.74	0.985	-0.041
4	Technology has permitted me to significantly reduced the amount of paper I use in my classroom.	346	4	4.02	1.364	-0.53
5	Discipline procedures are in place for students who are off task on their mobile device.	341	5	4.4	1.153	0.623
6	Students generally know how to use their mobile devices.	349	5	4.76	0.871	1.361
7	The parents of our students are supportive of our technology initiatives.	340	5	4.7	0.811	0.817
8	Students rely too much on technology to complete academic tasks.	344	4	3.94	1.179	-0.535
9	Overall, using mobile devices in class have been more of a distraction than a benefit.	347	3	3.31	1.305	-0.738
10	Technology enhances students' ability to problem solve.	342	4	3.63	1.117	-0.316
11	I have felt cyber-bullied by an administrator.	342	1	1.61	1.096	4.554

12	Technology has increased students' intrinsic motivation to learn.	340	4	3.53	1.148	-0.4
13	Mobile technology has aided in decreasing reading comprehension.	338	3	3.49	1.219	-0.318
14	Using mobile devices in class have made students more interested in science related fields.	315	4	3.81	1.121	0.136
15	Students have sufficient space on their desks for the use of their mobile devices.	341	5	4.18	1.363	-0.347
16	Mobile devices enhance student learning.	342	4	4.3	1.037	0.58
17	Ensuring students have time away from technology is valuable.	343	6	5.57	0.746	7.431
18	Mobile devices have changed the teacher-student relationships.	340	4	4.19	1.168	0.009
19	I have felt cyber-bullied by a parent.	339	2	2.65	1.642	-0.978
20	In my classroom, technology is used to create meaningful academic work rather than just student c...	345	5	4.37	1.084	0.597
21	I use technology to quickly assess students' understanding.	344	4	3.67	1.342	-0.781
22	Technology allows students to have more autonomy over their learning.	340	4	4.12	0.949	0.905
23	I plan time in my classroom for student initiated learning.	334	4	4.29	1.015	0.67
24	Overall, using mobile devices in class have been more of a negative than a positive for students.	344	3	2.96	1.312	-0.477
25	Students prefer using pen and paper to write.	344	3	3.38	1.115	-0.388
26	Mobile devices can help struggling students learn.	343	5	4.52	0.952	0.874

27	Students are allowed to use on their mobile device during group work time.	338	4	3.94	1.39	-0.417
28	Instant access to the Internet opens up new possibilities for student learning.	343	5	4.85	0.897	1.74
29	I have sent a digital communication that was intended to bully or intimidate a student.	343	1	1.18	0.658	27.332
30	Students are less formal in their written communication when using mobile devices.	347	5	4.79	1.144	0.693
31	I have felt cyber-bullied by a student.	343	1	1.57	1	4.994
32	Technical issues regularly interrupt instructional time.	346	4	4.05	1.2	-0.221
33	Students know how to find reliable sources on the Internet.	344	4	3.56	1.126	-0.353
34	I have used technology to teach students global awareness.	342	4	4.2	1.304	-0.191
35	School-provided mobile devices are having an impact on students home lives.	333	4	4.06	1.335	-0.398
36	Having a device in class encourages students to be creative.	339	4	3.82	1.144	-0.101
37	Professional development has adequately prepared me for using mobile devices in the classroom.	344	4	3.63	1.287	-0.601
38	I believe cyber-bullying is an issue among the students in my classroom.	337	4	3.48	1.466	-1.039
39	In the future, technology will likely play a more prevalent role in my classroom.	346	5	4.68	1.035	2.503

40	Students are allowed to use their mobile device during individual work time.	341	4	3.98	1.52	-0.667
41	Mobile devices have had a positive impact on students' interpersonal skills.	348	3	2.83	1.206	-0.131
42	Being connected is very important to my students.	344	5	4.83	0.906	1.189
43	Having mobile devices in the classroom encourages me to be creative in my lesson planning.	338	4	4.26	1.224	0.255
44	Students are more organized when using technology.	338	4	3.6	1.035	-0.09
45	I view the use of mobile devices as a way for students to make connections with other students.	344	4	3.58	1.145	-0.32
46	The physical barrier of the device between the students and the teacher has a negative impact on the classroom climate	340	4	3.59	1.215	-0.529
47	The school has established school-wide student use policies for mobile devices.	347	5	4.85	1.192	1.436
48	Students spend the majority of their free time interacting with technology.	347	5	4.57	1.098	0.8
49	I care about how my students are using their mobile device.	345	5	5.4	0.676	4.773
50	Students use technology to cheat by inappropriately sharing work.	341	4	3.82	1.23	-0.559
51	Technology discourages social interactions.	337	4	4.21	1.191	-0.083
52	Students are allowed to use on their mobile device during lecture or direct instruction.	343	2	2.9	1.598	-1.192

53	I use technology to select the content, topics and skills to be taught in my class.	342	4	3.95	1.349	-0.689
54	The administration in my school is supportive of technological innovation.	344	5	5.11	0.908	3.038
55	The administration has clearly articulated the role of technology in our building.	346	4	4.15	1.178	-0.032
56	My students are responsible enough to appropriately use the technology we have provided them.	341	4	3.62	1.186	-0.751
57	I have felt cyber-bullied by another teacher.	340	1	1.59	0.981	3.089
58	Colleagues provide assistance for the use of mobile device in the class.	340	5	4.51	1.054	1.406
59	Students use their mobile devices for student– initiated learning in my classroom.	345	4	3.75	1.288	-0.43
60	I would like to learn ways of further integrating technology into my lessons.	342	5	4.81	1.135	1.805
61	Understanding technology is an essential life skill for students.	346	5	5.31	0.749	0.839
62	The administration in my school allows technology to drive our curriculum.	341	4	3.9	1.273	-0.524
63	I believe that technology enhances innovation in my classroom	348	4	4.3	1.064	0.695
64	Mobile devices encourage a reliance of educators on pre-packaged curriculum .	341	3	3.16	1.184	-0.735
65	Internet access is required to be an effective teacher.	347	5	4.35	1.55	-0.336
66	When using mobile devices in class, students appear engaged.	339	5	4.36	1.136	0.631

67	Monitoring off-task behavior of students on their mobile devices is difficult.	338	5	4.54	1.225	0.028
68	Technology inhibits students' ability to communicate.	348	4	3.82	1.171	-0.146
69	I am able to manage the device in my classes.	345	5	4.48	1.123	1.128
70	Technology helps equalize the equity gap between students of different socio-economic classes.	340	4	3.59	1.234	-0.44
71	Students should be able to access their current grade information at anytime.	347	5	4.46	1.317	-0.094
72	Technology makes it difficult for students think deeply.	342	4	3.62	1.159	-0.602
73	Classroom policies for the use of mobile devices are clearly defined for students.	343	5	4.65	1.109	0.995
74	I enjoy teaching in a classroom with mobile devices.	342	4	4.17	1.262	-0.143
75	Students are more likely to turn in digital assignments on time.	340	4	3.57	1.146	-0.463
76	Students work together more frequently when using their mobile devices.	337	4	3.53	1.19	-0.449
77	Students Google answers before trying to think of answers.	343	4	4.26	1.289	-0.225
78	Mobile devices have changed how students relate to one another.	340	5	4.91	0.967	1.149
79	Technology helps students develop their own ideas about problem solving.	340	4	3.6	1.044	0.057
80	The use of technology for grading is efficient.	346	5	4.62	1.184	0.359

81	Students in my classroom report eye strain.	338	2	2.74	1.358	-0.445
82	Using mobile devices in class have made students more interested in computer and technology relat...	337	4	4.04	1.091	0.607
83	Using mobile devices in class have made students more engaged as learners.	340	4	3.77	1.215	-0.241
84	Lack of technological skills makes me feel incompetent as a teacher.	347	3	2.86	1.445	-0.986
85	I know of at least one student who has taught himself/herself a skill using YouTube.	338	5	4.56	1.329	0.454
86	Mobile devices have changed the way I plan for my classes.	344	4	4.32	1.187	0.272
87	Technology allows autonomy in selecting textbooks used in my classroom.	342	3	3.16	1.308	-0.815
88	The technology encourages a student-centered classroom environment.	342	4	3.7	1.114	-0.123
89	Digital citizenship is explicitly taught in my classroom.	338	4	3.79	1.341	-0.654
90	Students are enthusiastic about using technology in class.	341	5	4.93	0.938	1.362
91	Technology has limited our students' ability to reflect on their learning in meaningful ways.	348	4	3.53	1.17	-0.49
92	Students do not listen as intently to lectures when they know they have the presentations electro...	338	4	4.25	1.176	-0.542
93	Technology has decreased students' intrinsic motivation to learn.	339	4	3.46	1.214	-0.675

94	Students' eye focus on the screen, instead of looking towards the front, changes my ability to co...	341	4	4.43	1.188	-0.099
95	I find my students pay better attention in the classes where the use of mobile devices are allowe...	338	3	2.93	1.29	-0.646
96	Students currently have too little technology in their lives.	342	1.5	1.7	0.905	4.101
97	I trust my students to be on-task when they are working on a mobile device.	343	4	3.61	1.256	-0.667
98	Students prefer digital communication over face-to-face conversations.	346	4	4.16	1.203	-0.134
99	I use technology to differentiate instruction for students with special needs.	340	4	4.11	1.258	-0.24
100	I use technology to find instructional materials used in my class.	347	6	5.27	0.942	3.906
101	Many students are regularly off-task on their mobile device.	348	4	3.85	1.271	-0.65
102	Technology changes the types of projects I assign.	340	4	4.21	1.214	0.054
103	The use of mobile devices provides a way for me to make connections with my students.	341	4	3.77	1.22	-0.347
104	Technology encourages students to manage long-term projects.	343	4	3.81	1.131	-0.367
105	Being able to self-regulate use of technology is a skill that should be included in the school cu...	346	5	5.02	0.929	1.874
106	Using technology erodes basic academic skills.	342	3	3.33	1.163	-0.312

107	Students currently have too much technology in their lives.	347	5	4.67	1.124	0.08
108	Students collaborate more frequently outside of classes when they have access to mobile devices.	337	4	4.14	1.126	0.372
109	Lack of technological skills limits my work.	345	3	2.96	1.413	-0.908
110	Technology enhances student-to-student communication.	343	4	3.46	1.272	-0.675
111	Students have ample resources to study using technology.	342	5	4.44	1.025	0.471
112	Mobile technology has aided in increasing reading comprehension.	338	4	3.42	1.138	-0.429
113	Technology enhances student-to-teacher communication.	343	4	3.88	1.186	-0.177
114	Students prefer taking notes on their mobile devices.	340	4	3.67	1.133	-0.462
115	The informal use of digital communication has effected the level of respect between student and t...	342	4	3.59	1.233	-0.722

Appendix B

Content Analysis Results

APPENDIX B

Content Analysis Results

Number	Responses from Content Analysis Survey
1	How can we shift student's mindsets towards using the technology to benefit their academics, not just seeing them as devices for just play?
2	Gift and a curse / Distraction but engagement would be high for some students
3	Is the one model system hack free?
4	Do students really need more technology in their lives?
5	Is time away from technology more valuable?
6	Are we teaching students to rely exclusively on technology?
7	Will students know how to problem solve and find solutions without the use of technology with the current educational climate and position on technology in the classroom?
8	Is the budget for actual books cut?
9	Are students still using pen and paper to read and write?
10	What new possibilities will open up if each student had internet access at their fingertip?
11	How can projects look in the future? Movies, Reports, Online Field Trips?
12	I had the opportunity to teach at a 1 to 1 iPad school and had so much fun exploring new ways of learning where students created authentic projects and were able to answer their own questions with aid from online resources. Also students could keep organized with all of their information on one device, in a few apps, and online accounts.
13	How do encourage more social interaction?
14	How do we stop the rapid erosion of basic academic skills, like spelling, penmanship?
15	How have they impacted students ability to communicate in a classroom setting?
16	Could you be an effective teacher without internet access?
17	How can a teacher monitor off-task behavior on devices for 25 or more students?
18	Students have a tendency to google everything, how can we get them to think for themselves instead of just accessing information?
19	Phones are in the way of learning, kids use them for unproductive uses.
20	Whether/how iPads have changed the ways teachers & students communicate with each other in or out of the classroom?
21	Whether/how iPads have changed the ways students communicate with each other in or out of the classroom?
22	Whether/how iPads have changed the ways students spend their free time in or out of the classroom?
23	Whether/how iPads have changed the teacher-student relationship?

24 Whether/how iPads have changed the way students work together in groups?

25 Whether/how iPads have changed students approach to classroom tasks (like notetaking, textbooks, word processing, etc.)

26 In what ways are teachers asking students to use iPads in the classroom?

27 In what ways are teachers themselves using iPads in the classroom?

28 Whether/how iPads have changed the way teachers approach planning, lesson design, and lesson delivery.

29 Whether/how iPads have changed discipline or behavioral procedures in the classroom?

30 note taking preferences?

31 book reading preference?

32 eBook efficiency?

33 do we listen less well because we have an electronic back up for nearly everything?

34 What kind of teacher PD training is needed to effectively incorporate 1-1 technology into the classroom?

35 How does 1-1 technology impact students' ability to relate to the teacher AND their own peers in the classroom?

36 How do we measure whether or not 1-1 devices enhance student learning?

37 Does the one-to-one model influence students' interpersonal skills?

38 Are students more likely to turn to technology for a solution without trying to resolve a problem on their own?

39 How are mobile devices affecting students' vision?

40 Is reading comprehension increasing?

41 Are students reading with their mobile devices or do they prefer print books?

42 How has mobile devices changed student learning?

43 Impact on student focus

44 Impact on collective group work

45 Cheating on tests quizzes

46 Availability of resources for study

47 Reliability of device

48 Teacher preparation for instruction

49 How has the introduction of increased technology affected student organization and ability to complete and turn in required work?

50 How has technology affected students ability to communicate in person?

51 How has the introduction of technology affected the degree of formality in student writing and communication with teachers?

52 How has the introduction of technology affected students intrinsic motivation to learn?

53 How has the introduction of technology affected students ability to focus for long periods of time?

54 How has the introduction of technology affected students ability to manage long term projects (over the course of several days or weeks)?

How has the introduction of technology affected students ability to use
electronic resources and determine which sources are reliable and which are
55 not?

56 What methods do you use to manage appropriate use of the device?

How has the introduction of technology affected students ability to engage in
57 deep thought and deep knowledge of a subject?

58 What are best practices for note taking?

59 How do you accommodate special needs students with your device?

Have you seen any shift in the focus of students on instruction given in the
60 classroom with the advent of technology?

What issues have you come up against (if any) with students using their
61 devices for note-taking in class?

How has technology and device use in the classroom impacted off-task
62 behavior from your perspective as a teacher?

63 How do mobile devices in the classroom affect peer to peer communication?

How does screen time outside of classroom affect sleep cycles and the ability
64 of students to be present and engaged during the school day?

How can teachers better use mobile devices to transform the classroom into a
65 more student centered environment?

How can teachers better use mobile devices to create curriculum that pushes
66 students to be more self directed?

How can teachers better use mobile devices as tools for creation rather than
67 just consumption?

How can teachers better use mobile devices to foster communication and
collaboration between their own students and students around the country or
68 even around the world?

69 What do we mean when we talk about "digital citizenship"?

How do we take that piece of jargon "digital citizenship" and make it
70 something concrete that we can explore with students.

be aware students will try to tune into lecture and open other apps at the same
71 time.

How does technology help us to dig deeper into issues, and find deeper
72 meaning?

73 Does technology facilitate conversation in the classroom?

What is the effect of technology on the spirit of community in the
74 classroom?

75 What strategies do you use to reduce technological distractions?

76 How do you teach students to be good technology citizens?

What positive and negative effects do you suppose the ubiquitous use of
77 technology in the classroom will bring?

78 When do you ask students to not use the iPad at all?

79 How can distractions be minimized when students have access to iPads?

80 What sorts of activities, tasks, etc. best suited for the iPad?

Do you find it better/worse for notes to be taken on the iPad for particular
81 types of information being presented?

82 What are some good ways to have group projects using the iPad as the main instrument?

83 As teenagers become more familiar/acclimated to conversing through text, does group discussion become more honest and thoughtful through iPad/internet based group discussions?

84 Would having more online discussions and less face to face live classroom discussions hinder the development of social skills that might be needed in the future?

85 Do we need to worry about having extended screen time?

86 Does a teenager's brain/ocular development get hinder by extended screen time?

87 Do students ask the same amount of questions when they are taking notes on an iPad than when on paper?

88 What impact do they have on the home life (e.g, can now watch TV in their bedroom, receive email in private, etc.

89 What potential distractions can they pose in classroom

90 How to train teachers in creative uses.

91 We know that kids are mesmerized by screens but do we know how much screen time they should have before it is harmful?

92 How do you make sure the technology is not driving the instruction and learning, but is only acting as the medium for research or production?

93 Does the use of tablets reduces student interaction time, such as small group work, discussions?

94 How do you keep the student and learning first and the technology second?

95 We know that kids are mesmerized by screens but do we know how much screen time they should have before it is harmful?

96 Does the use of tablets reduces student interaction time, such as small group work, discussions?

97 How do you keep the student and learning first and the technology second?

98 How do you make sure the technology is not driving the instruction and learning, but is only acting as the medium for research or production?

99 In which ways are these devices helpful to classroom leaning?

100 In which ways are these devices harmful to classroom learning?

101 Are you concerned that devices make teaching a less personal profession?

102 Do you feel that you have enough knowledge of technology to use these devices effectively?

103 How often do students access their device during a class?

104 Do students complete homework or reading assignments on their devices?

105 What options do students have for note-taking?

106 Is internet access always available?

107 Do students refrain from interacting because of the devices?

108 How much eye contact is given while screens are in use?

109 Do students respect the code of conduct set for technology use?

110 Do you as a teacher feel like you are "policing" students while they use their device?

111 How has the presence of mobile devices in the classroom affected your efforts to promote collaboration and collegiality in your classroom?

112 I think that too much technology may not be a good thing. My students only have use technology when I ask them to bring their IPADS to class. The subject area that I teach does not use technology on a regular basis.

113 Do students lose the ability to print/ write effectively by hand when all their practice goes into typing?

114 Do students interact with each other--face to face--as much as they did before 1:1 iPads?

115 What is the effect on the sleep habits of the students?

116 What sorts of rules should be in place about appropriate use of the technology?

117 If students are required to have a particular technology, when is "screens down" time appropriate?

118 What interpersonal skills are our students not learning in their daily lives that they now need to be explicitly taught in a classroom?

119 How do we as educators fight the technology-driven impulse toward flashy and shallow answers (as opposed to digging deeper into an issue and sitting with uncertainty)?

120 Technology is useful if used to enhance the study of this subject. Opens classroom to wide world. But it is often abused. Students need to be self disciplined because the teacher can't be looking over every student's shoulder all the time. If a teacher doesn't trust her students are properly using the technology, she will have a tendency to become a policewomen, and this isn't a good model for classroom management.

121 Does it make more work for students. Format etc.

122 How has the class room dynamic changed since iPads were introduced?

123 How well do students concentrate on the lesson/activity at hand?

124 How much are the students distracted by the various options they have on their devices?

125 one to one iPads promote independence... I would like some more ways to use them in teams and/or groups.

126 What are some good ways to catch students using said devices improperly and keep them on task?

127 Have you found yourself making claims about technology and its ability to transform a class room and after using it, found that you miss some of what may have been "left behind" as far as interaction, give and take, tracking and following and is that important to know as you plan ahead?

128 Do you feel the device has positively affected your community? Negatively?

129 When it comes to personally connecting with individual students, do you feel that something has been lost/gained with these new devices?

130 How do you feel it affects the classroom atmosphere to have students staring at their screens?

131 Do you find it distracting?

132 Does technology drive your curriculum or does curriculum direct technology use?

133 Is technology use (tablet/laptop) a collaborative experience involving all students and the classroom teacher or is it merely a "new tool" for student use?

134 What do you do when it does not work.

135 Is it used for education

136 Do the students focus on the teacher/screen/board as much as they used to?

137 Is there eye contact with the teacher?

138 How can you as an effective teacher interplay between a highly deflective device such a an interactive screen and a goal of transferring information?

139 How does the way you treat technology in your life influence your methods of connecting with students?

140 How do students generally start the class period when they have a device?

141 In what ways has the device resulted in positive engagement in the course material? Negative?

142 Do you witness any equity problems BECAUSE of the device?

143 How do you reconcile the use of technology with studies that show that creating the most neural networks (ie. handwriting) is the best way to learn?

144 How do you keep students focused on the task/conversation at hand when they are so used to mindlessly looking at technology?

145 Has said technology use empowered students to be "co-teachers" in the classroom?

146 How do quieter or even behaviorally problematic students respond to your technology use?

147 Do you find students more engaged when using technology?

148 How does technology change communication in your classroom?

149 Impact of social media on behavior.

150 Impact on handwriting?

151 The personal impact of grading (being able to see students responses/thinking).

152 Overreliance on technology that is not accessible on test(sat etc).

153 How do you monitor what students are doing on their iPads during class?

154 Compare ibooks to paper books for ease of use, cost, and amount of use by students.

155 What ways does one to one technology enhance student-teacher interaction?

156 Reliance on canned curriclum.

157 Do students relate to each other or the teacher differently when iPads are available in the classroom?

158 Are teachers offered development to increase meaningful use of technology in the classroom, so that the device is more than just a textbook?

159 How is one to one tech a classroom distraction?

160 Is digital citizenship part of the curriculum?

161	How will they be used?
162	Are the students responsible enough to handle a device?
163	Can they be implemented into multiple subjects?
164	Would they be used daily?
165	How will Technology affect face-to-face interactions between students and between students and teachers?
166	What is the best way to see what students are actually doing on the screen is there is limited space to move around?
167	Multitasking studies are not promising in terms of ability to focus on both long-term tasks, and short term tasks. Are we exacerbating a significant problem?
168	Do kids use it to bully others?

Appendix C

Rotated Factor Matrices

APPENDIX C
Rotated Factor Matrices

4 Factor Model

	Factor			
	1	2	3	4
88	0.672			
76	0.671			
43	0.638			
36	0.636			
63	0.621			
83	0.606	-0.403		
79	0.589	-0.361		
45	0.582			
104	0.575			
16	0.574	-0.354		0.334
10	0.559	-0.317		
74	0.549	-0.404		
102	0.549			
26	0.548			0.364
21	0.546			
113	0.537			
59	0.531		0.338	
22	0.528			
112	0.522			
14	0.521			
103	0.52			
20	0.519			
110	0.5			
95	0.497	-0.34		
108	0.491			
99	0.487			
82	0.481			
39	0.471			0.337
28	0.467			
87	0.46			
70	0.457			
44	0.457			
86	0.449			
75	0.447			
41	0.445			
34	0.421			
60	0.413			0.345
85	0.375			
65	0.351			
23	0.35			
53	0.349			
89	0.344			

114	0.311			
33				
8		0.654		
46		0.645		
72		0.639		
94		0.627		
77		0.616		
18		0.609		
50		0.594		
24		0.589		
9	-0.376	0.589		
106		0.576		
3		0.572		
56	0.364	-0.565		
101		0.563		
92		0.521		
78		0.518		
67		0.514		
48		0.508		
93		0.503		
51	-0.358	0.503		
68		0.497		
91		0.496		
107		0.47		
81		0.466		-0.314
13		0.457		
115		0.441		
12	0.414	-0.431		
30		0.407		
98		0.405		
97	0.32	-0.402		
35		0.387		
66	0.35	-0.386		
38		0.363		
62		0.33		
64		0.308		
32				
40			0.562	
55			0.535	
58			0.498	
27	0.404		0.484	
47			0.458	
71			0.449	
37			0.434	

2			0.434	
111			0.433	
4	0.397		0.426	
73			0.421	
5			0.398	
15			0.358	
84			-0.334	
105				
109				
19				
90	0.315			0.548
80				0.424
52			0.409	-0.411
61				0.41
7				0.405
1				0.379
25				-0.364
6				
Extraction Method: Principal Axis Factoring.				
Rotation Method: Varimax with Kaiser Normalization				
Rotation converged in 8 iterations.				

5 Factor Model

	Factor				
	1	2	3	4	5
88	0.67				
76	0.659				
43	0.648				
36	0.628				
63	0.624				
83	0.594	-0.42			
102	0.577				
45	0.573				
79	0.57	-0.384			
104	0.564				
16	0.559	-0.373		0.303	
74	0.556	-0.4		0.329	
21	0.552				

10	0.539	-0.341			
20	0.535				
113	0.53				
26	0.528			0.305	
59	0.527		0.333		
103	0.522				
22	0.514				
14	0.506				
110	0.496				
112	0.496				
99	0.496				
108	0.495				
39	0.487			0.41	
95	0.481	-0.361			
28	0.48				
86	0.475				
82	0.459				0.317
87	0.45				
34	0.437				
75	0.436				
44	0.433		0.354		
70	0.432				
41	0.422				
60	0.406			0.328	
85	0.372				
65	0.363				
89	0.359				
23	0.357				
53	0.352				
114					
6					
8		0.649			
46		0.648			
72		0.648			
94		0.621			
18		0.614			
50		0.605			
77		0.603			

9	-0.383	0.582		-0.303	
56	0.345	-0.579			
24		0.578		-0.324	
106		0.576			
101		0.572			
3		0.571			
92		0.527			
78		0.518			
67		0.518			
93		0.506			
51	-0.352	0.502			
48		0.495			
91		0.494			
68		0.494			
81		0.469		-0.316	
13		0.466			
107		0.462			
12	0.389	-0.461			
115		0.441			
30		0.427			
97	0.301	-0.417			
35		0.397			
66	0.344	-0.396			
98		0.386			
38		0.374			
62		0.333			
55			0.573		
40			0.547		
58			0.524		
47			0.513		
5			0.447		
37			0.444		
2			0.442		
71			0.442		
27	0.408		0.436		
15			0.42		
111			0.417		
73			0.411		

52			0.411	-0.396	
4	0.397		0.397		
33			0.305		
19			-0.304		
90	0.313			0.544	
61				0.459	
80				0.409	
7				0.362	
25				-0.347	
105					
84					0.542
109					0.512
1					0.458
64					0.305
32					
Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.a Rotation converged in 8 iterations.					

Six Factor Model

	Factor					
	1	2	3	4	5	6
88	0.684					
76	0.643					
63	0.642					
43	0.637					
83	0.613	-0.393				
36	0.61					
79	0.597	-0.35				
104	0.577					
16	0.576	-0.363				
99	0.562					
102	0.559					
74	0.556	-0.406	0.346			
26	0.547		0.307			
10	0.539	-0.326				

45	0.539					
21	0.534					
20	0.528					
14	0.522					
95	0.514	-0.333				
112	0.512					
39	0.504		0.384			
108	0.502					
34	0.494					
22	0.494					
103	0.483				0.315	
86	0.482					-0.306
28	0.48					
113	0.479					
82	0.479					
110	0.471					
59	0.47				0.392	
41	0.431					
87	0.431					
75	0.429					
70	0.428					
89	0.407					
60	0.407		0.356			
65	0.402					
66	0.387	-0.359				
85	0.379					
53	0.37					
23	0.36					
8		0.645				
72		0.642				
46		0.632				
94		0.616				
18		0.612				
106		0.608				
77		0.597				
50		0.59				
9	-0.396	0.581	-0.31			
3		0.577				

24	-0.326	0.562				
56	0.384	-0.55				
101		0.54				
91		0.521				
78		0.519				
51	-0.322	0.513				
93		0.511	-0.303			
67		0.508				
92		0.498				
68		0.496				
48		0.483				
13		0.482				
115		0.469				
107		0.467				
81		0.462	-0.343			
30		0.445				
12	0.425	-0.431				
97	0.345	-0.395				
35		0.384				
98		0.368				
38		0.368				
62		0.332				
64		0.329				
32						
42						
69						
61			0.482			
90	0.366		0.462			
25			-0.396			
80			0.389			
2			0.386	0.318		
7			0.33			
105			0.328			
114			0.314			
6						
55				0.629		
73				0.589		
47				0.586		

58				0.519		
5				0.504		
37				0.405		
111				0.347		
33				0.325		
71			0.311	0.313		
15				0.313		
52					0.598	
40				0.324	0.552	
27	0.316				0.549	
44	0.372				0.404	
4	0.341				0.38	
19						
84						0.513
109						0.504
1			0.336			0.478

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 11 iterations.

Seven Factor Model

	Factor						
	1	2	3	4	5	6	7
76	0.695						
88	0.674						
79	0.631	-0.33					
36	0.626						
83	0.609	-0.384					
43	0.597						
63	0.596						
10	0.595						
104	0.589						
14	0.578						
16	0.574	-0.35	0.331				
95	0.573						
45	0.565						

26	0.559		0.34				
112	0.558						
82	0.541						
21	0.534					0.389	
22	0.534						
70	0.522						
41	0.517						
99	0.51						
12	0.509	-0.38					
113	0.501						
74	0.501	-0.405	0.376				
87	0.498						
75	0.486						
59	0.483				0.371		
103	0.482				0.354		
102	0.479					0.356	
110	0.466						
20	0.458						
44	0.458						
108	0.451						0.316
34	0.428						0.372
28	0.412						
53	0.393						
60	0.392		0.383				
97	0.386	-0.359					
85	0.373						
66	0.365	-0.36					
23	0.358						
4	0.355					0.345	
8		0.671					
72		0.653					
18		0.633					
46		0.626					
94		0.625					
106		0.617					
77		0.613					
3		0.59					
9	-0.345	0.587	-0.333				

24		0.569	-0.312				
91		0.563					
50		0.561			0.343		
51	-0.334	0.548					
78		0.539					
93		0.538	-0.303				
68		0.534					
48		0.527					
56	0.418	-0.524					
101		0.514					
92		0.499					
115		0.498					
13		0.496					
107		0.488					
67		0.48					
81		0.472	-0.396				
30		0.424					0.34
98		0.421					
35		0.385					
62		0.35					
61			0.556				
90	0.321		0.542				
25			-0.493				
80			0.479				
39	0.409		0.43				
2			0.413	0.363			
7			0.406				
1	0.349		0.391				-0.374
105			0.348				
114	0.308		0.343				-0.329
6			0.338				
47				0.709			
55				0.67			
73				0.656			
5				0.616			
58				0.537			

15				0.407	0.313		
33	0.325			0.374			
111				0.365			
71			0.33	0.352			
27	0.304				0.539		
52					0.525		
40				0.376	0.503		
64		0.421			-0.448		
38		0.325			0.417		
42					0.413		
84						-0.664	
109						-0.66	
32						-0.429	
37				0.376		0.4	
86	0.381					0.383	
69							
19							0.488
65	0.329						0.428
89	0.324			0.303			0.396

Extraction Method: Principal Factor Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 16 iterations.