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Validity of Subjective Self-Assessment of Digital Competence Among Undergraduate Preservice Teachers

Joseph Andrew Maderick
University of Nevada, Las Vegas

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VALIDITY OF SUBJECTIVE SELF-ASSESSMENT OF DIGITAL
COMPETENCE AMONG UNDERGRADUATE
PRESERVICE TEACHERS

by

Joseph Andrew Maderick

Bachelor of Arts in English
California State University, San Bernardino (Palm Desert)
1999

Master of Education
University of Nevada, Las Vegas
2008

A dissertation submitted in partial fulfillment
of the requirements for the

Doctor of Philosophy - Curriculum and Instruction

Department of Teaching & Learning
College of Education
The Graduate College

University of Nevada, Las Vegas
August 2013

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THE GRADUATE COLLEGE

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Joseph Andrew Maderick

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Department of Teaching and Learning

Kendall Hartley, Ph.D., Committee Co-Chair

Shaoan Zhang, Ph.D., Committee Co-Chair

Steven Grubaugh, Ed.D., Committee Member

Gwen Marchand, Ph.D., Committee Member

Carole Anne Kardash, Ph.D., Graduate College Representative

Kathryn Hausbeck Korgan, Ph.D., Interim Dean of the Graduate College

August 2013

Abstract

Validity of Subjective Self-Assessment of Digital Competence Among Undergraduate Preservice Teachers

by
Joseph Andrew Maderick

Dr. Kendall Hartley, Examination Committee Co-Chair
Associate Professor of Teaching and Learning
University of Nevada, Las Vegas

Dr. Shaoan Zhang, Examination Committee Co-Chair
Associate Professor of Teaching and Learning
University of Nevada, Las Vegas

Technology is now integrated into the Technological Pedagogical Content Knowledge (TPACK) required to be a highly qualified 21st century teacher. Accurate measurement of digital competence has become critical. Self-assessment has been used widely to measure the digital competence of preservice teachers who are expected to integrate technology into their teaching. There is little in the literature indicating that there has been validation of self-assessment as a measure of that competence. While recent research studies have tested the validity of self-assessment verses objective testing among business and accounting students, there have been no studies of self-assessment validity conducted on digital competence among preservice teachers. This study matched surveys of subjective self-assessment and objective assessment on seven domains of digital competence for preservice teachers. The results indicate that all participant groups inaccurately self-assessed their digital competence. The study concluded that subjective self-assessment lacks appropriate validity and is not an accurate predictor of digital competence among preservice teachers.

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Chapter 1: Introduction

Background

Our colleges and universities are now populated with students who have been born into lives in which they have never experienced their existence without the presence of digital technology in most, if not all, aspects of their lives. These students who were born after 1980 have been identified by a number of labels: Millennials, Net Generation, and most commonly Digital Natives (Cuban, 2001; Lei, 2009; Oblinger, et al., 2005; Prensky, 2001a, 2001b, 2005). The Pew Research Center's American Life Project (2012) and ECAR surveys report that 98% of college students have Internet access, 88% own laptops (59% desk tops), and 99% own cell phones (Levin & Arafeh, 2002; Smith, Salaway, & Caruso, 2009; Zickuhr, & Smith, 2012).

Ownership of digital technology devices for Digital Native college students is now at saturation. It is easy to see how such saturated use would lead to the conclusion that the users were expected to be comfortable and competent in the use of these devices. In spite of the wide-spread ownership and evident use of these digital devices and applications, there is little research focused on whether the users have the requisite digital knowledge and competence skills for successful integration and implementation in their teaching careers (Lei, 2009).

The assumption that most students preparing for professions outside of the immediate purview of computer science, electronics, and information technologies possess adequate knowledge of both computer concepts and computer literacy skills is not accurate. The need for accurate evaluation of digital competence is illustrated by the results of a study examining incoming freshmen business students regarding their digital competence (Wallace & Clariana, 2005). Their average scores of 58 percent on a

computer concepts pre-test and 60 percent on a Microsoft Excel spreadsheet pre-test, indicates that these students did not possess the necessary prerequisite skills to function acceptably and be successful as students in an undergraduate business school. In addition, in this study, “almost two-thirds of the students failed by scoring below 60 percent in one of the two tests. Overall, 39 percent failed both tests” (Wallace & Clariana, 2005, p. 149). It is not unreasonable to suggest that these incoming students were ill-prepared and required remediation to bring their skills and knowledge up to levels that lend themselves to success in their academic program and that their competence was far below that required for professional status.

While this is a study of undergraduate business students, there is little reason to assume that similar findings would differ with other groups of undergraduate students from non-technology based programs including preservice teachers. As specific digital skills are critical in the functioning of the accounting and business professions and are requisite for success in those fields, similar critical needs exist for success and qualification for teachers. Additionally, these digital skills are of importance to preservice teachers because the demand for digital competence in the art and science of teaching, as in other professions, is steadily growing (Ertmer & Ottenbreit-Leftwich, 2010; Harris, Mishra, & Kohler, 2009).

There is considerable agreement within the literature on the evolving critical importance of integrating digital technology into the preservice teacher education programs on an almost universal basis (Angeli & Valanides, 2008; Cuban, 2001; Harris, et al., 2009; Mishra & Kohler, 2006). This integration is now a requirement for

accreditation. The stakes are great for both preservice teachers and the institution conducting their education program.

The importance of ensuring that students coming out of preservice teacher education programs demonstrate competence in each of the elements of Technological Pedagogical Content Knowledge (TPACK) is widely documented. Shulman (1986) established Pedagogical Content Knowledge (PCK) as the standard for novices to become qualified as competent teachers. Since then the element of technology has been added to the framework. While one might maintain an opinion that one element or another of TPACK, Technology, Pedagogical, or Content knowledge, is more or less important than another, there is little doubt that they all are significant and like a three legged-stool, have their place in holding up their respective ends. Adequate knowledge of technology is requisite for integrating it into the classroom.

It is easy to argue that there are phenomenal amounts of learning required to keep up with developments in virtually all aspects of education. Digital technology may be the most demanding development in this respect due to the ever-evolving advances and rapid changes. Further, it is reasonable to assume that there will be no respite in these demands to keep up in the foreseeable future. With this simple and logical perspective, it is easy to see that preservice teachers emerging from their educational programs will need to be competent with an array of digital technologies. Further, educational programs and instructional design managers will need to ensure that the digital competence levels of these emerging preservice teachers are adequately achieved to meet the mandates and expectations that define the high quality teacher of the 21st century. The primary question is how can these critical assessments be effectively accomplished?

Many preservice teachers have high and usually strong, opinions about how much or how skilled they are with digitally based technology in which their culture is deeply immersed. These opinions could be considered *subjective self-assessments*. Are such subjective self-assessments accurate? How do they compare to measures that are more objective? If substantial differences do exist, are there implications for teacher training programs regarding the expectation of effective implementation of technologies in education? Those fundamental questions are at the heart of the research reported in this study.

Conceptual Basis for the Study

There are many means of assessing competence. Among them are both subjective and objective forms of assessment. Self-assessment tends to measure sentiments and dispositions as evaluated by the individual doing the self-assessment and may be considered as responses subject to opinion or bias by the respondent. They do not measure objective competence and may or may not be valid or accurate. These subjective self-assessments have the possibility of multiple correct answers to a given question including relative responses based on the degree or on a scale of the respondent's perceived correctness. On the other hand, determination of what learners know or do not know can be accomplished through strictly objective assessment. An objective assessment is based on an instrument, which relies on fact-based items with well-defined, widely accepted answers and is not subject to opinion on their correctness by the respondent. However, there are many important and consequential determinations made by accepting only the results of subjective self-assessment, the validity of which is questionable or not determined.

Studies on self-assessment accuracy date to 1932 when Sumner (1932) examined agreement between self-assessments and teacher issued grades. While a few subjective self-assessment instruments have proved to be accurate and valid in content domains other than preservice teacher education programs (Fox & Dinur, 1988; Matthews & Beal, 2002; Sullivan & Hall, 1997), other recent studies have indicated a lack of validation (Ballantine, McCourt Larres, & Oyelere., 2007; Boud & Falchikov, 1989; McCourt Larres, Ballantine, & Whittington, 2003; van Vliet, Kletke, & Chakraborty, 1994).

Subjective self-assessment has been a means to assess computer knowledge and skills among students in various content domains (e.g., Hakkarainen, Ilomaki, Lipponen, Muukkonen, & Rahikainen, 2000; Karsent & Roth, 1998; Nurjahan, Lim, Foong, Yeong, & Ware, 2000; Stoner, 1999; van Braak, 2004). However, while self-assessment is useful in deriving data on student attitudes and dispositions that can contribute effectively to course design and programs (Karsent & Roth, 1998), its accuracy in providing information on knowledge and competence is questionable.

Self-evaluating digital skills and knowledge is not without problems. They can include fundamentally inaccurate self-perceptions of one's own competence coupled with the possible levels of the one's actual incompetence. Asking students to self-assess their digital competence as a stand-alone determinant simply may be too inaccurate for effective adoption. This idea is reinforced by a quote from a study by Kennedy, Lawton, and Plumlee (2002), "When people are unable to judge their own achievement, they are in a double bind; they have neither a particular skill nor the cognitive ability to realize their own level of incompetence" (p. 243).

In addition to the problems of naïve self-perceptions and actual incompetence, numerous research studies have reported significant leniency bias among subjects who were asked to self-assess. *Leniency bias* is defined as being positively generous in assessing or over-estimating one's ability or knowledge. The tendency towards leniency has been reported as being more prevalent among less able [competent] subjects, with those of better ability and experience [competence] producing greater accuracy in their self-evaluation assessments. However, despite these reported flaws in self-assessment among students and novices, it is still being relied upon in current studies as an indicator of digital competence among university students (van Braak, 2004). It seems to be nonsensical when considered that the worst performers return the highest self-assessments and an institution will consider relying on that flawed data to make a variety of important decisions.

Statement of the Problem

Subjective self-assessment approaches to gathering data on entry-level [for business applications] digital competence has been used for more than twenty years. In spite of its general acceptance as a means of assessment, its use as the *only* indicator for basing the design of instruction and educational programs and the dedication of valuable resources might be suspected of being inadequate or at best, weakly valid (see Ballentine, et al., 2003; Boud, 1989; Hakkarainen, et al., 2000; Karsent & Roth, 1998; Nurjahan, Lim, Foong, Yeong, & Ware, 2000; Orsmond & Reiling, 1997, 2000; Stefani, 1994; Stoner, 1999; van Braak, 2004). As such, there has been little research to validate subjective self-assessment for determining digital competence among preservice teachers.

There are few studies since 1990 that have compared self-assessment and objective testing in order to determine the validity of self-reporting as a means of determining competence. These studies have examined accounting students, medical students, business and general education students with comparison measurements made between self-assessment and instructor predictions or objective assessment measures (e.g., Ballantine, et al., 2007; Chen, 1986; Collis, 1987; Crosby & Yarber, 2001; McCourt Larres, et al., 2003; Pershey, 2010; Ruble, Walters, Yu, & Setchel, 2001; Sundström, 2011; van Vliet, et al., 1994). The results of these studies have produced a mixed bag of outcomes that in several cases are in conflict with studies in other domains. Ballantine, et al. (2007), Cartwright, Daniels, and Zhang (2008), McCourt Larres, et al., (2003) and van Vliet, et al., (1994) found notable leniency bias in subjective self-assessment compared to matched objective assessment results while Crosby and Yarber (2001) found mixed leniency bias based on demographic variables. Sullivan and Hall (1997) and Stefani (1994) found little leniency bias in self-assessment compared to other objective means of assessment. Since there are no reported studies that specifically examine preservice teacher students, it is undetermined if and how leniency bias might apply.

Purpose of the Study

Since there are conflicting results from various content domains, a major gap in the research emerged regarding the validity of self-assessment of digital competence among undergraduate preservice teachers. No study has compared the results between subjective self-assessment and objective assessment measures for digital competence among preservice teachers. What is in question is whether subjective

self-assessment can prove to be valid in the context of the digital competence of undergraduate preservice teachers.

Studies have sought to validate subjective self-assessment as a means of determining competence in domains other than preservice teacher education with inconsistent and mixed results (Ballantine, McCourt Larres, & Oyelere, 2008; Boud & Falchikov, 1989; McCourt Larres, Ballantine, & Whittington, 2003; Ross, 2006). In his review of relevant literature Ross (2006) notes that “discrepancies between self-assessment and scores on other measures should be the stimulus for further inquiry” (p. 4).

More to the focus of this study’s research, there has been a notable paucity of studies in the literature that have validated subjective self-assessment as a means of determining the digital competence of students in preservice teacher programs. It has not been determined if the subjective self-assessment leniency bias pertains to preservice teachers and if so to what extent is it evident.

With the noted increasing critical importance of digital competence in education, definitive determinations need to be made regarding the digital competence of emerging preservice teachers. Perhaps subjective self-assessment may retain a valuable role if used in conjunction with other assessments. Alternatively, if appropriately validated by statistical testing it may, indeed, prove to serve as a valid measure as a stand-alone assessment. The literature of the past decade indicates that a large share of decision making for technology instruction for teachers has been predicated on self-reporting or subjective self-assessment surveys and questionnaires (Archambault & Crippen, 2009).

With accreditation, valuable resources, and an inherent desire to produce quality teachers at stake, it seems unreasonable to continue to rely on possibly faulty assessments.

This study seeks to determine the validity of subjective self-assessment as a means of determining digital competence among undergraduate preservice teacher students by conducting a comparison study between the results of a subjective self-assessment instrument and an objective instrument for digital competence.

Research Questions

This study seeks to validate self-assessment of digital competence among preservice teachers. The following research questions serve as the focus of this study.

1. Research Question 1: Does subjective self-assessment accurately reflect agreement with performance on objective competence assessments by undergraduate preservice teacher students?
2. Research Question 2: Is there a tendency toward leniency in subjective self-assessment of digital competence among different demographic groups of undergraduate preservice teacher students?
3. Research Question 3: To what do the subjects attribute any differences between their subjective self-assessment and objective measurements of their digital competence?

Definitions of Terms

This study focuses on evaluating the validity of self-assessment as a measure of digital competence among entry-level undergraduate preservice teachers by comparing it to matched objective measurement. The methodology approaches the questions by measuring digital literacy and competence in seven digital topic groups and comparing

them with the results of an objective instrument on the same seven digital topic groups as appropriate for integration and use among preservice teachers.

1. The seven groups are General Computer Knowledge, Spreadsheets, Presentation Software, Word Processing , E-mail & Internet, Web 2.0, and Databases. These *Digital Topic Groups*, as how they will be referred to hence, are designed and chosen to not be subject to specificity based on platforms or proprietary ownership (eg. word processing will not be specific to Microsoft Word®, nor will the groups or items be specific to operating systems or machine manufacturers such as Apple®, Mac®, or PCs.)
1. Objective assessment shall be limited to mean assessment in which the correct response will be composed of definitive fact-based items with well-defined, single, widely accepted answers.
2. Subjective assessment shall be open to bias and opinion of the participating respondent with the possibility of relative correctness in response choices.
3. Digital competence is knowledge and skill based ability to effectively use a given Digital Topic Group device or application as practically applicable for use by undergraduate preservice teachers as expected for use in a K-12 classroom.

Summary

The importance of integrating technology into twenty-first century classrooms is widely documented. The inclusion of technology into the Pedagogical Content

Knowledge (PCK) model of developing highly qualified teachers has placed a new emphasis on the need to design instruction and educational programs that meet the growing demands for technology savvy teachers. Technological Pedagogical Content Knowledge (TPACK) now insists on the inclusion of technology in the model of a quality teacher in the 21st century. As a means of providing the highest quality educational programs for preservice teachers accurate assessment measures are needed for institutional decisions.

For decades, subjective self-assessment has been the subject of educational studies in a variety of domains that compare the results of subjective self-assessments and objective tests of literacy and competence related to digital technology. The results have been mixed and there has been a tendency toward a notable lack of validity and accuracy in the subjective self-assessment by the individuals being examined. While these studies have been enlightening, there has been no study that has compared the results of subjective self-assessment and objective test performance among preservice teachers regarding digital competence. With the critical need for effective and efficient planning of instruction and programs in preservice teacher education the need to determine the validity of self-assessment has become more critical.

The study will conduct a comparison between subjective self-assessment and objective test results among undergraduate preservice teachers at a major southwestern public university. This study explores the validity of self-assessment as a tool for determining the course of educational design in teacher education programs and will further seek to determine how the responding participants arrived at their estimations about their digital competence.

Chapter 2: Literature Review

Introduction

The focus of this dissertation is to conduct a comparison between the results of self-assessment and objective assessment measures to determine the validity of subjective self-assessment as a means of determining digital competence among undergraduate preservice teachers. It also seeks information regarding the effects on the results of several demographic variables including age, gender, and completion of one or more technology classes. This chapter provides a current review of the literature related to the validation of subjective self-assessment, related subjective self-assessment and objective assessment instruments used to determine digital competence. Further, it will explore studies that utilized comparisons conducted between subjective self-assessments and objective assessment. The review will first explore the literature on digital competence including definitions and qualifications. The second section will examine the literature on subjective self-assessment and the concept of leniency bias. The final section will review the literature that has sought validation of subjective self-assessment related to digital competence among students from various content domains.

Digital Competence

In virtually every kind of organization and profession, computers have become omnipresent. Covello (2010) conducted a comprehensive compilation of assessment instruments used to test digital competence globally. The review reported dozens of tests and assessments with little consensus of what should be tested and how it should be accomplished.

Using computers has gone beyond being a valuable skill to becoming a critical requirement. The term digital literacy is associated with the skill sets and knowledge of the use of digital technology (computers). However, since the advent of the age of the desktop computer sometime around 1980, the definitions for terms such as computer literacy, computer proficiency, computer competence, digital literacy, digital proficiency, or digital competence have remained unclear, non-specific, and ill-defined, but are frequently used in the literature as though they are all synonymous. The terms, computer competence or digital competence, have no widely accepted general definition despite common usage in the literature. Offering a definition for the term *digital literacy* will help to clarify the scope of the definitions utilized in this study.

Digital literacy requires more than just the ability to use software or to operate a digital device; it includes a large variety of complex skills such as cognitive, sociological, and emotional that users need to have in order to use digital technology effectively (Gilster, 1997). This suggests that digital literacy can exist on a wide spectrum of levels and environments.

This somewhat fuzzy definition coupled with standards established by the International Society of Technology in Education (ISTE) (2012) describes how and what a user should do with technology. They do not offer any specifics on what the user needs to know as far as specific applications. While *literacy* is commonly used interchangeably with competence, they are not the same. Competence has a much narrower definition than literacy.

Recent use of the term digital literacy in the literature, as stated, varies widely, ranging from the purely technical or procedural realm (Bruce & Peyton, 1999; Davies,

Szabo, & Montgomerie, 2002; Swan, et al., 2002), to cognitive, as well as psychological and sociological meanings (Gilster, 1997; Papert, 1996; Tapscott, 1998). In spite of the common usage of the term digital literacy, it remains ill-defined and is used without a distinct definition (Calvani, Cartelli, Fini, & Ranieri, 2008; Haigh, 1985; McCade, 2001; Overbaugh, 1993; Pietrass, 2007; Zeszotarski, 2000).

Complicating this lack of clear definition the literature indicates that digital competence falls into limiting groupings based on temporal, industry specific, and platform specific applications (Norton & Wilburg, 1998). Temporal limits refers to the life span that falls to obsolescence for certain skill sets necessary for digital competence while other skill sets are emerging and may not yet be defined. DOS was once a special skill set necessary for competence with PCs. It has fallen to obsolescence while the use of Windows® and mobile apps have emerged and risen. These represent temporal limitations on skill sets. This suggests that the definition of digital competence is directly related to specific conditions.

Industry specificity further limits definitions based on the paradigmatic content areas to which the definition applies. Simply, digital competence with certain group-based applications may be expected of that group and not be relevant to a different group as a needed skill set or competence. Those definitions that are relevant to chemical processing, accounting, or education may have little applicability for a medical student.

Platform specific competence can be demonstrated with the notion that one specific platform brand such as Microsoft Office® may not translate to Oracle® or Apple® software applications. Lastly, as an example of domain platform specific competence expectations Calvani, et al. (2008) insists that ideas such as computer

programming logic processes that are typically utilized for flow-charting is a critical element of any measure of digital competence. While this was once true, one could convincingly argue that it has retreated to being a function specific to Computer Science and is seldom used outside of that specific domain platform.

These limitations of temporal, industry/profession, and platform specificity have contributed to the generation of ambiguous perspectives in defining digital competence (Norton & Wilburg, 1998). These paradigmatic limitations to the definition of digital competence further confound the attempt to narrow the usability parameters of the term.

The importance of these general points of discord in the literature regarding the definition of digital competence may contribute to invalidating assessments because of the inapplicability of the definition across temporal, industry/profession, or platform lines. If assessment is not accurately aligned with the temporal, industry/profession, and platform of the person being assessed, the results will be uselessly inaccurate, rendering them invalid. The digital competence of a nurse cannot be valid, when based on tests that assess digital competence for teachers. However, this very narrowness provides the possibility for the comparison of subjective self-assessment and objective assessment of digital competence as it constrains and contains the scope of the survey's content items into a manageable set of matched groupings specifically intended to measure competence within the temporal, industry/profession, or platforms parameters (Baird, 1973, in LeBold, et al, 1998; Davies, Szabo, & Montgomerie, 2002; Kvakik & Caruso, 2005; O'Connor, Radcliff, & Gedeon, 2009; Sieber, 2009).

With the contentious environment generated by the lack of accepted and agreed upon definitions, it was decided to limit this study to digital competence by following the

lead of previous studies that adopted a definition in which digital competence is focused on student skill and abilities to perform specific tasks on or with a digital computer related to their specific content area domains [teaching] (Ballantine, et al., 2007; Larres McCourt, et al., 2003; van Vliet, et al., 1994). It is conceded that this narrowness, due to specificity may leave vast areas of digital competence unaddressed. However, more importantly it does contribute to validation on those narrowly specific competencies as needed by preservice teachers.

In summary, the term digital competence has been effectively made interchangeable with a wide array of other terms. Yet, its definition is emerging and is adapting to the growth of digital technology and is evolving with the innovations. Obsolete applications that once defined digital competence have withered with the progress of technology while new expectations are blossoming. As the need for flow charting and logic skills have become less appropriate for the vast population of digital users, other skills such as texting, have shot to the forefront. Meanwhile, the digital competence needed in specific professions and content areas continues to develop as core type competencies specific to applicable content domains. Among these, and on point, is that education has evolved the notion of digital competence as a core requirement that meets expectations for compliance with TPACK, and the established standards of ISTE and NCATE in the preparation of preservice teachers for the 21st century classroom. Therefore, for the purposes of this dissertation the terms digital competence shall be construed and limited to mean having the skill, ability, and knowledge to successfully use computers and their related applications in the practice of teaching and education.

Accuracy and Validity of Subjective Self-assessment

The literature regarding self-assessment uses a wide variety of definitions that makes a precise meaning of the term problematic at best. Other terms encountered in the literature include, self-evaluation, self-assessment, self-grading, self-estimation, self-reporting, and self-impression all of which have varying specific definitions. All of these terms share the common element in that they reflect the individual's sentiments and judgments about their own performance or understanding. In this context, there is no necessarily right or wrong answer.

There is a large body of literature that reports on studies of subjective self-assessment dating to the early 1930s (Boud & Falchikov, 1989; Sumner, 1932). Self-assessment refers to the means that learners evaluate and make judgments about the outcome of their own learning activities (Boud & Falchikov, 1989). While this serves as one viable definition, Boud (1995) asserts that subjective self-assessment is an effective formative evaluation that assists in reflecting on the process, progress, and results of one's own knowledge. A second example is based upon the definition of self-evaluation posited by Sedikides and Strube (1997). They forwarded the notion that:

Self-evaluation, the process by which the self-concept is socially negotiated and modified, is motivated. Motives have long been postulated to color the ways in which people select self-relevant information, gauge [sic] its veracity, draw inferences about themselves, and make plans for the future. (p. 209-210)

While the point of the above quotes are well taken, they simply relate to personality disposition and do not seem to directly reflect competence in the context of

this study; as a result of this interpretation the term, self-evaluation, was eliminated from searches and utilization in this review.

Klenowski (1995) defines self-assessment as “the evaluation or judgment of ‘the worth’ of one’s performance and the identification of one’s strengths and weaknesses with a view to improving one’s learning outcomes” (p. 146).

Breidert and Fite (2009) refined the field of terms to three distinct domains; self-assessment, self-grading, and self-impression. They conclude as follows:

A new and clearer way of discussing self-assessment is proposed as a continuum. The self-assessment continuum allows movement from end to end with regards to objectivity and specificity depending on the situational demands for type of assessment. On the most objective and specific end of the continuum lies self-grading; at the most subjective and ambiguous end of the continuum lies self-impression. The continuum is an attempt to minimize and utilize the differing influences that moderating variables impose on the accuracy of self-assessment (pg. iv).

Consistent with Boud (1995) and Boud and Falchikov (1989) the Breidart and Fite (2009) literature review reported that most of the studies defined subjective self-assessment “as an estimate of how skilled/competent one is regarding a particular skill, ability, or characteristic” (p. 18). The author of this dissertation accepted and elected to use this Breidert and Fite (2009) definition for addressing the question of testing the validity of self-assessment of digital competence.

The literature on self-assessment validity and accuracy is at times ambiguous and contradictory. This translates into difficulty in establishing validity for subjective

self-assessment. The review of the literature produced a few studies that maintain the position that as a stand-alone method, subjective self-assessment is accurate. However, a much larger proportion of the studies examined contend that self-assessment is fundamentally flawed “as being biased toward inaccuracy” (Breidert & Fite, 2009, p. 13).

Individuals tend to be inaccurate because they are unaware of their own level of competence and are likely to underestimate their skill (Fischhoff, Slovic, & Lichtenstein, 1977; Kruger, 1999; Kruger & Dunning, 1999). Kruger and Dunning (1999) reported that incompetent individuals “will tend to grossly overestimate their skills and abilities” (p. 1122). This misestimating, whether over-estimation or under-estimation, is termed *leniency bias*.

According to the literature, various factors contribute to the tendency to erroneously estimate one’s abilities. These include the test subject’s level of expertise on the material being tested (Lichtenstein & Fischhoff, 1977; Shaughnessy, 1979), the level of difficulty of the material (Kruger, 1999), and the specificity of the ability being evaluated (Dunning, Meyerowitz, & Holzberg, 1989). Other factors affecting the accuracy of self-assessment include; how desirable the particular skill or ability is (Alicke, 1985), gender differences (Lundeberg, Fox, Brown, & Elbedour, 2000; Lundeberg, Fox, & Puncochar, 1994), possible cultural differences (Lundeberg, et al., 2000; Yates, Lee, & Bush, 1997) and individual differences in ability (Maki, Jonas & Kallod, 1994; Moreland, Miller, & Laucka, 1981). Lahore (2008) conducted a study that examined community college students preparation for technology use in tertiary education based upon a variety of demographics including ownership of home digital

equipment. The common thread that emerged from these studies is that an individual's ability to self-assess their own abilities, skills, or knowledge is, at best, poor.

Comparing Estimations for Accuracy

Much of the following literature focuses on the validity and validation of subjective self-assessment and the individual's ability to self-assess accurately, rather than focusing on assessing the actual digital skills and knowledge themselves (Ballantine, et al., 2007; Larres McCourt, et al., 2003; Larson & Smith, 1994; Smith & Necessary, 1996; Stefani, 1994; van Vliet, et al., 1994; Wallace & Clariana, 2005). This is the point of the study conducted within this dissertation. It seeks to validate subjective self-assessment not questions about any particular skill or ability regarding a given digital element.

Studies showed inconsistent findings of whether and how participants of subjective self-assessment underestimated or over-estimated their performance. More studies showed that participants overestimated their performance than the studies that showed underestimated their performance.

Over-estimation in self-assessment.

Several studies found that participants overestimated their performance in the subjective self-assessment. Parker, Alford, and Passmore (2004) utilized a formative objective test instrument, the In-training Examination (ITE), to examine self-assessments among medical resident personnel to determine their ability to subjectively self-assess their performance. The medical personnel were asked to take a self-assessment survey prior to the administration of the In-Training Examination objective instrument. The results indicated inaccuracy in their self-assessed predictions. The subjects poorly

predicted their scores in all of the content areas tested. Those in the lowest quarter of scores on the ITE were the poorest predictors, in a range between 3% and 23% accuracy. These residents “greatly overestimated their performance” (p. 705). Overall, the better the residents performed on the ITE the more accurate their subjective self-assessment.

Kruger and Dunning (1999) studied a variety of subject’s self-assessment and self-estimation of the abilities across multiple content domains. These researchers found that those in the bottom quarter on the performance scale tended to overestimate their ability. These same participants tended to over-estimate their self-reported percentile rank prior to taking an objective test and under-estimated their test performance after they took the test. This illustrates the “dual burden” (p. 1121) of those with low ability. “Not only do they reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the ability to realize it” (Kruger and Dunning, 1999, p. 1121).

Balch (1992) examined students in an introductory psychology class and found results consistent with earlier studies in that below average students over-estimated their test scores while above-average students slightly under-estimated their competence. Similarly, Kuncel, Credé, and Thomas (2005) reported that high achieving students reported their grades more accurately than lower achieving students did.

In keeping with the findings in this area, Kennedy, Lawton, and Plumlee (2002) found that the lowest performing individuals are the ones who most likely demonstrated over-estimation of skills in the tested domains. The study further suggested that students need to have reasonable competence levels as a starting point in the tested domain to accurately assess their ability in that area. The consequence of this is that if such students lack adequate competence levels, their ability to accurately self-assess will be impaired.

Consistent with more recent studies (e.g. Breidert & Fite, 2009; Kruger & Dunning, 1999), Boud and Falchikov (1989) conducted a meta-analytic review of 48 other studies that measured the differences between student subjective self-assessments regarding their predictions of their grade and actual teacher determined grades. Overall, they also found that students in higher level classes and better performing students tended to more accurately self-assess their skills and competence than those who were poor performing or in lower level classes and grades.

Under-estimation in self-assessment.

One study found that the participants of self-assessment underestimated their performance. Chur-Hansen (2000) reported that self-assessing medical students evaluated themselves more severely than their grading instructors. McKinstry, Peacock, & Blaney (2003) reported that professional instructors of educational registrars rate their own abilities below the scores made by others. A study of dental professionals found that dentists rate their own work with greater criticism than other evaluators (Milgrom, Weinstein, Ratener, Read, & Morrison, 1978).

The cited studies mostly reported findings that subjective self-assessment over-estimated performance relative to objective assessment. Only a few studies have reported that subjective self-assessments underestimate performance.

Breidert and Fite (2009) list five major categorical variables that may account for the apparent inconsistency of self-assessment accuracy: ambiguity of the items being self-assessed; skill level of the tasks and self-assessors, the level of learned accuracy in self-assessment, individual differences, and methodological problems. Regarding ambiguity, Dunning, Meyerowitz, and Holzberg (1989) found that when the abilities

being subjectively self-assessed were given very specific definitions, the ratings by the testers tended to be less lenient. Additionally, in another study, subjective self-assessment indicated more concurrent validity [consistency] with other means of rating when the abilities being self-assessed were well-defined (Hayes & Dunning, 1997; Story, 2003).

As illustrated above, the more skill or knowledge a specific ability or competence requires, the less leniency bias or inaccuracy in subjective self-assessment will be demonstrated. Thus, for example, doctors and dentists, masters of high skill levels, self-assessed more accurately than K-12 students did.

Most of the reported studies reviewed used subjects who had little or no instruction or experience with subjective self-assessment. This appears to be a contributing factor for leniency bias. Individual differences also accounts for a spectrum of subjective self-assessment leniency based on elements such as personality and experiential development.

In summary, the literature suggests that individuals with the lowest levels of expertise, training, and are the lower performers will tend to demonstrate leniency bias by overestimating their knowledge and skills in their given domain. While there is little reason to expect otherwise, this leniency bias would apply to digital competence. Despite there being a large body of experimental research on subjective self-assessment there is a notable paucity of studies that examine self-assessment among preservice teachers. Furthermore, there are few studies comparing self-assessment to objective assessment of digital competence.

Student Based Self-assessment of Digital Competence

The following literature focuses on the validity and validation of subjective

self-assessment of digital competence and the individual's ability to self-assess this competence accurately (Ballantine, et al., 2007; Larres McCourt, et al., 2003; Larson & Smith, 1994; Smith & Necessary, 1996; Stefani, 1994; van Vliet, et al., 1994; Wallace & Clariana, 2005). The point of this study is to seek to validate subjective self-assessment and is not about any particular skill or ability regarding a given digital element.

There is little available in terms of either separate or stand-alone instruments that could provide support a comparison between objective and subjective self-assessed digital competence for this study. Three studies from the literature did, however, emerge that utilized undergraduate students and compared their digital competence levels based on subjective self-assessments and then on objective testing. This was, on the surface, precisely the type of study that this study sought to design for utilization with undergraduate preservice teachers.

Comparison Studies Seeking Validation of Self-assessment

Comparison studies between self-assessment and evaluation of competence by mentors, peers, and instructors have been successfully undertaken (Fox & Dinur, 1988; Stanton, 1978; Stefani, 1994). Three other studies were conducted recently that sought to validate subjective self-assessment by conducting comparison studies between self-assessments and objective testing. Since the intent in this study is to determine the validity of subjective self-assessment of digital competence among undergraduate preservice teachers it was decided that this study would follow the model of these successful previous studies (Ballantine, et al., 2007; Mc Court Larres, et al., 2003; van Vliet, et al., 1994).

The earliest comparison study, by van Vliet, et al., in 1994, was conducted to compare subjective self-assessment and objective testing of computer literacy among Management of Information Services (MIS) students and served to provide the basis for two later studies. This first study focused on the fundamentals of comparisons based on the notion that it was insufficient to accept subjective self-assessment as the reason for making decisions in educational programs because those self-assessments tended to be biased in over-estimating objective skills and abilities. The study sought to compare the results of a subjective self-assessment survey with the results of a matched objective test. It was intended to examine how the results of the comparison related to the measurement of computer literacy across time and demographic domains (van Vliet, et al., 1994). An evaluation of these instruments and research methods aligned with the intentions and directions of the study herein.

The van Vliet, et al., (1994) study began by creating and then thoroughly validating a subjective self-assessment instrument. The researchers then developed a matching objective instrument that they then validated. The researchers administered these newly developed instruments to 131 undergraduate MIS students.

Although van Vliet, et al., (1994) reports considering other assessment means such as peer evaluation and teacher/mentor evaluation they concluded that objective testing was the best choice as the others were judged both, “less appropriate and less feasible” (p. 838). Further they chose an objective multiple-choice test because it coincided with what Nunnally (1987, p. 41) determined to be responses that “required judgment and had only one correct answer” as opposed to self-assessment tests that

measured “sentiments” (p.42) for which no single answer is known. This provided the basic platform for devising the instruments to be compared.

The objective instrument was again derived from procedures developed by Cheng, Plake, and Stevens, (1985) (as cited in van Vliet, et al., 1994). Additionally, based on admonitions by Nunnally (1987) care was taken to protect against threats to reliability and internal validity. Additional protection was taken to protect for mediating variables such as gender and experience. These variables came to be recognized as demographic variables that were inconsistent in a variety of studies across the literature (Ballantine, et al., 2007; Chen, 1986; Collis, 1987; McCourt Larres, et al., 2003; Murphy, et al., 1989; LaLomia & Sidowsky, 1991; Shaft & Sharfman, 1991). The objective test as used in the van Vliet study only covered four content topic areas. The scores were tested for reliability by Cronbach’s *alpha* and returned acceptable values above .70. Content validity was ascertained by a panel of authorities in the respective content domains and accepted. A Confirmatory Factor Analysis returned four loadings consistent with the design model.

The van Vliet et al., (1994) study’s extensive cross-validation procedures and statistical analysis includes before and after treatments and examinations that considered the effect of gender and the class in which the subject population was enrolled. In the case of the van Vliet, et al. (1994) study, the results indicated that males did not show more leniency bias than females.

The van Vliet, et al. (1994) findings generally indicated that as expertise increased gender based bias faded on both the objective and subjective tests. However, subjective self-assessment leniency seemed to remain consistently higher than on objective tests

regardless of gender. Most importantly after conducting this multi-trait, multi-method matrix comparison, self-assessment did not correlate well with the objective instrument results indicating that subjective self-assessment was not an accurate predictor of computer literacy.

Kletke and van Vliet (1992) (as cited in van Vliet, et al., 1994) and van Vliet, et al., (1994) concluded that no significant statistical convergence was found between subjective self-assessment and objective tests among the undergraduate MIS students. Additionally, the self-assessments were upwardly biased compared to the objective instrument. Lastly, males tended to be more lenient than females and those with higher levels of expertise tended to be less lenient with the gender difference fading at higher expertise levels. As a part of their research design they also conducted before and after testing of the subjects that they used to determine their “levels of expertise.” These contribute to the literature on the examination of demographic type biases based on expertise or skill levels as opposed to the more common gender or age variables.

It was concluded after an in depth evaluation that the van Vliet, et al. (1994) study provided the necessary guidelines and was very closely aligned with the purposes and intentions of this study and therefore would provide a touchstone for the research design and methodology.

A study conducted by McCourt Larres, Ballantine and Whittington, (2003) in the United Kingdom immediately showed great promise for guidance and utilization for this study. The first line of the abstract was nearly identical to what was being considered for this dissertation. “This paper considers the validity of using self-assessment to measure

computer literacy among entry level undergraduate accounting students” (p. 97). The study considered subjects from two British universities that compared subjective self-assessment and objective testing of digital literacy (competence) among accounting students. A major basis for their research was that they could effectively and better groom undergraduate accounting students for their future professional careers and could base what was needed to accomplish this educational objective through the determination of student needs by way of subjective self-assessments. McCourt Larres, et.al., (2003) sought to validate the use of self-assessments for that end use with accounting students.

McCourt Larres, et.al., (2003) encountered the same dilemma regarding the use of subjective self-assessment varying across content areas and domains as experienced by Kletke and van Vliet (1992) (as cited in van Vliet, et al., 1994), van Vliet et al. (1994), and other early digital literacy/competence research studies. Like the impact of TPACK in education the impact of Information and Communication Technology (ICT) in the domain of the business world is similarly significant for success in the field. The researchers saw the need to determine actual computer literacy among accounting students as a means for determining and providing the requisite skills to adequately integrate technology in professional business practices. Following the lead of van Vliet, et al. (1994) they additionally sought to determine if subjective self-assessment was valid for some demographic groups within the accounting student sample and among applied technology content areas and not valid for others. McCourt Larres, et al. narrowed the inquiry and sought to determine if subjective self-assessment was valid for accounting students and to determine if there was bias in the degree of leniency of the subjective

self-assessments among demographic variables when compared to the results of measurable objective instruments.

The study was conducted with 397 entry-level undergraduate business school accounting students who had no college level computer class experience from The Queen's University of Belfast and the University of Warwick, Coventry. The McCourt Larres, et al. researchers developed both a subjective five-level Likert instrument for the self-assessment side of the comparison and a directly related objective multiple-choice instrument. The researchers constructed the subjective self-assessment and the objective portions of the comparison tests by first identifying six areas (topic groups) of computer literacy that were appropriately relevant to undergraduate accounting education programs then constructed the two sections of the survey to provide a matched inquiry.

The McCourt Larres, et al., (2003) researchers performed nonparametric statistical analysis on the scores of the two instruments and then conducted a nonparametric Wilcoxon matched-pair signed-rank *t*-test comparison. The results rendered significant differences between the scores that indicated that the subjects showed a leniency bias in their subjective self-assessment versus their actual competence levels. But the scores also indicated that, in concurrence with van Vliet et al., (1994), that higher scoring objective instrument participants tended to be more accurate in their self-assessments (less leniency bias). Further, the McCourt Larres, et al., (2003) study confirms that self-assessment, as a sole measurement for decision making among educational program designers, is inappropriate. Yet, objective testing could determine content and learning needs for students, while leaving subjective self-assessment to make determinations regarding student dispositions and attitudes. Combined, the objective and

subjective assessment approach could serve the designers to better fit the needs of the students.

However, the above study presented a notable limitation. Unlike the van Vliet, et al. (1994) study, they did not provide preliminary and basic validation and reliability data for the survey. While this throws the veracity of the results and methodology of the McCourt Larres, et al., (2003) into question, it did provide a methodology and comparative statistics template that aligns with the purpose of this research study. This is with the caveat that the study will perform the appropriate statistical procedures required to determine validity and reliability of the data.

Ballantine, McCourt Larres, and Oyeler (2007) engaged a third study to measure subjective self-assessment of computer competence among first year business students. It was conducted as a response to research that has utilized subjective self-assessment as the stand-alone means of assessing business students' digital competence. The purpose of the study was to evaluate the reliability of subjective self-assessed computer competence versus scores achieved in objective instruments. The study is essentially a modified replication of the earlier McCourt Larres, et al., (2003) study. In this study, 123 undergraduate business students from a Southeast Asian and a New Zealand university participated. The study focused on levels of digital device usage and access to digital equipment at home and at school as variables that may pose as possible determinants of the accuracy of subjective self-assessment estimations.

The researchers once again began with the instruments initially adopted by van Vliet et al, (1994) and modified by McCourt Larres, et al., (2003), then further developed a set of instruments compatible with the business school context of the student

participants. Consistent with the earlier McCourt Larres, et al., study of accounting students, the Ballentine, et al., (2007) study used the same format of a subjective self-assessment instrument with a similar five-part Likert scale in conjunction with a directly related objective multiple-choice test. These assessments both utilized the previously agreed upon six core areas of digital [computer] competence as validated by a panel of professors of Educational Technology.

The Likert scale was set with “1” representing “strongly disagree” and “5” representing “strongly agree.” The multiple choice test offered questions matching each of the content areas used in the subjective test, each having one correct answer three defectors and one “I do not know.” The fifth level, “I do not know” was to reduce guessing (Curtis, Gardener, & Litzenberg, 1986).

Their research questions, like the previous two studies discussed in this section, first sought to test for accuracy in subjective self-assessment. The second major inquiry sought to determine if experience, or lack of experience, with digital devices effected the accuracy and leniency bias. They then applied nonparametric statistical procedures to complete the comparison of the objective and subjective assessments similar to the procedures utilized by both van Vliet, et al., (1994) and McCourt Larres, et al., (2003).

Although the Ballentine, et al., (2007) study was limited due to a small sample size (n=123), it was consistent with the findings of the two earlier studies. They concluded:

Their [business students in New Zealand and Asia] ability to self-assess appears to be every bit as inaccurate as that of their less experienced colleagues. The simple conclusion to be drawn from this study is that while a [subjective]

self-assessment questionnaire can be used to collect attitudinal data on computer confidence among entry-level students (van Braak, 2004) the data collected from such a distribution should not be used to assess computer competence (p. 998).

As noted in their quotation and consistent with the accounting student study (McCourt Larres, et al., 2003), Ballentine, et. al., indicates that subjective self-assessment is not valid as a stand-alone or sole means of measurement of digital competence. Both of these studies refer to van Vliet, et al., (1994) as having done a similar initial study and indicate similar findings.

These three studies were testing nearly identical digital literacy and competence skills that are to be tested in this dissertation. Unfortunately, none of the published versions of these three studies provided the instrumentation. McCourt, et al. (2003) and Ballentine, et al. (2007) in particular, did have possible limitations and questionable generalizability due to the narrow scope of the items tested. One studied accounting students and the other business students and focused on digital competence directly related to their professions and occupations. While van Vliet, et al., (1994) did, neither McCourt, et al., nor Ballentine, et al. reported performing appropriate factor analysis on the subjective instruments and did not report an item analysis of the objective surveys.

Summary

In summary, while the literature reports many means of determining digital competence by testing, many of the reported tests are focused on specific audiences such as K-12 students or business applications. Many of the instruments used to determine digital competence in educational settings are subjective self-assessment instruments that fail to provide valid assessments of the students' actual demonstrable skills when

compared to results of objective measures. The greater majority of objective instruments are specifically targeting K-12 students rendering them inappropriate for the purposes of this dissertation. Many of the instruments have sufficient obsolescence to render them unacceptable for current comparison studies. Others have elements that are too arcane for fair administration to preservice teachers.

The few comparison studies that sought to test the validity of self-assessment were designed to measure specific skill sets appropriate to content areas other than that related to preservice teachers. These included accounting, business, and nursing. However, with preservice teacher education missing from the literature the need to fill this gap is evident. Three comparison studies from the literature, van Vliet, et al., (1994), McCourt Larres, et al., (2003), and Ballentine, et al., (2007), do provide a template to model a study to explore this need.

The literature reviewed leads to the conclusion that subjective self-assessment when compared to objective methods of assessment has tended to demonstrate a general inaccuracy based on variable factors that relate to the level of skill expertise the self-assessor has attained and to the amount of experience and prior knowledge the assessor brings to the self-assessment. Overall, in consideration of demographic influences such as gender, age, and content domains it appears that they have less influence on leniency bias and inaccurate subjective self-assessment and estimation of digital competence than those study participants possessing lower expertise levels in the given content domain being examined.

Chapter 3: Research Methodology

Introduction

The intention of this study is to conduct a comparison between subjective *perceived* digital competence and *actual* demonstrable skills and knowledge. This is to be accomplished by conducting a comparison study between results of administered subjective self-assessment instrument and an objective instrument matched by digital content topic groups. The chapter will discuss the research questions and hypotheses, participant sample and the context in which the study is conducted, the methodology, instrumentation, data collection, and data analysis.

Research Questions and Hypotheses

Research Questions.

This study seeks to validate self-assessment of digital competence among preservice teachers. The following research questions serve as the focus of this study.

1. Research Question 1: Does subjective self-assessment accurately reflect agreement with performance on objective competence assessments by undergraduate preservice teachers?
2. Research Question 2: Is there a tendency toward leniency in subjective self-assessment of digital competence among different demographic groups of undergraduate preservice teachers?
3. Research Question 3: To what do the subjects attribute any differences between their subjective self-assessment and objective measurements of their digital competence?

Research Hypotheses.

1. H_{01} : There is no significant difference in the relative score achieved on the objective assessment and relative score achieved in the subjective self-assessment test by undergraduate preservice teachers in each of seven domains of digital competencies.
2. H_{02} : There is no significant difference in the relative overall score achieved in the objective assessment and relative overall score achieved in the subjective self-assessment based on demographic variables among undergraduate preservice teachers in the areas of *general digital competence*.

The first hypothesis is directly related to the seven digital topic groups separately while the second relates to overall or the total of the combined topics as a whole of general digital competence. This will separate the demographic groups and will analyze them on each of the seven topic areas and on the basis of total scores on all the topic groups combined.

Participants and Context

The participant sample drawn for the study was derived from undergraduate preservice teachers who were currently enrolled in classes at the College of Education at a major public Southwestern university with enrollment exceeding 25,000. The only two exclusions from the sample were, first, students who had graduate standing and second, students who were enrolled in programs other than those that led to certification in occupations outside of K-12 environments (e.g. workforce education). The population includes students from the various disciplines typical of a college of education including

special education, elementary, pre-K, secondary, and educational leadership paths. Being that the university is a research institution; the College of Education maintains a pool of all enrolled students in the college that is available for research projects. The participation in research projects approved by the college provides credit points that are accumulated as *participation points* that are required for certification or graduation. The mandate is included as a part of a basic undergraduate class that all education students are required to successfully complete, thus all teacher education students are included in the pool. While the students have options as to which projects in which they may participate, all enrollees are required to participate in multiple projects during their period of enrollment and thus are incentivized to participate. There is no incentivizing beyond the departmental requirement.

The 1187 students in the college research pool ranges from 18 to approximately 60 years of age in both genders. The spectrum of K-12 content areas such as English, foreign language, math, social sciences, science and others as offered by the college is adequately represented by the enrolled students. The teaching specialties represented include elementary, secondary, special needs education, educational leadership, and early childhood development and education. This wide spectrum provides an acceptable degree of heterogeneity among the entire sample of participants and offers a picture of the diversity within the population of the participants. Additionally, this diversity provides the base for examining variance within the various demographics (Konijn, 1973). This primarily applies to Research Question 3 regarding the possible tendency for leniency bias in subjective self-assessment among the three groups delineated within the

demographics categories of gender, age, and completion of one or more technology class (van Vliet, et al., 1994).

Mixed Methods

This dissertation utilizes a mixed methods approach to the research design. Mixed methods is a third means, besides purely quantitative and qualitative, of conducting a research study that is characterized as a methodological blend of quantitative and qualitative procedures that is informative complete and balanced (Johnson, Onwuegbuzie, & Turner, 2007). This design was chosen based on the notion “that mixed methods research is likely to provide superior research findings and outcomes” (p. 129). A mixed methods study can address more comprehensive research purposes than either quantitative or qualitative alone (Mallette, 2011; Newman, Ridenour, Newman & DeMarco, 2003). Additionally, this will allow greater degrees of flexibility in the study’s investigative techniques as the possible complexities of emergent results manifest themselves in the progression of the study (Onwuegbuzie & Leech, 2004). The mixed methods design of the study for this dissertation is characterized as an *explanatory* design because qualitative elements and analysis are used to provide additional insights and detail to the quantitative findings (Creswell & Plano Clark, 2011). This design assists in offering triangulation to support the overall findings.

Instruments

Digital Competency Survey

The quantitative portion of the study used three instruments combined under one heading called the *Digital Competency Survey* with the purpose to determine the validity of subjective self-assessment to measure digital competence. The *Digital Competency*

Survey instruments are a Likert based *Subjective Self-assessment Survey Instrument* (SSAI) (see Appendix A) matched by digital content topic groups with an objective multiple-choice instrument, the *Objective Assessment Instrument* (OAI) (see Appendix B) that includes the *Demographic Questionnaire Survey* (DQ) (see Appendix C).

It is necessary to note that in spite of admonitions regarding validity and reliability that few subjective self-assessment and objective instruments used to measure digital competence actually had appropriate statistical tests applied to them as reported in the literature. Cases in point include the Microsoft Digital Literacy Assessment (Microsoft, 2001) that was written based upon workshops presented to teach proprietary (Microsoft) digital skills then tested the workshop participants for mastery. Although reliability and validity procedures may have been utilized, the test guardians at Microsoft provided no data regarding reliability or validity. Many objective tests of digital competence are commercially owned and were generally unresponsive to inquiry regarding the possible use of their test for this dissertation and were practically non-responsive regarding reliability and validity (e.g. iSkills-ETS, 2010; SAILS, 2002; California, 2008 James Madison University, 2010). This does not imply that the related tests were not, in fact, reliable or valid. It may have simply been not documented or reported. Other tests explored were state owned instruments and displayed a similar lack of interest in participation. ISTE had a comprehensive test in the early part of the last decade but withdrew it for lack of use (ISTE, 2007). One extensive instrument constructed in Italy for the European Union (iDCA, 2009) was generous in providing the instrument for use in this dissertation but also did not conduct adequate validity or reliability procedures on the instrument even so far as basic factor analysis. Additionally,

the test itself is 78 questions in length. On the other hand, the validation of the Florida State Technology for Teachers Test (FI ST²) published their procedures and results (Hohlfeld, Ritzhaupt, & Barron, 2010). Unfortunately, the State of Florida Department of Education was not forthcoming for the use of the instrument for this dissertation.

Subjective Self-assessment Instrument (SSAI)

The *Subjective Self-assessment Instrument* (SSAI) (see Appendix A) consists of 45 questions in eight digital topic groups. Table 1 illustrates the eight topic groups that comprise the SSAI and the OAI of the *Digital Competence Survey*. With a basic template for the questionnaire established by McCourt Larres, et al., (2003) and Ballantine, et al., (2007), modifications regarding the timeliness of certain elements were updated. For example, the original instruments included questions regarding floppy disks and dial-up connections and had no reference to flash drives or broadband. Since Web 2.0 was not yet an established element of digital and educational technology at the time of the instrument construction, it too was missing.

Table 1: *Item Composition of the Subjective Self-assessment Instrument (SSAI) and the Objective Assessment Instrument (OAI) of the Digital Competence Survey^a*

Topic Groups	Number of Survey Items per Instrument	
	SSAI	OAI
Technology Awareness	6	n/a
General Computer Knowledge	12	7
Spreadsheets	4	6
Presentation Software	4	6
Word Processing	4	6
e-mail & Internet	5	10
Web 2.0	6	6
Databases	4	6
Total Survey Items	45	47

^a Composition prior to CFA and model modification

Additionally, many of the original instrument items were composed as

“double-barrelled” questions, multiple variable points within a given question. As an example, one question asked if the respondent was “comfortable composing and sending e-mails” (McCourt Larres, *et al.*, 2003). The modification for use in this study removed one of the elements, leaving a simple single variable question, as in, “I am comfortable sending e-mails.” (Brace, 2004; Czaja & Blair, 2005). The resultant instrument is otherwise written in a manner consistent with the McCourt Larres, *et al.* (2003) format and content. In each of the eight topic groups one or more questions were reverse worded making the question require a negative response in an effort to encourage the participants to read and answer the questions authentically and thus reduce threats to construct reliability based on test “response bias.”

The SSAI is comprised of eight digital topic groups as listed in Table 1. The *General Computer Knowledge* group is composed of 12 questions of which seven are *relative* variables asking students to self-evaluate their skills compared to their college classmates while the other six are absolute variable items. An example of the relative self-assessment type item is: *I am more experienced word processor user than my peers.* Students are also required to respond to absolute statements such as *I feel comfortable opening a file,* by responding on a five point Likert scale with a positive high point on one end and a negative low point on the other. The responses are represented by, one, *I strongly agree*; two, *I agree*; three, *Neutral*; four, *I disagree*, and fifth, *I strongly disagree*. These are offered across all of the eight digital topic groups of the subjective instrument as a consistent means for the respondents to represent their perceived self-appraised level of skills and knowledge and likewise use the same five-point Likert scale as described above to identify their self-assessed position relative to their classmates.

The remaining seven topic groups are *Databases*, four items; *Web 2.0*, six items; *e-mail & Internet*, five items; *Spreadsheets*, *Presentation Software*, *Word Processing*, four items each, and *Technology Awareness*, six items; for a total of 45 subjective survey items.

Validation of SSAI.

The basic design of the instruments chosen for this this dissertation was used multiple times between 1985 and 2008 (Ballantine, et al., 2007; Chen, 1985; McCourt Larres, et al., 2003; van Vliet, et al., 1994). It provided reasonable content validity but lacked reliability data. Since all of the other criteria the author sought had been met, it was decided to subject the instrument to appropriate reliability measurements as a confirmatory measure before use of the instrument. Reliability was determined by the use of Cronbach's α (alpha). According to Cronbach's theory alpha serves as a reasonable estimate of generalizability and thus serves as a measure of reliability in test theory (Cronbach, 1951). Acceptable levels were set at .80 as indicated by Nunnally (1987: p. 245). At the .80 level, it is suggested that a self-assessment test will possess sufficient reliability. All of the topic sections were subjected to the Cronbach's α procedure to test for reliability.

While Cronbach's α can also serve as a measure of construct validity, it was deemed insufficient for the purpose of the study in this dissertation. Alternatively, for the purpose of construct validity a confirmatory factor analysis was performed. The Kaiser-Meyer-Olkin (K-M-O) Measure of Sampling adequacy was processed to determine if the groups of variables were fit for factor analysis by virtue of a sufficient sample size relative to the number of questions in the survey. Kaiser (1974) recommended that a

value of .50 to be sufficient for proceeding with a factor analysis with a value above .90 being excellent. For the study, a value of .80 was determined to be more than sufficient for acceptance (Kaiser, 1974). The Kaiser-Meyer-Olkin (K-M-O) Measure of Sampling Adequacy returned a value of .849 that signified a high enough level of adequacy regarding sample size to proceed with a Confirmatory Factor Analysis.

Confirmatory Factor Analysis of SSAI.

Factor analysis examines the underlying structure or components of a survey instrument through an ordered reduction of data. Herein, a Confirmatory Factor Analysis (CFA) is applied to the Subjective Self-Assessment Instrument (SSAI). The notion of *fit* is associated with the idea that the observed data will fall (load) into expected groupings with the intention that the observed variables (test items, for example) actually belong together (Ferguson & Takane, 1989; Harrington, 2009; Kline, 1994; McDonald, 1985; Torkzadeh & Lee, 2003). Following the suggestions forwarded by Harrington (2009) potential problems were resolved prior to running the CFA. The potential problems requiring resolution involve missing data, normality and outliers, and sample size. The entire data set from the subjective self-assessment, objective, and demographic survey instruments was checked for any missing elements and found none. Missing data would have required statistical completion procedures to remedy the missing elements. There was no missing data detected from any of the survey instruments.

Objective Assessment Instrument (OAI).

The multiple-choice objective assessment instrument, *Objective Assessment Instrument* (OAI) is the second component of the *Digital Competence Survey*. The OAI was developed for the study and provides the individual objective topic group items used

for the comparison with the *Subjective Self-assessment Instrument* (SSAI) that addressed the first three research questions. Nunnally (1987, pp. 270, 274, 287) suggests that due to the inherent difficulty in attempting to control for threats to reliability and internal validity, care must be used in the construction of objective instruments. Seven major content areas were compiled, again, based upon those utilized in McCourt Larres, et al. (2003) and Ballantine, et al., (2007). These content areas directly correspond in content to the seven of the eight digital topic groups of the previously discussed *Subjective Self-assessment Instrument* (SSAI).

Since the SSAI and the OAI were constructed independently of each other and then brought together for comparison, the initial topic group development was slightly different. During the construction of the two instruments, the eighth and un-matched section of the SSAI, *Technology Awareness*, was utilized as a deflector/distractor section. The topic group was then was later excluded from the matched pairs comparison and subsequent analysis. The *Technology Awareness* section was left intact as a deflector device in the SSAI to maintain the appearance that the two sections were not to be considered as matched pairs to the research participants. This was intended as a means of contributing to the reduction of threats to validity through test experience bias. The remaining seven topic group items of digital competence comprising the OAI were presented to a panel of four educational technology researchers at the major Southwestern university where the study for was to be performed. They reviewed the items and had the option of deleting, modifying, or retaining, *as-is*, the objective survey items. The digital topic groups appropriate to technology for teachers were agreed upon, were in concordance with previous literature, and matched the Subjective Self-assessment

Instrument (SSAI) in terms of digital topic group pairings. Lastly, the topic groups were consistent with the content from the syllabus used for *Technology for Teachers in the Classroom* class.

The seven surviving topic groups used in the objective survey instrument (OAI) included: general computer knowledge, spreadsheets, word processing, Web 2.0, presentations, databases, and e-mail/Internet (See Table 1).

For each topic group of the objective survey a bank of multiple-choice questions were compiled. The questions for each topic group were chosen for inclusion in the objective assessment instrument. In an effort to discourage respondents from guessing the final choice for each question, a fifth response was added to the answers. This added response is “I do not know” in compliance with suggestions by Curtis, et al. (1986). Upon consensus, the instrument was compiled in its final form. Each item was constructed with one correct answer, three distracters, and “I do not know.”

As a means of reducing for “response set” bias effect, one randomly chosen question from each section is reworded (reversed) requiring a response to a negatively worded question. This was used to discourage automatic responses from the respondents by requiring them to completely read the question before answering (Rennie, 1982). Kerlinger (1973, p. 497) believes that “while response set is a mild threat to valid measurement, its importance has been overrated.” In this case, bias based on the attitude of the respondents seems less likely. This was due to the design and intention of the questions focusing on knowledge rather than having been directed towards attitudes or dispositions. Standard procedures for attitude based questions would have dictated that 50 percent of the questions be reverse worded to have created an affective scaling situation.

However, the questions in the study as a part of this dissertation were solely centered on a knowledge base and thus were intentionally designed with only a leaning toward negative response as a means to reduce the possible threat of question response bias. The decision to offer a warning that the questions *were not all the same* and that some were *negatively worded* was additionally utilized as a *light-handed* approach to reducing other possible inherent problems of threats by response biases.

Validation of OAI.

Following these procedures and after a thorough review and evaluation of compliance with accepted item writing practices (Fink & Kosicoff, 1998; Nunnally, 1987; Sue & Ritter, 2007) the compiled items were again presented to the panel of four educational technology researchers for their review with the opportunity to accept, reject, or modify the surviving question items. This confirmed content validity was, indeed, reasonably met for the objective survey instrument for use in the study of this dissertation. Finally, in the interest of reliability, the presentation order of the questions was randomized to further reduce the possibility of response biases.

After administration of the complete *Digital Competence Survey*, the results *Objective Assessment Instrument*, were tested for reliability, the absence of measurement error. It was tested by applying Cronbach's α (Alpha) procedure. The Cronbach's α (Alpha) procedure measured the reliability by computing the ratio of the instrument's [survey's] error variance in relation to its test variance and moderated it according to its relation with the sample size. As Cronbach's α (Alpha) ratio approaches 1.0, the more reliable the test is considered to be. A test result above .80 was determined to have adequately demonstrated reliability (Cronbach, 1951).

Demographics Questionnaire (DQ).

The *Demographics Questionnaire Instrument (DQ)*, the third part of the *Digital Competence Survey*, was comprised of questions regarding the subjects: current status as teachers, the number of digital technology classes completed, gender, year of their birth (to determine if they are Digital Native or Digital Immigrant), completion of one or more technology class, content area of teaching interest, year in school, and e-mail address (secured and eliminated after coding). Each of the questions (See Appendix C) were expected to provide relevant data used in determining factors and variables that contribute to the over-estimating or under-estimating or leniency bias of self-assessment by undergraduate preservice teachers. Several demographics, gender, home computer usage, college affiliation, and major have been used in earlier studies with significant effects and notable leniency bias dimensions (e.g., Ballantine, et al., 2007; Chen, 1986; Collis, 1987; McCourt Larres, et al., 2003; van Vliet, et al., 1994). Other studies failed to find demographic bias such as gender-bias (e.g., Gabriel, 1985, Evans & Simkin, 1989; Murphy, Coover, & Owens, 1989).

Specifically, age, completion of one or more technology class, and gender demographics were expected to provide data that no previous studies had previously reported. This study sought to determine significance related to the accuracy and validity of subjective self-assessment of digital competence for undergraduate preservice teachers. In determining the impact of demographic and experience variables the study produced results that can point to factors that can influence the design of instruction and program development for undergraduate preservice teachers. Additionally, the responses to the demographic and experience questions were expected to provide the bases for

developing focused explanatory qualitative questions to support the quantitative results of the *Digital Competence Survey*.

Quantitative Research Design

Quantitative procedures were utilized to address Research Question One, Two, and Three. The design utilized a primary survey, the *Digital Competence Survey* including three surveys: the *Subjective Self-assessment Instrument* (SSAI), the *Objective Assessment Instrument* (OAI), and the *Demographics Questionnaire Instrument* (DQ). The whole *Digital Competence Survey* was administered via an automated online survey (see Appendix A). The three quantitative assessment instruments were administered successively with the subjective self-assessment (SSAI) being administered first so as to not bias the responses to the items in the subjective self-assessment by the respondents seeing their responses on the objective instrument (OAI) and becoming aware that they do not actually have the level of competence or knowledge (higher or lower) that they would report on the subjective self-assessment portion. The demographics portion, DQ, was administered after the SSAI and the OAI to the same student subjects.

The responses from the *Subjective Self-assessment Instrument* (SSAI), the *Objective Assessment Instrument* (OAI) were subjected to statistical confirmatory procedures to test and establish the reliability and validity for each of the two instruments. A comparison of the results of the two instruments was undertaken utilizing nonparametric Wilcoxon matched-pair signed-rank test procedures. The nonparametric Wilcoxon matched-pair signed-rank analysis was utilized to compensate for the problem of scaling differences (ordinal vs. binary). The data from the third instrument, the *Demographics Questionnaire* (DQ), was recorded and categorized. Additional statistical

procedures sought differences among three demographic groups, gender, age, and completion of one or more technology classes, by isolating them and applying them as variables for further nonparametric comparisons again utilizing the nonparametric Wilcoxon matched-pair signed-rank test between their relative scores on the *Subjective Self-assessment Instrument* (SSAI) and the *Objective Assessment Instrument* (OAI).

Data Collection

Kaiser-Meyer-Olkin (K-M-O) Measure of Sampling Adequacy ($d=.849$) produced a sample size of 160 participants as a minimum for an acceptable sample size. This was further confirmed by applying the Bayesian rule of thumb parameter that the ratio between participants and items in the survey exceeds four or five to one (Lee & Song, 2004). The recruitment process was accomplished by sending 1187 e-mail invitations to potential participants in the Department of Educational Psychology & Higher Education research pool. Those given notification of the study and choosing to respond were included in the participant sample for the study. Non-responding students were sent second and if needed, a third invitation e-mail to ensure that the minimum 160 participants were secured. A total of 184 respondents were secured for the study. The demographic breakdown of the respondents is reported in Chapter 4.

The SSAI, OAI, and DQ of the *Digital Competence Survey* were administered to 184 participants. The anonymous response assessments were administered successively in order, SSAI, OAI, and DQ, to the participating students who completed the IRB approved Informed Consent form. The subjective self-assessment (SSAI) was administered first so as to not bias the responses to the items in the subjective self-assessment by the respondents seeing their responses on the objective instrument and becoming aware that they do not actually have the level of competence or knowledge

(higher or lower) that they would authentically report on the subjective self-assessment portion.

Later in the semester, after completing the primary quantitative analysis of the SSAI, OAI, and DQ, the four-question *Digital Competence Qualitative Support Survey* (DCQSS) was administered to the same subjects who had successfully participated in the quantitative portions of the study and agreed to participate further with the follow-up by submitting their e-mail addresses.

Since the intents of the qualitative and quantitative portions of the study are different, the collection of data was also different. The quantitative portion sought to establish a generalization for a sample while the qualitative portion sought to develop a deeper understanding of the results from a small group of individuals (Creswell & Plano Clark, 2011). Based upon the acceptability of this condition the sample sizes were notably unequal with 184 completing the quantitative portions and 12 participating in the qualitative follow-up.

Quantitative data analysis.

The *Subjective Self-assessment Instrument* (SSAI) and the Objective Assessment Instrument (OAI) sections of the *Digital Competence Survey*, were constructed differently with their respective results measured on two distinctly different scales. The SSAI was constructed with a five-level Likert scale representing an ordinal scale while the OAI was multiple-choice which is a binary scale. However, both the OAI and SSAI were constructed utilizing the same digital topic groups as matched pairs of question item groups. While the digital topic groups contained the same basic content, they were not exactly the same. The objective section was constructed with a binary scale where a

correct response equaled 1 and everything else, non-correct responses equaled a 0. The subjective section was designed with an ordinal scale relative to positive answers ranging from one to five. In order to level or equalize the scales, both scores were transformed to a percentage of total possible points for each topic group section in their respective instrument. Due to the conflicting scalar issue, typical analysis of variance could not work. The scores for each digital topic group in each instrument were totaled and expressed as a percentage of the total possible for each of the content area sections (Ballentine, et al., 2008; McCourt Larres, et al., 2003; van Vliet, et al., 1994).

Since the SSAI required scoring on an ordinal basis, and the OAI on the binary scale, a simple comparison of the respective percentages would yield severely faulty results. Therefore, a nonparametric statistical test was determined to be the most appropriate tool to facilitate analysis (Siegel & Castellan, 1988). The Wilcoxon matched-pairs signed ranks test is the nonparametric statistical version of the paired-difference *t*-test. It was applied to the matched pairs of the seven digital topic groups of the *Digital Competence Survey*'s SSAI and OAI to determine if there was any significant difference between the respondents' subjective self-assessment and the objective multiple-choice test scores for each of the compared digital topic groups. The significance level for this version of the nonparametric *t*-test was done at the 1% level. The analysis recorded the scores, relative scores, the number of ties, and then calculated the *Z* scores with the 2 tailed *p* levels at the .01 level ($p < .01$)(Ballantine, et al., 2007). The results of the Wilcoxon matched-pair treatment determined if the subjective scores were greater or lesser than the objective scores and determined if the null hypotheses were to be confirmed or not. This, in turn, indicated the answer to the research question

regarding the validity of subjective self-assessment as an accurate measure of digital competence among undergraduate preservice teachers. They further answered the second research question regarding the agreement between the objective and subjective assessments for undergraduate preservice teachers.

To address Research Question 3, demographic variables related to the accuracy of subjective self-assessed digital competence was conducted on each of the variable demographic groups. The test was repeated for Age, Gender, and Completion of one or more technology classes. The scores from the seven sets of topic groups from the *Digital Competence Survey* were segregated into the three demographic segments, Age, Gender, and Technology Classes then submitted again to the nonparametric Wilcoxon matched-pair signed-rank test as matched-pairs from the Subjective Self-assessment Instrument (SSAI) and the Objective Assessment Instrument OAI) to determine possible areas of significance for each of the demographic segments. The segregated demographic groups were then further divided into appropriate categories for analysis. For example, gender was separated into male, female, and refuse to reply. Age was divided into those born prior to 1980, Digital Immigrants, and those born since, Digital Natives. The completion of the technology class was separated into those who have completed one or more technology class and those who have not completed any such classes. The application of the nonparametric Wilcoxon matched-pair signed-rank test sought to determine if there is a predisposition to leniency in subjective self-assessment among the undergraduate preservice teachers based on the above demographic variables (Ballantine, et al., 2007; Jawahar, 2001; Longhurst & Norton, 1997; McCourt Larres,

et al., 2003; Mowl & Pain, 1995; van Vliet, et al., 1994). This served as a means of confirming the null hypotheses for H₀₁ and H₀₂ regarding which groups may indicate a predisposition towards leniency in their subjective self-assessment of digital competence. The differences between the objective and subjective sections combined with the differences among the demographic segments provided the basis for designing the qualitative follow-up questions.

Qualitative Research Design

Digital Competence Qualitative Support Survey (DCQSS).

A follow-up survey comprised of four open-ended questions regarding the participants' responses to items on the Subjective Self-assessment Instrument (SSAI) and the Objective Assessment Instrument (OAI) was administered to participants who had completed the three primary instruments, the SSAI, the OAI, and the DQ, of the Digital Competence Survey and agreed to follow-up questions. The follow-up survey responses were then subjected to qualitative content analysis to unearth explanatory data and details related to the results of the quantitative, Digital Competence Survey findings (Feucht, Bendixon, Winsor, & Zemp, 2011; Mayring, 2002). The explanatory nature of the follow-up inquiry allowed for better understanding of context and for the development of emergent themes that contribute to understanding how the participants came to answer questions on the survey and their perceptions regarding their performance on the two digital competence instruments, the SSAI and the OAI.

A follow-up questionnaire was administered at the conclusion of the Digital Competence Survey titled the *Digital Competence Qualitative Support Survey (DCQSS)*. This second phase of the study sought explanatory support for the quantitative elements

of the study. Whether or not the outcome of the quantitative *Digital Competence Survey* comparisons between the SSAI and the OAI sections reveal accuracy and/or validity of subjective self-assessment by undergraduate preservice teachers, several salient questions arose for the application of such data to the design of technology classes in teacher education programs. The qualitative questions served to offer a degree of explanatory evidence to support the quantitative data from the administration of the *Digital Competence Survey*. However, in accordance with Creswell and Plano Clark (2003, 2011) the actual finalized explanatory qualitative follow-up questions required the completed statistical results from the quantitative phase of the study to determine, with any precision, the questions to be asked. The qualitative phase, being emergent in nature, remained speculative until the earlier quantitative phase was subjected to the requisite statistical analysis and a clearer picture regarding the differences between the *Subjective Self-assessment Instrument* (SSAI) and *Objective Assessment Instrument* (OAI) scores developed. However, the four questions comprising the *Digital Competence Qualitative Support Survey* (DCQSS), to a moderate degree, might have been predictable regardless of the specific outcomes, as the general intention was to determine and explain how and why the respondents came to achieve the scores and survey results that they did. The four emerged questions comprising the DCQSS are as follows:

1. As a general basis----on what did you judge your own digital ability?
2. Based upon the results---what impact do you think this over-estimation has?
3. Overall----To what do you attribute this overestimation of digital competence?

4. Last one----Feel free to offer any opinions or comments you feel may be appropriate or significant....

Since significant statistical differences had emerged from the comparisons conducted SSAI and the OAI sections of the *Digital Competence Survey*, it was evident that the respondents misestimated their own sense of digital competence. Essentially, the overarching question that emerged sought their opinions on what factors contributed to their estimate regarding their digital competence and as applicable, what factors contributed to the difference in what they objectively demonstrated. This led to the emergence and development of questions one and three. Further, the follow-up questions sought to find explanatory data in the respondents' sense regarding the impact of the over-estimating or under-estimating of their digital competence. The final response was an opportunity for the respondents to offer any open-ended commentary, as they felt appropriate.

The responses to the first three qualitative questions were expected to reveal the specific elements that exerted the most influence on how they come to self-assess their digital competence. It was further anticipated that in doing so, might assist in offering educational program and instructional designers a better picture of how and what the students actually need and to shed light on those inherent elements that most influence their digital performance while explaining how the participants came to the self-assessed

Qualitative data analysis.

The qualitative data was visually inspected and descriptive analysis was commenced while scanning the data for trends, distributions, or possible anomalies of

interest. Concurrently, a qualitative codebook for all of the entries and questions was established.

The results and responses to the four qualitative questions were submitted to *Atlas ti* ® for content and text analysis to discover and develop the themes that assisted in devising a consensus for the explanations that emerged from the respondents. As a means of improving validity, the results of the quantitative sections were presented to the respondents as a part of the qualitative section that requested feedback in the form of their open-ended explanation of quantitative results. This procedure added a degree of authenticity and served to improve the interpretation of the quantitative results (Creswell, 2007; Creswell & Plano Clark, 2011; Onwuegbuzie & Leech, 2004). The intention here was to reveal additional details related to the quantitative phases. Only three questions and the open-ended response question emerged as listed above. To closely examine these and similar questions, Mayring's (2002) qualitative content analysis method was utilized. This method is derived from a more traditional but widely criticized, quantitative content analysis method from Kohlbacher, (2005); and Titscher, Meyer, Wodak, and Vetter (2000). Mayring (2002) applies a systematic, theory guided approach that analyzes text using inductive coding. It is open to context, thematic, and individual variations all of which are grounded as a theory guided investigation (Glaeser & Laudel, 1999).

Mayring's approach follows a definitive sequence for analysis in three phases. The first is the summary phase that reduces the overall material into a manageable body of generalized, paraphrased and reduced textual data. The second phase attempts to explain, clarify, and further distill or reduce the textual material into explanatory categories. These relate to the questions seeking explanatory data. Then the categories are

reduced and refined. Thirdly, the data is selected and coded into a structured arrangement that codes and explicates the responses into underlying themes. The codes are reviewed and revised and refined so that similarities, commonalities, and distinct differences emerge in ways that provide the desired explanatory data that supports and explains the quantitative data. Additionally, the emergent themes, codes, and patterns of response are supported with direct quotations from the respondents as support for the analysis.

The results of the initial processing and coding of the data collected from the quantitative follow-up survey was submitted to a colleague researcher to recode the raw results and develop themes without prior knowledge of the first pass results. With the two codings complete, the results were compared and consensus established provided inter-coder agreement (Creswell & Plano Clark, 2011).

In the analysis, outliers and extreme examples were not evident in any of the results and therefore presented no need for further inquiry as regarded their scores. The explanatory questions were therefore focused only upon participants with quantitative scores that fell within the normal curve distribution to determine their explanations for their responses or scores based on gender, age, or technology class completion.

Regardless of the specifics the general intention remained consistent with Creswell and Plano Clark's (2011) suggestion to answer the qualitative questions but also to address the larger research questions with the purpose of interpreting them to "draw meta conclusions" (p. 237). In this case, the term "meta" does not indicate global or generalized conclusions but rather is limited to the results of the study alone. These "meta conclusions" can only be drawn at the conclusion of a study and are essentially only about the study while they provide the intended better understanding. These "meta

conclusions” are drawn from the answers to mixed methods questions (pgs. 237-238). In the case of this dissertation, the questions regarding the demographic influences on leniency in self-assessment came to offer some oblique explanations as to how and why the study participants responded as they did. These results offer insight into the preservice teachers’ dispositions and perceptions regarding digital competence and the integration of technology in general.

Summary

This dissertation examined the validity of subjective self-assessment among undergraduate preservice teacher students at a major Southwestern public university. The study drew from students enrolled in the College of Education. The students represented both genders, five undergraduate college grade levels, a wide spectrum of ages from 18 to mature adult (representing the Digital Native and Digital Immigrant), and both those who have completed one or more technology classes and those with no training. The participant preservice teachers completed the *Digital Competence Survey*, a three-part set of surveys comprised of the *Subjective Self-assessment Instrument* (SSAI), the *Objective Assessment Instrument* (OAI), and the *Demographic Questionnaire Instrument* (DQ). A qualitative explanatory support survey was administered as a follow-up to gather explanatory data regarding the responses on the three sections of the DCS. The two quantitative sections of the DCA, the SSAI and the OAI, were tested for sample adequacy, validity, and reliability. The subjective section was subjected to a confirmatory factor analysis and the objective to an item analysis.

The SSAI and the OAI were submitted to Wilcoxon nonparametric analysis of matched-pair comparisons and analyzed. Lastly, the Wilcoxon test was applied to

demographic groupings to determine if one group or another from undergraduate preservice teachers is pre-disposed to leniency bias in subjectively self-assessing their perceived digital competence.

With the overall results from the Wilcoxon procedures a final analysis was undertaken using those results to create the explanatory questions in the qualitative follow-up survey. The follow-up survey was e-mailed to those participants that had previously agreed to the follow-up inquiry. This qualitative analysis was to suggest reasons for predispositions for leniency bias and to offer reasons for the over-estimation or under-estimation of the participants' digital competence. Support questions asking how respondents made their self-assessments and what they based that estimation on, provides insights into the processes and how teacher educators may need to alter their approach to providing authentic and accurate useful data for the design of educational programs and instruction.

Chapter 4: Results

The Results section includes two parts. Part one reports the quantitative results and part two, qualitative results. Before the report of the quantitative results, the results of examination of null hypotheses were reported to better understand the findings of the study.

Research Hypotheses

The results relative to the Research Hypotheses of the study are displayed in Table 2. They are consistent with the results of the nonparametric comparisons. The first hypothesis is directly related to the seven digital topic groups separately while the second relates to overall or the total of the combined topics as a whole of general digital competence. This will separate the demographic groups and will analyze them on each of the seven topic areas and on the basis of total scores on all the topic groups combined.

1. H_{01} : There is no significant difference in the relative score achieved on the objective assessment and relative score achieved in the subjective self-assessment test by undergraduate preservice teachers in each of seven topic groups of digital competencies.
2. H_{02} : There is no significant difference in the relative overall score achieved in the objective assessment and relative overall score achieved in the subjective self-assessment based on demographic variables among undergraduate preservice teachers in the seven areas of *digital topic groups*.

Quantitative Results

Participation Demographics.

A total of 184 responses were collected from 1187 invitations. Of the 184 responses, 174 (n=174) remained after a cleaning process eliminated pilot test participants and duplicates (n=4), and graduate and students in rolled in non-applicable programs (n=6). All responses and data were complete. This is a 14.7% successful rate of return on the invitations. There was no missing data (see Table 2).

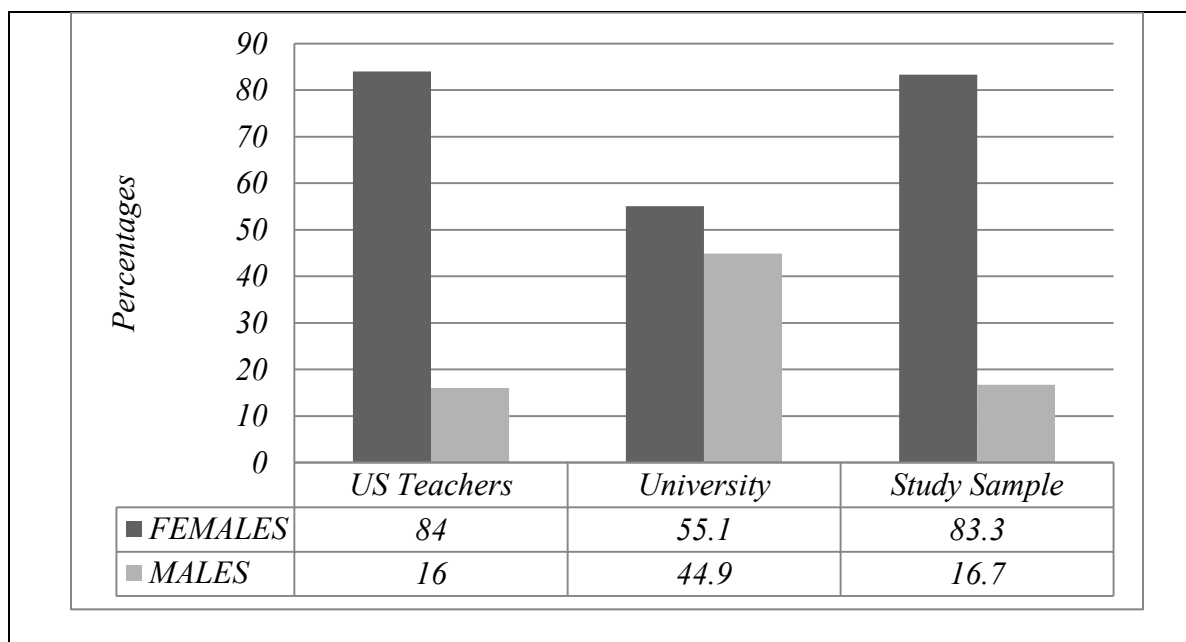


Figure 1: *Gender Percentages: US Teachers, University, and Study Comparison*

The number of females in U.S. teaching tends toward a female bias, in 2011 females comprised 84% of the teacher population (NCEI, 2011) nationwide. This is closely reflected in the study sample with 83.3 percent. Of the 174 subjects there were 16.7% males (n=29) and 83.3% females (n=145). While convenient, no generalization is made to the population in general based on the proximal close similar percentages. The

general population at the university is 55.1% female and 44.9% male (see Figures 1 and 2).

Table 2: *Final Descriptive Demographics of Survey Participants*

<i>Participants by Groups</i>	<i>Number (n=174)</i>	<i>Percentages</i>
<i>Females</i>	<i>145</i>	<i>83.30%</i>
<i>Males</i>	<i>29</i>	<i>16.70%</i>
<i>Digital Immigrants</i>	<i>27</i>	<i>15.50%</i>
<i>Digital Natives</i>	<i>147</i>	<i>84.50%</i>
<i>Subjects with No Technology Classes</i>	<i>90</i>	<i>51.70%</i>
<i>Students with One or More Technology Class</i>	<i>84</i>	<i>48.30%</i>

The university population is 78.9% Digital Native and 21.1% Digital Immigrant while the study sample has an 84.5% Digital Native and 15.5% Digital Immigrant sample (see Figure 3). This is both a reflection of the expected general youth of college students and is almost the numerical opposite of the US teacher workforce that has approximately 22% Digital Natives with the rest (78%) being Digital Immigrants. The number of Digital Immigrants has indicated a drop in their numbers since 2005. “Clearly, the older teachers

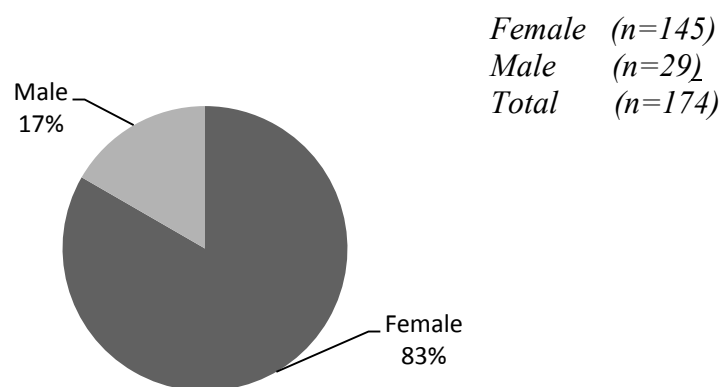


Figure 2: *Percentage of Study Participants by Gender*

are retiring and being replaced once again by teachers in their 20s and 30s” (NCEI, 2011, p. 12). This indicates that the Digital Natives are having an increasing impact and influence on the teacher workforce population.

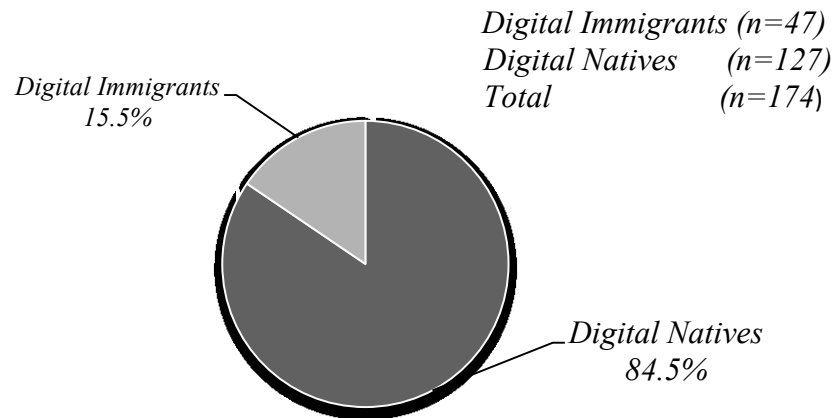


Figure 3: *Percentage of Study Participants by Age*

While the college where the study was conducted currently requires all enrolled students to complete a *Technology for Teachers in the Classroom* class, it is in no way extensive regarding digital technologies nor is it content intensive or specific. The participating preservice teachers were expected to possess a variety of skills, experience, and depth of knowledge regarding digital technology. Some were expected to have completed fewer or more technology classes than others.

The 174 subjects were divided into two groups based upon completion of one or more post-secondary digital technology classes. The two categories are: those who completed no post-secondary technology class (n=90) and those who completed one or more post-secondary technology classes (n=84) (see Table 2) (see Figure 4).

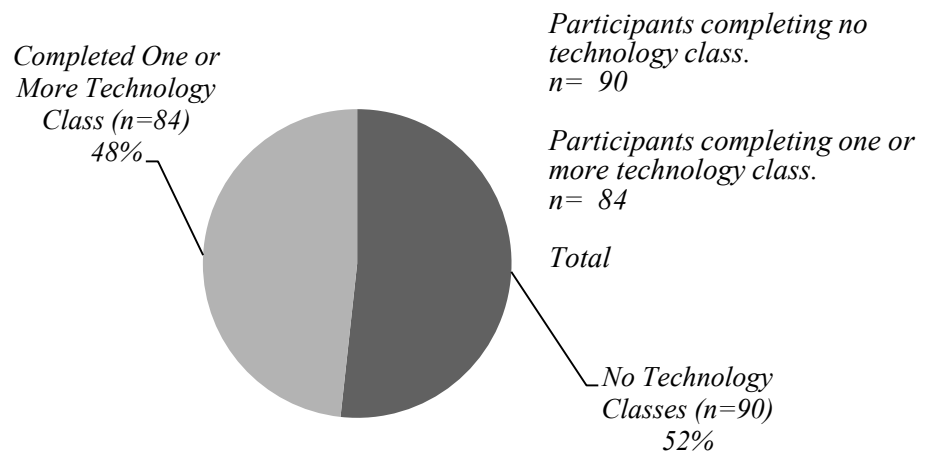


Figure 4: *Participant Percentages by Completion of Technology Class*

Instrumentation Data.

The *Subjective Self-assessment Instrument* (SSAI) (see Appendix A) was comprised of eight conceptual topic groups with 45 subjective questions. After the designed elimination of the deflector section, seven topic content groups consisting of 33 subjective questions remained. The SSAI was submitted to Confirmatory Factor Analysis that resulted in seven latent factor groupings consistent with the hypothesized conceptual groupings (see Table 3).

Table 3: *Item Composition of Digital Competence Survey*

<i>Conceptual Topic Sections</i>	<i>Number of Questions</i>	
	<i>SSAI</i>	<i>OAI</i>
<i>General Computer Literacy</i>	6	7
<i>Technology Awareness</i>	12/0	0
<i>Spreadsheets</i>	4	6
<i>Presentation Software</i>	4	6
<i>Word Processing</i>	4	6
<i>e-mail & Internet</i>	5	10
<i>Web 2.0</i>	6	6
<i>Databases</i>	4	6
<i>Total Items</i>	45/33	47

Each of the conceptual topic groups were scored as detailed in Chapter 3 with the totals for each set of questions in each of the groups then divided by the total possible scores for that particular group resulting with mean scores for each topic group. The Objective Assessment Instrument (OAI), 47 questions, was submitted to the same respective scoring procedure (see Table 4).

Table 4: Means Scores for Each Digital Topic Group

<i>Digital Topic Group</i>	<i>SSAI^a</i>	<i>Mean Score</i>	<i>OAI^b</i>	<i>Mean Score</i>
<i>General Computer Knowledge</i>	<i>SGC</i>	<i>0.875</i>	<i>OGC</i>	<i>0.491</i>
<i>Web 2.0</i>	<i>SW2</i>	<i>0.535</i>	<i>OW2</i>	<i>0.359</i>
<i>Presentations</i>	<i>SPT</i>	<i>0.807</i>	<i>OPT</i>	<i>0.459</i>
<i>E-Mail & Internet</i>	<i>SEI</i>	<i>0.926</i>	<i>OEI</i>	<i>0.600</i>
<i>Databases</i>	<i>SDB</i>	<i>0.564</i>	<i>ODB</i>	<i>0.143</i>
<i>Spreadsheets</i>	<i>SSS</i>	<i>0.664</i>	<i>OSS</i>	<i>0.397</i>
<i>Word Processing</i>	<i>SWP</i>	<i>0.818</i>	<i>OWP</i>	<i>0.325</i>

a Identifier codes for *Digital Topic Group* Question in SSAI

b Identifier codes for *Digital Topic Group* Question in OAI

The finalized data sets were submitted to IBM SPSS 20.0. The finalized 23 Subjective Self-assessment Instrument (SSAI) items returned a Cronbach's Alpha for 174 (n=174) subjects or .867, indicating an acceptable reliability statistic (see Table 5).

The *Objective Assessment Instrument* (OAI), comprised of 47 survey items in seven conceptual digital topic areas, was submitted to Cronbach's Alpha for 174 (n=174) subjects and returned .802. This is closer to the lower limit for acceptable reliability but still above the cut off and is sufficiently reliable (see Table 5).

The results of the collected data were separated into demographic groups divided by age, gender, and completion of one or more technology class completion. The means of each group is displayed in Table 6.

Table 5: <i>Cronbach Reliability Statistics for Subjective Self-Assessment and Objective Assessment</i>				
<i>SSAI</i>			<i>OAI</i>	
<i>N of Items=23</i>			<i>N of Items=46</i>	
<i>Cronbach's Alpha</i>			<i>Cronbach's Alpha</i>	
<i>0.867</i>			<i>0.802</i>	
<i>Cronbach's Alpha Based on Standardized Items</i>			<i>Cronbach's Alpha Based on Standardized Items</i>	
<i>0.812</i>			<i>.812</i>	
<i>Cases</i>	<i>N=174</i>	<i>Excluded Cases=0</i>	<i>Total=174</i>	<i>100%</i>

a. List-wise deletion based on all variables in the procedure

Confirmatory Factor Analysis Data Preparation.

Factor analysis examines the underlying structure or components of an instrument. This method helps in identifying “factorially pure items” (Torkzadeh & Lee, 2003, p. 610) and to identify the components that make up the total measure (Campbell, 1976). The purpose of the CFA is to utilize the hypothesized model to estimate the population covariance matrix and compare it to observed covariance matrix. The intention is to develop a model with minimal differences between the estimated and observed matrices. While there may be a tremendous number of possible models, this

treatment seeks to extract a model that does not decimate the theoretical connections between construct topics by eliminating individual items from the survey results. Therefore, the specific aim is to find a useable model that conforms with acceptable good fit parameters.

Harrington (2009) suggests that a confirmatory factor analysis (CFA) requires that the following list of potential problems in the data be resolved prior to running a CFA:

- a. Missing Data
- b. Normality and Outliers
- c. Sample Size

Table 6: Mean Scores for Seven Digital Topic Groups by Demographic Variables

Digital Topic Group	Survey Code	Age		Gender		Complete Technology Class	
		Digital Immigrants <i>n</i> =29	Digital Natives <i>n</i> =145	Females <i>n</i> =145	Males <i>n</i> =29	No Classes <i>n</i> =90	One or more <i>n</i> =89
General Computer Knowledge	SGC	.900	.870	.873	.886	.873	.877
	OGC	.498	.490	.475	.571	.471	.512
Word Processing	SWP	.871	.859	.861	.860	.864	.858
	OWP	.397	.310	.318	.356	.304	.347
Web 2.0	SW2	.484	.531	.521	.535	.510	.537
	OW2	.345	.362	.350	.402	.346	.373
E-Mail & Internet	SEI	.915	.940	.935	.938	.933	.939
	OEI	.548	.609	.585	.671	.594	.605
Presentations	SPT	.768	.815	.803	.828	.799	.815
	OPT	.425	.466	.452	.494	.404	.518
Spreadsheets	SSS	.686	.660	.651	.729	.636	.694
	OSS	.460	.385	.385	.460	.365	.432
Databases	SDB	.617	.553	.553	.621	.541	.589
	ODB	.201	.131	.136	.178	.143	.143

There was no missing data. There is, therefore, no need to consider mediating statistical treatments or considerations regarding this point.

The test for significant skew and kurtosis was conducted by dividing the unstandardized skewness or kurtosis index by its related standard error. This is the z -test of skew or kurtosis. Kline (2005) stipulates that ratios between than 1.96 and -1.96 are acceptable parameters for normality properties. Ratios above 1.96 would have a p -value less than 0.05, and ratios greater than 2.58 would have p -value less than 0.01. This would indicate increasingly significant skewness or kurtosis and thus present a problematic situation. To determine the normality conformation the Shapiro-Wilk Test for Normality was conducted. The results fell within the acceptable parameters indicating acceptable normality. The results all scored above .90 and approached the ideal of 1.00 indicating a normal distribution (see Table 7). Table 8 displays the results of SPSS's descriptive

Table 7: *Shapiro-Wilk Test of Normality for Subjective Self-assessment Instrument*

	<i>Statistic</i>	<i>df</i>	<i>Sig. (p)</i>
<i>SGC</i>	<i>0.970</i>	<i>174</i>	<i>0.001</i>
<i>SEI</i>	<i>0.966</i>	<i>174</i>	
<i>SPT</i>	<i>0.957</i>	<i>174</i>	
<i>SSS</i>	<i>0.975</i>	<i>174</i>	<i>0.003</i>
<i>SWP</i>	<i>0.948</i>	<i>174</i>	
<i>SW2</i>	<i>0.985</i>	<i>174</i>	<i>0.060</i>
<i>SDB</i>	<i>0.977</i>	<i>174</i>	<i>0.005</i>

a Lilliefors Significance Correction

Table 8: *Test for Skewness and Kurtosis*

based on their Monte Carlo approach to determining sample size requirements. Since this study has no missing data and is normally distributed it adopts the approach that 174 exceeds the 150 subject size determined by Muthén and Muthén (2002) and “fits’ the medium size criteria that Kline (2005) offers as a rule of thumb determinate. Further, Lee

Table 9: *One-Sample Kolmogorov-Smirnov Test*

		<i>Total Scores</i>	
		<i>SSAI</i>	<i>OAI</i>
<i>N</i>		<i>174</i>	<i>174</i>
<i>Normal Parameters^{a,b}</i>	<i>Mean</i>	<i>5.2301</i>	<i>2.7729</i>
	<i>Std. Deviation</i>	<i>.64778</i>	<i>.91567</i>
	<i>Absolute</i>	<i>.039</i>	<i>.051</i>
<i>Most Extreme Differences</i>	<i>Positive</i>	<i>.039</i>	<i>.051</i>
	<i>Negative</i>	<i>-.030</i>	<i>-.035</i>
<i>Kolmogorov-Smirnov Z</i>		<i>.517</i>	<i>.668</i>
<i>Asymp. Sig. (2-tailed)</i>		<i>.952</i>	<i>.763</i>

a. Test distribution is Normal.

b. Calculated from data.

& Song (2004, p. 680), states that the Bayesian approach improves with larger samples and “produces accurate parameter estimates and a reliable goodness of-fit test” when the ratio of sample size to parameters is 4:1 or 5:1. Their findings suggest that under some cases, these rules of thumb suggestions may be a reasonable guide for a sample size estimate, “at least for normally distributed data” (p. 680). This dissertation utilizes 23 survey items with 174 subjects and approximates a ratio of closer to 7.5:1 exceeding their suggested minimum ratio of 4:1 or 5:1. Lastly, and more definitively, the data was subjected to SPSS’s Kaiser-Meyer-Olkin Measure of Sampling Adequacy

(K-M-O) which produced a .844 result that exceeds the generally accepted level .50 for adequacy levels. Dziuben and Shirley (1974, p. 359) quote Kaiser's categorized scoring matrix that a K-M-O score in the 80's is "meritorious" (see Table 10).

Table 10: *KMO and Bartlett's Test*

<i>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</i>		<i>.844</i>
<i>Bartlett's Test of Sphericity</i>	<i>Approx. Chi-Square</i>	<i>1716.494</i>
	<i>df</i>	<i>276</i>
	<i>Sig. ($p \leq .001$)</i>	<i>.000</i>

a Based on correlations

Along with the K-M-O, the Bartlett's Test of Sphericity was run as a function of SPSS's descriptive statistics package. The results of the test indicate from the significance level ($p \leq .001$) of the test that the null hypothesis should be rejected and that the CFA can be conducted (see Table 10). With the major criteria issues addressed the CFA can proceed. The next step is the establishment of criteria and parameters of the CFA.

Results of Confirmatory Factor Analysis

The literature indicates that there are many possibilities for conducting and setting parameters for reporting fit indices and their corresponding criteria for what indicates adequate or what is more commonly called "good fit" (e.g., Kline, 2005; Raykov, Tomer, & Nesselroade, 1991). There are many recommendations for which fit indices and their underlying criteria to report and which of them indicate adequate or good fit (e.g., Kline, 2005; Raykov, et al., 1991). The description of these various goodness of fit indices themselves tend to be better understood as statistical explanations of why their related models do NOT fit the data rather than why they do. Brown's (2006) recommendations

are adopted herein as they are based on contemporary citations in the research literature and its support from Monte Carlo based research. Since each type of model fit index focuses on presenting different images regarding respective model fit or respective lack of fit, the literature indicates that studies should report multiple fit indices (Harrington, 2009). Brown (2006) lists Absolute Fit Indices, Parsimony Correction Indices, and Comparative Fit Indices as applicable categories for Model Fit Indices (MFI).

Absolute Fit Indices.

Absolute fit indices answer the question “Is the residual (unexplained) variance appreciable?” (Chan, et al., 2006, p. 1012). Chi-square (χ^2/df) is the most common absolute fit index and tests how well the observed model fits exactly to the population.

Standardized Root Mean Square Residual (SRMR) is based on the degrees of differences between the correlations in the input matrix and the correlations predicted by the model. This is standardized, making it easier to interpret.

Parsimony Correction Indices.

The Root Mean Square Error of Approximation (RMSEA) tests the extent to which the model reasonably fits. Brown (2006) reports that it is a particularly sensitive test. The parsimony correction indices formulae are designed with penalizing elements for poor parsimony. Complex models become quickly unwieldy and unworkable as indicated by low RMSEA result scores. This test was one of two, along with Comparative Fit Index (CFI), that drove the fit of the study. As revisions removed individual subjective conceptual survey items from the model, the complexity of the survey diminished and the RMSEA index rose precipitously indicating a continually improving fit (closer to the ideal 1.0).

Comparative Fit Indices.

The Comparative Fit Index (CFI), the Tucker-Lewis index (TLI), and the Non-Normed Fit Index (NNFI) are examples of the more common comparative fit indices. As noted earlier the CFI drove the fit development of the model that ultimately was utilized as the finalized data for the nonparametric comparisons in the study. The results of the CFI and TLI are reported in Table 12.

Model Fit Evaluation.

The initial run of the *Subjective Self-assessment Instrument* (SSAI) data was composed of eight constructs (eight Digital Topic Groups) composed of 45 related subjective survey variable items (survey questions). The regression coefficient was fixed to “1” to minimize the number of parameters to be estimated in the model. The hypothesized model is illustrated in Figure 5. The entire data set was submitted to AMOS 20.0 for tests of covariance and the inclusion of unobserved variables for each of the survey items. The initial run of the program was unable to process the data due to the number of errors in the model. The first step was the elimination of the section classified as *Technology Awareness* (initially coded STW). While this improved the AMOS output, the model remained an unacceptable fit across multiple fit parameters.

Since the usable model was expected to conform to a model with seven factors, as there were seven general topic/concept areas the analysis began there. The second trial resulted in AMOS 20.0 reporting that the “solution is [was] inadmissible.” The default model for the Residual Standardized Covariance matrix indicated that every latent variable produced covariance scores exceeding 2.0. According to Harrington (2009), it is not unusual for initial models to be poor fits. Commonly, specifying too few or too many

factors or using inappropriate indicators results in the poor fit. The poor fitting model required revisions. The revisions were undertaken and the resultant models re-tested for fit.

Using the Modification Index (MI) output and beginning with the highest index scores the model was revised by the linking of exogenous variables. The intention was to maintain the theoretical links between the variables as close to the experimental set of conceptual topics as practical. While the number of iterations and modifications conducted in attempts to bring the experimental model into proximity with the observed fit indices failed by simply using the error covariance scores and links, the next set of iterations produced better results that approached the usable model.

Re-sorting of the conceptual topic items to facilitate a better model fit would defeat the purpose of the analysis in seeking a factor-based model with an acceptable fit. Maintaining the theoretical groupings was critical in modifying the model.

In this study, indices of goodness-of-fit such as χ^2 , ratio of χ^2 to degrees of freedom, RMSEA, goodness of fit index (GFI), and comparative fit index (CFI) are used to evaluate the hypothesized model. The Modification Indices (MI) generated by SPSS AMOS 20.0 are data-driven indicators of probable changes to the demonstrated model that would improve the fit of the theoretical model. Again, these changes needed to retain the theoretical concept groupings. Harrington (2009) states that MI indices are analogous to individual Chi-square/df tests. Any MI greater than 3.84 indicates that a change that will probably result in a discernible improvement in fitting the model. Utilizing the Modification Indices (MI) and beginning with the elimination of indices that were the highest (above 4.0) and continued to adjust the model multiple times resulting in a

finalized model (see Figure 6). This finalized model conforms with the pre-established acceptable parameters is illustrated in Table 13.

While the finalized model (Figure 6) indicates thirteen unstandardized estimates of covariance below the .10 level, indicating weak connections between variables all of the low level connections are either between error variables or between different conceptual topics. It is important to note that all of the connections between the conceptual topic and each of the individual related conceptual topic items are at or above the .86 level. This indicated that the factor loading for the conceptual topics meets or exceeds the unstandardized covariant minimums as they all reasonably approach 1.0 (see Figure 6).

“Rather than evaluate a single model in isolation, it is often more informative and productive to compare a set of alternative models and possibly select a preferred model from the set” (MacCallum, 2003, p. 130). Sampling models provide rationale for excluding items before attempting to reprocess a factor analysis. The rationale is based on an assumption that all items being utilized *belong somewhere*. The intention is that they

Table 11: *CFA Model Fit Matrices (Normal and Standardized)*

Random Covariance																								
Code	SMP4	SMP2	SMP3	SSS4	SSS1	SSS1	SSS2	SMB4	SMB3	SMB1	SMB2	SMP2	SMP4	SMP7	SMP7	SMP7	SEI4	SEI2	SEI3	SMP24	SMP21	SMP22	SCS3	SCS6
SMP4	0																							
SMP2	-0.003	0																						
SMP3	-0.002	-0.029	0																					
SSS4	-0.006	-0.006	0.014	0.01	0																			
SSS1	-0.079	-0.009	0.172	-0.02	0.002	0																		
SSS1	-0.058	0.009	0.095	-0.012	0.008	-0.055	0																	
SMB4	-0.026	-0.035	0.03	-0.008	-0.035	-0.038	0.216	0																
SMB3	-0.008	-0.027	0.009	0.004	0.011	-0.074	0.036	-0.008	0															
SMB1	-0.001	-0.022	-0.017	0.14	0.154	-0.023	0.073	0.031	-0.008	0														
SMB2	-0.001	0.078	-0.036	-0.056	-0.152	-0.087	-0.025	-0.014	0.014	-0.024	0													
SMP2	-0.058	-0.098	-0.038	-0.006	-0.18	-0.144	-0.038	0.011	-0.012	0.038	0.011	-0.027	0											
SMP4	-0.06	-0.049	0.036	0.006	-0.008	0.083	-0.038	-0.038	0.001	0.017	0.094	0.01	-0.021	0										
SMP7	-0.011	-0.121	-0.032	0.019	-0.085	0.077	-0.049	0.011	-0.032	0.024	-0.005	-0.031	-0.043	0										
SMP7	-0.013	-0.09	-0.005	0.072	-0.074	0.099	-0.075	-0.009	0.019	0.097	0.007	-0.001	-0.062	0.09	0									
SEI4	-0.023	0.079	-0.013	-0.039	-0.016	0.064	-0.018	-0.018	-0.011	0.004	0.003	0.016	0.001	0.017	-0.011	0								
SEI2	-0.006	0.063	-0.045	-0.058	-0.019	0.094	-0.025	-0.035	-0.041	-0.015	-0.033	-0.004	-0.075	0.016	0.001	-0.016	0							
SEI2	-0.016	0.049	-0.015	0.007	-0.008	0.067	-0.029	-0.039	-0.039	0.017	0.004	-0.001	-0.001	-0.009	0.011	-0.02	0							
SMP4	0.007	-0.068	0.11	0.024	-0.097	-0.083	-0.079	0.111	-0.075	-0.045	-0.012	0.066	0.064	-0.013	0.025	0.008	0.02	0.024	0					
SMP2	0.016	-0.18	0.094	0.11	0.076	0.04	0.154	0.211	-0.024	0.041	-0.024	0.064	0.11	-0.079	-0.087	0.011	0.011	0.011	0.188	0				
SMP2	-0.026	0.023	0.01	0.216	0.011	0.036	0.038	0.002	0.012	0.017	0.024	-0.024	0.056	0.057	-0.012	0.02	-0.002	-0.014	-0.008	-0.028	0			
SCS3	-0.006	-0.049	-0.011	0.002	0.04	0.029	-0.039	-0.039	-0.031	-0.023	0	-0.03	-0.018	0.023	0.016	-0.046	-0.001	-0.001	-0.001	-0.017	-0.017	0.071	0	
SCS6	-0.015	-0.049	-0.017	-0.139	-0.038	-0.081	-0.08	0.01	0.01	0.091	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0	0

This symmetric matrix displays the differences between sample covariance and random covariance. If the model is correct, since the differences are small, the model can be considered correct.

Standardized Residual Covariance																								
Code	SMP4	SMP2	SMP3	SSS4	SSS1	SSS1	SSS2	SMB4	SMB3	SMB1	SMB2	SMP2	SMP4	SMP7	SMP7	SMP7	SEI4	SEI2	SEI3	SMP24	SMP21	SMP22	SCS3	SCS6
SMP4	0																							
SMP2	-0.071	0																						
SMP3	0.019	-0.013	0																					
SSS4	-1.423	-0.244	0.756	0																				
SSS1	-0.939	-0.084	0.361	0.009	0																			
SSS1	1.552	-0.098	2.469	-0.202	0.017	0																		
SSS2	-0.827	0.69	0.978	-0.219	-0.18	-0.548	0																	
SMB4	0.405	-0.294	0.345	-0.766	-0.303	-0.303	1.744	0																
SMB1	-0.127	0.236	0.102	0.03	0.251	-0.831	0.206	-0.118	0															
SMB1	0.014	-0.665	-0.205	1.236	1.312	-0.267	0.61	0.45	-0.058	0														
SMB2	-0.008	0.706	0.217	-0.491	-1.301	-1.032	-0.212	-0.126	0.114	-0.2	0													
SMP2	-1.063	-0.363	-0.507	-0.896	-1.764	-2.131	-1.311	-0.12	0.392	0.119	-0.267	0												
SMP4	1.165	-0.54	0.312	0.061	-0.087	1.193	-0.602	1.035	0.191	1.108	0.113	-0.271	0											
SMP7	-0.224	-1.467	-0.797	0.23	-0.866	1.216	-0.544	0.134	-0.631	0.116	-0.062	-0.724	-0.644	0										
SMP7	-0.267	-1.084	-0.076	0.838	-0.832	1.524	-0.836	0.915	-0.11	0.313	1.225	-0.011	-0.007	1.441	0									
SEI4	0.836	1.757	-0.363	-0.876	-0.447	1.923	-0.39	-0.247	0.103	0.073	0.197	0.023	-0.245	0.525	-0.317	0								
SEI2	0.179	1.103	-1.016	-1.03	-0.343	2.249	-0.419	-0.76	-0.292	-0.633	-0.072	-1.595	0.37	0.031	-0.397	-0.174	0							
SEI2	-0.531	0.958	-0.48	0.145	1.79	-0.523	-0.215	-0.055	0.795	0.083	-0.01	-0.21	0.868	-0.192	0.36	0.233	0.444	0.602	0					
SMP2	0.141	-0.687	1.509	0.246	-0.868	-1.146	-0.283	-1.178	-0.822	-0.499	-0.134	0.35	0.868	-0.192	0.36	0.233	0.444	0.602	0					
SMP21	0.608	-1.631	1.145	1.021	0.686	0.495	1.314	2.375	-0.234	0.403	-0.658	-0.524	1.223	-1.054	-1.124	1.264	0.806	0.514	2.084	0				
SMP22	-0.428	0.207	0.367	1.957	0.272	0.433	0.495	0.017	0.111	0.732	-0.228	0.26	0.787	-0.173	0.38	-0.062	-0.269	-0.978	-1.047	-0.271	0			
SCS3	-0.205	-0.394	0.314	0.037	0.253	0.241	-1.073	-0.663	-0.424	-0.609	-0.635	-0.422	0.56	0.446	-1.219	-0.057	-0.02	0.632	0.733	-0.717	-0.246	0		
SCS6	0.346	-0.628	-0.258	-2.091	-0.751	0.645	-0.883	0.403	1.262	1.097	1.093	0.501	0.249	0.319	-1.219	-0.057	-0.021	-0.947	-0.733	-0.246	0.998	0	0	

The matrix displays each residual covariance that has been divided by an estimate of the standard error (Kendall & Stouffer, 1964). These standardized residual covariances have a standard normal distribution if the model is correct. Very few in this model (.7%) exceed two in absolute value, indicating an acceptable normal distribution and a correct model.

The matrix displays each residual covariance that has been divided by an estimate of the standard error (Kenny & Cohen, 1984). These standardized residual covariances have a standard normal distribution if the model is correct. Very few in this model (few) exceed two in absolute value indicating an acceptable normal distribution and a correct model.

This symmetric matrix displays the differences between sample covariances and expected covariances. If the model is correct, since the differences are small the model can be considered correct.

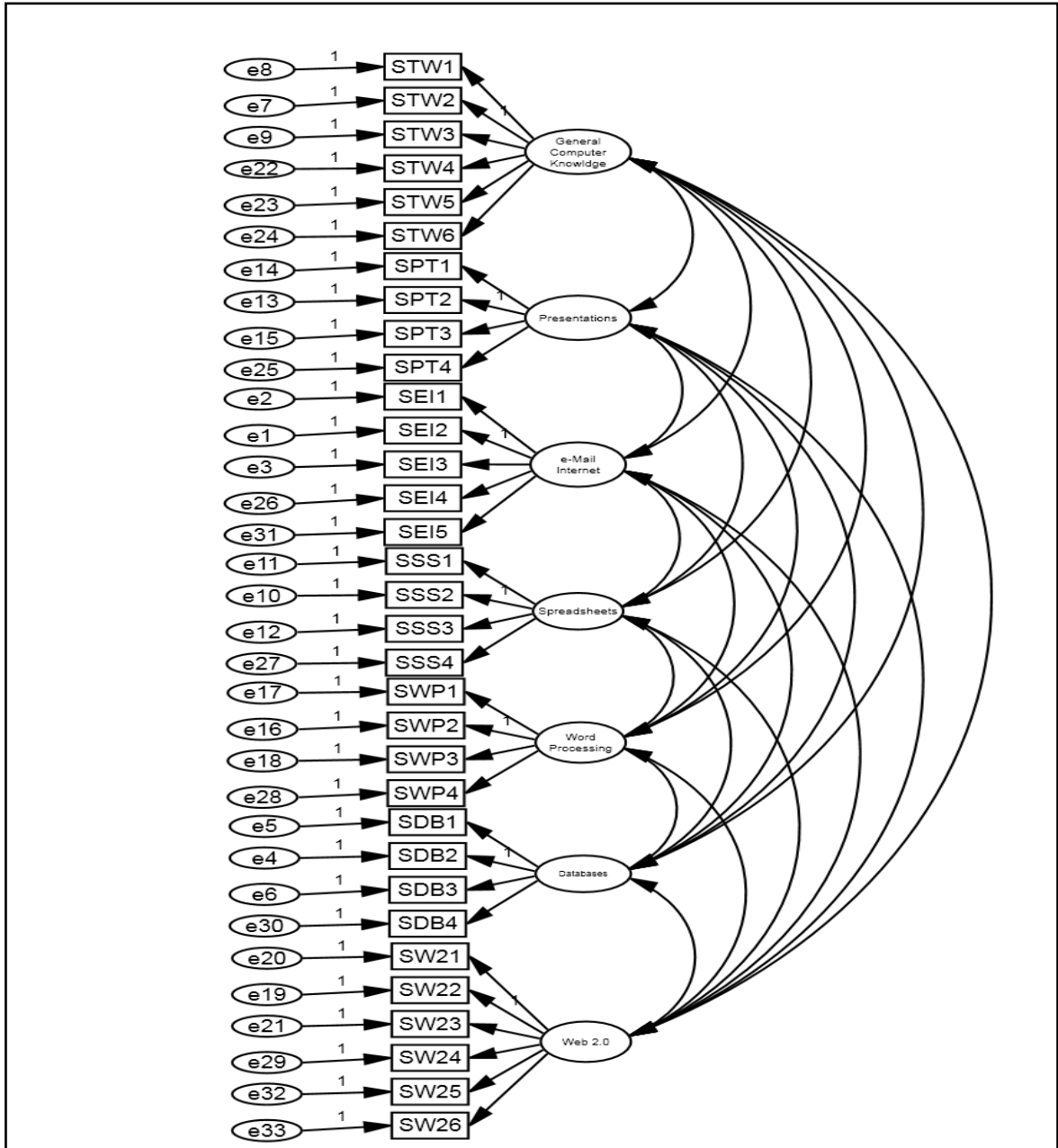


Figure 5: *Theoretical model of the Subjective Self-assessment Instrument (SSAI) with the Technology Awareness group eliminated, leaving the 33 initial questions for factorial analysis*

Thus, they have, or should have, equal amounts of explanatory power. It is logical that if all the items in a group of instrument items are part of a single construct their respective responses should be highly inter-correlated. This seems to not happen as planned as often as researchers might hope. It appears that the purification process needs

to happen as early as practical and as well as possible. Churchill (1974) warns that when a factor analysis is done before a model is adjusted and cleaned-up one should expect more dimensions than can be effectively fit to the related concepts. Falling victim to this failure the revised models for this study numbered in the dozens including complete re-specification of the conceptual factors based on entirely different sets of parameters. Ultimately, the best fit models all conformed to or exceeded the expectations for the final hypothesized conceptual topics. The exception is the Tucker-Lewis Index (TLI) which produced a fit index of .945, but is a close fit. The finalized observed model produced seven factors that specifically correspond to the seven conceptual topic groups as designated as the major conceptual topics accepted as requisite for digital competence and as designated by the validated SSAI. The seven topic groups were represented by 23 remaining intact specific survey items (See Appendix A). These remaining items related to the seven conceptual topic groups provide adequate items to conduct the nonparametric tests.

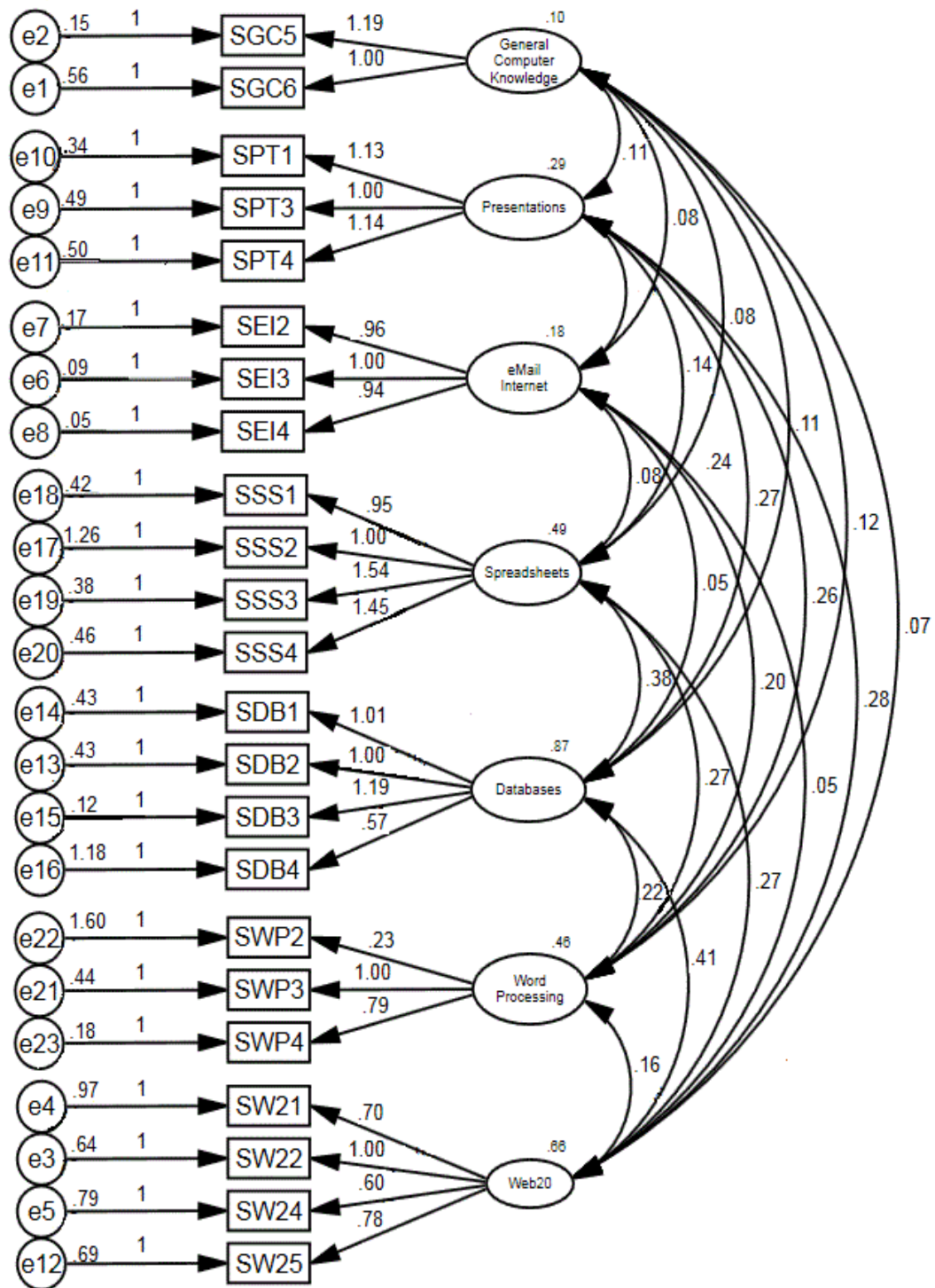


Figure 6: Final Seven-Factor CFA Model Displaying Standardized Covariance

Model Fit Summary.

There are multiple guidelines available for model fit that are considered acceptable. It is important to note that these are not rigid guidelines (Harrington, 2009, p. 53). Brown (2006) and Kline (2005) both recommend reporting several of the same indices, their criteria for fit, however, are different. Brown (2006) is the more conservative and recommends RMSEA close to 0.06 or less; SRMR close to 0.08 or less; CFI close to 0.95 or greater; and TLI close to 0.95 or greater (see Table 12).

Table 12: *Model Fit Tests*

<i>Model Fit Tests</i>		<i>Brown (2006) Recommended Guidelines</i>	<i>CFA Results</i>
<i>Chi-square</i>	<i>(χ^2)</i>		<i>1.34</i>
<i>Standardized Root Mean Square Residual</i>	<i>(SRMR)</i>	<i>0.08 or less</i>	<i>0.059</i>
<i>Root Mean Square Error of Approximation</i>	<i>(RMSEA)</i>	<i>0.06 or less</i>	<i>0.045</i>
<i>Comparative Fit Index</i>	<i>(CFI)</i>	<i>0.95 or greater</i>	<i>0.954</i>
<i>Tucker-Lewis Index</i>	<i>(TLI)</i>	<i>0.95 or greater</i>	<i>0.945</i>

Kline (2005, p. 139) reports that “RMSEA \leq .05 indicates close approximate fit.” The study’s CFA reports .045, a close approximate fit. CFI “greater than roughly .90 may indicate reasonably good fit of the researcher’s model” (Kline, 2005, p. 140). The study reports .954, above the “reasonably good fit.” Lastly, Kline reports SRMR values “less than .10 are generally considered favorable” (Kline, 2005, p. 141). The study reports .045, “favorable.”

Since the criteria were met according to Brown’s (2006) conservative guidelines the model fit is considered acceptable and the finalized list of subjective survey items were committed to further examination and the nonparametric tests for comparison of the two portions of the survey, the subjective and the objective.

The finalized model for the subjective survey consisted of 23 Likert questions grouped into the confirmed seven conceptual topic groups (See Appendix A). The SSAI is matched to the OAI by matched conceptual topic groups. The objective survey is composed of 47 multiple-choice questions (see Appendix B).

Objective Survey Instrument

The *Objective Assessment Instrument* (OAI) is composed of objective multiple choice questions. These questions are the objective portion for the nonparametric comparison procedures. Following Nunnally (1987, pp. 270, 274, 287) care was used in the construction of the objective instrument to control for threats to reliability and validity. The construction of the objective *Digital Competence Survey* followed basic procedures established by Cheng, et al. (1985) (as cited in van Vliet, et al., 1994). Again, seven major content topic groups were drawn from McCourt Larres, et al. (2003). These

content areas correspond in content to the seven of eight corresponding topic groups of the SSAI. The eighth section, *Technology Awareness*, is excluded from the matched pairs. The remaining seven major topic groups related to digital competence were presented to a panel of professors of Educational Technology at the major Southwestern research university where the study was to be performed. The content areas of the OAI, appropriate to technology for teachers, were agreed upon, were in concordance with previous literature, and match the Subjective Self-assessment Instrument (SSAI) in terms of topic/content pairings.

The seven content areas used in the OAI, are general computer knowledge, spreadsheets, word processing, Web 2.0, presentations, databases, and e-mail/Internet (see Table 13).

Table 13: *Composition of Objective Assessment Instrument (OAI)*

<i>Conceptual Topic Group</i>	<i>Number of Questions (n=46)</i>
<i>General Computer Literacy</i>	7
<i>Spreadsheets</i>	6
<i>Presentation Software</i>	6
<i>Word Processing</i>	6
<i>e-mail & Internet</i>	9
<i>Web 2.0</i>	6
<i>Databases</i>	6

The consensus for the items of the OAI compiled in its final form was approved by panel of four educational technology researchers establishing acceptable content validity.

Item Analysis

The items were subjected to a difficulty item analysis using the formula of correct responses divided by total responses. The results indicated that several items be excluded as excessive percentages of respondents got them incorrect or conversely an excessive

number answered them correctly. However, since these surveys are intended to determine a “snapshot in time” model of what the subjects contend they know and what they actually demonstrate at that given moment, the decision to leave all of the objective items in place was made. This is not a summative or formative examination to determine what they have learned but rather what they already know. Consistent with this decision the multiple choice surveys were scored for all subjects (n=174) with 9.8 percent scoring less than 60% correct. The remaining 90.2% scored above 60%, the default score for passing a given “school-based” examination (WebCampus, 2012). The Kaiser- Meyer-Olkin Measure of Sampling Adequacy returned .858 which also exceeds the accepted .60 level for adequacy (see Table 15). See Table 5 for mean scores for the digital topic groups of the OAI.

Table 14: *Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett’s Test*

<i>Kaiser-Meyer-Olkin Measure</i>		0.858
	<i>Approx. Chi-Square</i>	300.123
<i>Bartlett’s Test of Sphericity</i>	<i>df</i>	21
	<i>Sig.</i>	0.00

Comparison Of Subjective To Objective Survey Instruments

As can be observed in Table 16, all of the differences between the SSAI and OAI matched mean ranks as represented by the z-scores are large and the scores are all significant ($p < .01$).

Table 15: *Wilcoxon Test Statistics a - Z-scores for All Subjects and Variables (n=174).*

	<i>Z Scores by Digital Topic Group</i>						
	<i>OGC - SGC</i>	<i>OEI - SEI</i>	<i>OPT - SPT</i>	<i>OSS - SSS</i>	<i>OWP - SWP</i>	<i>OW2 - SW2</i>	<i>ODB - SDB</i>
<i>Z</i>	-11.448 ^b	-11.444 ^b	-10.962 ^b	-10.768 ^b	-11.445 ^b	-7.907 ^b	-11.190 ^b
<i>Asymp. Sig. (2-tailed)</i>	0	0	0	0	0	0	0
<i>P < .01</i>							

^a. Wilcoxon Signed Ranks Test ^b. Based on positive ranks.
^c. P is at 1% level

These results indicate that the null hypotheses for all of the conceptual groupings be rejected. Therefore, there is a statistically significant difference between the results of the SSAI and the results of the matched OAI. This difference is reflected by the negative z-scores and is an indication of leniency bias in favor of over-estimation of digital competence by the participants.

The Wilcoxon Signed Ranks Test was utilized for a second time to compare the preservice teacher participants of the two groups divided by gender to determine if there was a leniency bias by either. The first group is composed of 29 males and the second of 145 females (n=174). Each group was submitted to SPSS 20.0. The results are posted in Table 16.

All of the matched pairs are significant with negative z-score differences among the female subject sample. This indicates an overestimation and leniency bias of the female subjects' digital competence.

Table 16: *Results of Wilcoxon Signed Ranks Tests by Gender.*

<i>Z Scores by Digital Topic Group</i>								
		<i>OGC - SGC</i>	<i>OEI - SEI</i>	<i>OPT - SPT</i>	<i>OSS - SSS</i>	<i>OWP - SWP</i>	<i>OW2 - SW2</i>	<i>ODB - SDB</i>
<i>Females (n=145)</i>	<i>Z</i>	-10.453 ^b	-10.449 ^b	-10.102 ^b	-9.921 ^b	-10.449 ^b	-7.410 ^b	-10.218 ^b
	<i>Asymp. Sig. (2-tailed)</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	<i>p<.001</i>							
<i>Males (n=29)</i>	<i>Z</i>	-4.709 ^b	-4.705 ^b	-4.316 ^b	-4.142 ^b	-4.713 ^b	-2.823 ^b	-4.564 ^b
	<i>Asymp. Sig. (2-tailed)</i>	0.000	0.000	0.000	0.000	0.000	0.005	0.000
	<i>p<.01</i>							

^a. Wilcoxon Signed Ranks Test
^b. Based on positive ranks
^c. p= 1%

d.

e.

f.

The male subjects (n=29) were submitted to the Wilcoxon Signed Ranks Test process with the following results (see Table 16). All of the comparisons indicated a rejection of the null hypothesis except the comparison scores for Web 2.0. This nonparametric comparison produced significance at the .01 level (.009) indicating that the subjective self-assessment of the males' Web 2.0 competence is an accurate reflection of their demonstrated competence in this conceptual topic area. The related Z-scores all fell within the -4.250 and -4.750 level except the Web 2.0 level which fell at -2.606. The male subjects came closer to accurately estimating their self-assessment on Web 2.0 items only. The females remained consistent with their subjective self-assessed over-estimation of their objective abilities across all of the seven conceptual topic groupings.

Like the above gender related section, the subjects were again segregated into two groups. Based upon their year of birth the subjects were divided into what Prensky (2001) tagged Digital Natives, those born after 1980 and Digital Immigrants, those born prior to 1980. While approaching the issue of age, rational divisions might have suggested more groupings. However, the intense popularity of the 1980 dividing year suggested that the study should test the theory based on that dividing point. The preservice teachers

participating in the study were divided as follows: 29 subjects were born prior to 1980, and 145 fall into the Digital Native, post 1980 category, again totaling 174, with no missing data.

The Digital Natives, post 1980 participating preservice teachers, did demonstrate significance across all of the matched tests indication that the Natives all tended to over-estimate their digital competence against their objective (OAI) performance. This led to rejection of the null hypothesis for their test performance on all seven conceptual digital topic groups. The Digital Native subjects, born in 1980 or later, presented a notably higher set of mean rank scores than the Digital Immigrant group by more than twice. The Digital Natives over estimated their digital competence with a mean rank of -9.86 opposed to the older Digital Immigrants with a mean rank of -4.19 (see Table 17).

Table 17: *Results of Wilcoxon Signed Ranks Tests by Age.*

		Z Scores by Digital Topic Group						
		OGC - SGC	OEI - SEI	OPT - SPT	OSS - SSS	OWP - SWP	OW2 - SW2	ODB - SDB
Digital Natives (n=145)	Z	-10.453 ^b	-10.449 ^b	-10.102 ^b	-9.921 ^b	-10.449 ^b	-7.410 ^b	-10.218 ^b
	Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	p<.001							
Digital Immigrants (n=29)	Z	-4.709 ^b	-4.705 ^b	-4.316 ^b	-4.142 ^b	-4.713 ^b	-2.823 ^b	-4.564 ^b
	Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.005	0.000
	p<.01							

Wilcoxon Signed Ranks Test

b. Based on positive ranks

c. p= 1%

A final set of statistical tests were initiated utilizing the Wilcoxon Signed Ranks Test to examine the possible effect of completing one or more post-secondary technology

classes upon self-assessment accuracy among undergraduate preservice teachers. The subjects (n=174) were divided into those who have completed no classes (n=90) and those having completed one or more post-secondary technology classes (n=84). No distinction is made between types or level of such classes. The intention was to examine the possible impact of minimal academic exposure to technology (total n=174). There was no missing data (see Table 18).

Table 18: *Results of Wilcoxon Signed Ranks Tests by Completion of Technology Class.*

		Z Scores by Digital Topic Group						
		OGC - SGC	OEI - SEI	OPT - SPT	OSS - SSS	OWP - SWP	OW2 - SW2	ODB - SDB
One or More Class (n=90)	Z	-8.245 ^b	-8.229 ^b	-7.914 ^b	-7.824 ^b	-8.072 ^b	-5.631 ^b	-7.843 ^b
	Asymp. Sig. (2-tailed) p<.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
No Class (n=84)	Z	-7.965 ^b	-7.972 ^b	-7.646 ^b	-7.392 ^b	-7.713 ^b	-5.554 ^b	-7.964 ^b
	Asymp. Sig. (2-tailed) p<.01	0.000	0.000	0.000	0.000	0.000	0.005	0.000

- a. Wilcoxon Signed Ranks Test
b. Based on positive ranks
c. p= 1%

The results of the Wilcoxon Signed Ranks Test for those subjects who did not complete a post-secondary technology class indicated over-estimation in all seven conceptual topic groupings according to the results as indicated by the Z-scores. All were significant at the .01 level and required the rejection of the null hypotheses. This indicates that the “No Classes” participating preservice teachers over-estimated their digital competence.

As with the participants who had completed no post-secondary technology classes, those who completed one or more classes also demonstrated significance at the .01 level in all conceptual topic groupings. The Z-scores as illustrated in Table 18

indicated over-estimation of digital competence across all seven conceptual digital topic groupings.

While the comparison tests reveal a consistent self-assessed over-estimation (leniency bias) of digital competence and conform to earlier findings related to accounting and business students (Ballantine, et al., 2007; Mc Court Larres, et al., 2003), there may be elements at work that lend to this over-estimation that quantitative statistics do not illuminate. The phenomena warrant qualitative inquiry in an effort to explain the consistency across diverse subject samples. For example, participants who have reported no post-secondary academic technology training over-estimate similarly to those who completed one or more classes. This suggests that training, or lack of formal training, may not be the driving factor for this subjective self-assessed over-estimation.

Findings of Qualitative Research

The fourth research question of this dissertation is intended as a means of contributing to the explanation of the quantitative results. The question is: *To what do the subjects attribute any differences between their subjective self-assessment and objective measurements of their digital competence?*

The results of the nonparametric results indicate that subjective self-assessment of digital competence among undergraduate preservice teachers over-estimate their demonstrated objectively measured competence. The participants demonstrate this leniency bias in their subjective self-assessment. As noted above, this over-estimation phenomenon is fundamentally consistent with previous research that examined accounting and business students in the United Kingdom, New Zealand and Eastern Asia (Ballantine, et al., 2007; McCourt Larres, et al., 2003; van Vliet, et al. 1994).

Consistent with Creswell and Plano Clark (2011, p. 9) “. . .the [quantitative] results of a study may provide an incomplete understanding of a research problem and there is a need for further explanation.” The consistency of leniency bias and subjective over-estimation of digital competency has now spanned nearly three decades, coinciding with the birth of the personal computer digital age. The notion of the Digital Native being imbued with certain acquired and ostensibly natural skill sets warrants inquiry into not only how they perceive and explain their sense of their digital competence but how they explain their self-assessed over-estimation of their competence and to what do they attribute it. See Appendix D for a copy of the follow-up e-mail invitation.

The Digital Immigrants and the Digital Natives were evenly divided with three males and three females in each age group (see Table 19). The follow-up inquiry did not provide a means of determining if the respondents completed a post-secondary technology class. Twelve responses were received and analyzed.

The twelve respondents were given pseudonyms, coded with typical female names for the females and male names for the males with the first letter being at the beginning of the alphabet for Digital Immigrants and the end of the alphabet for Digital Natives (see Table 19).

Table 19: *Qualitative Coded Respondents (n=10)*

<i>Pseudonym</i>	<i>Gender</i>	<i>Age</i>
<i>Alan</i>	<i>Male</i>	<i>Digital Immigrant</i>
<i>Alicia</i>	<i>Female</i>	<i>Digital Immigrant</i>
<i>Betty</i>	<i>Female</i>	<i>Digital Immigrant</i>
<i>Bob</i>	<i>Male</i>	<i>Digital Immigrant</i>
<i>Carla</i>	<i>Female</i>	<i>Digital Immigrant</i>
<i>Ed</i>	<i>Male</i>	<i>Digital Immigrant</i>
<i>Rose</i>	<i>Female</i>	<i>Digital Native</i>
<i>Steve</i>	<i>Male</i>	<i>Digital Native</i>
<i>Tina</i>	<i>Female</i>	<i>Digital Native</i>

<i>Victor</i>	<i>Male</i>	<i>Digital Native</i>
<i>Will</i>	<i>Male</i>	<i>Digital Native</i>
<i>Zita</i>	<i>Female</i>	<i>Digital Native</i>

The responses to the questions were sent to two other research affiliates who coded them. Where differences in the coding appeared, the raters discussed the meanings and interpretations and came to a consensual agreement. The results of the coding were entered into a matrix based on the four questions in the follow-up survey (see Appendix D).

On what did you judge your own digital ability?

The responses to this question coded as follows in Table 20.

Table 20: *Coded Responses to the Question: On what did you judge your own digital competence?*

	<i>Professional Experience</i>	<i>Common Use Familiarity</i>	<i>Special Use Experience</i>
<i>Females</i>	2	4	
<i>Males</i>	1	4	1
<i>Digital Immigrants</i>	3	2	
<i>Digital Natives</i>		4	1

Professional Experience is the common code derived from the acquisition of digital ability/competence from usage in the work place. *Special Use Experience* is derived from using technology to assist special needs individuals. While this may be

interpreted as work place derivation in the sense that the respondent worked as a special education assistant it is not consistent with the other work place experience responses as they indicated positions in data entry and information technology positions. *Common Use Familiarity* is derived from comments that the respondent learned technology from personal usage at home, in school and their daily non-professional lives.

Based on the results—what impact do you think this over-estimation has?

Two somewhat divergent paths emerged from the response to this question. The first path was the response to the question as to the impact of over-estimation and the second was the tone of the response, which may be the more significant of the two.

Table 21: *Response to “Based on the results—what impact do you think this over-estimations has (n=8)?*

	<i>Improved awareness, recognition and willingness to learn</i>	<i>More and better training</i>	<i>No Comment</i>	<i>Academic/ Moot</i>	<i>Pedagogically Important</i>	<i>Personally Affronting</i>
<i>Females</i>	4	1	1	3	3	0
<i>Males</i>	3	1	1	2	1	2
<i>Digital Immigrants</i>	3	3	1	4	2	1
<i>Digital Natives</i>	2	1	1	1	0	1

At face value the responses to the question resulted in two general response sets. Six of the respondents indicated that the impact of over-estimation is that the collective *we* (preservice teachers, educators, and students) need to improve awareness, recognition, and willingness to learn that which is not known [digital?]. There was no elaboration by any respondents regarding what constitutes “what is not known.” Since this is taken in the context of this dissertation it is interpreted to mean the gap between what they are

aware they currently hold as digital knowledge and the rest of the vast and expanding digital universe.

Two respondents, one Digital Native male and one Digital Immigrant female simply stated that more and better training is needed, with no further elaboration.

The second path, the tone of the response, produced a slightly different picture of the respondents' reaction to the question. The five female respondents were split, three/two, with two expressing the opinion that the impact of overestimation as being an academic argument that simply needs to be dealt with by adding awareness training to preservice teacher curriculum. The remaining three reflected that the over-estimation was professionally and/or pedagogically salient to the tenets of a career in a classroom. Two of the males, both Digital Natives, agreed that the impact was an academically moot issue. One, Bob, noted the pedagogical importance. The remaining two males indicated that being, "called out" on the over-estimation had the impact of suggesting that they were among *un-identified* others to whom they felt [inaccurately] "superior" (Victor) and that being questioned had the suggestion that they were made to feel "foolish" (Alan).

Overall—To what do you attribute this over-estimation of digital competence?

This question is the most closely related to Research Question: 4, that seeks to inquire, as the questions state, "to what do the participating subjects attribute the over-estimation?" This is addressed in more detail in Chapter 5. The responses to this question aligned along both gender and age lines. These responses may offer the bases for follow-up studies that can explore them in specific, in-depth, and expanded detail.

The constant comparison analysis developed three general response sets to the empirical question. Two more sets of response factors emerged from the constant comparison. Tables 21 and 22 illustrate the responses.

Table 22: *Responses to question: “Overall—To what do you attribute this over-estimation of digital competence?” (n=8)*

	<i>We are sufficient. We know enough to get around the Digital Universe. We have just seen how much more there is to know.</i>	<i>There is an awareness of what we don't know that isn't acknowledged and/or admitted.</i>	<i>We don't know what we don't know and that is important in training teachers.</i>	<i>I will learn as I go along.</i>	<i>I don't care .</i>	<i>I'm okay with this.</i>
<i>Females</i>	3	2	1			
<i>Males</i>	3	2	1			1
<i>Digital Immigrants</i>	2	2	2	1		
<i>Digital Natives</i>	4	2	0	3	1	2

The responses by the female participants answered the question by attributing their subjectively self-assessed over-estimation to a general lack of awareness regarding that the gap between what they *think they know* and what they *actually know* exists. Further, two of the female participants provided the general indication was that there is a vast area of technology that they have not acquired or even experienced. Yet, they expressed that, in spite of the things they did not know, that they still feel reasonably competent because they *do* know enough “to get around the digital universe.” The third female participant commented that her perspective attributed the over-estimation to an awareness of the gap in knowledge but due to fear or ignorance cannot or will not acknowledge it. This contributed to the inaccuracy of the reporting. Other than one comment that the awareness and consequent closing of the gap has important

implications in professional education there was no more notable commentaries offered by the females.

Open Ended Comments.

Three males essentially responded like the females, regarding the idea that they are sufficiently capable with technology but also are aware of the vast amount they have not learned, experienced, or to which they had little or no exposure. Two males also attributed their over-estimation to fear or ignorance and an unwillingness to acknowledge or reveal the personal gap. However, four males commented and suggested that they are not particularly concerned about the over-estimation and that they will pick it up as they go along. Two of the males, both Digital Natives, indicated that they are specifically unconcerned. Victor, stated “I’m okay with this” [gap and over-estimation]. Steve said, “I don’t care.” Lastly, Ed, alternatively, indicated a sense of caution and a need to protect oneself and one’s digital material.

Research Questions

The three research questions will be addressed briefly regarding the results of the study. They are as follows:

Research Question 1: Does subjective self-assessment accurately reflect agreement with performance on objective competence assessments by undergraduate preservice teachers?

The results of the study indicate that subjective self-assessment does not accurately reflect agreement with demonstrated performance by objective assessment. The results of the Wilcoxon nonparametric comparison indicates that there is a statistically significant difference between the results of the subjective SSAI and the results of the matched

objective OAI. This difference is reflected by the negative z -scores and is an indication of leniency bias in favor of over-estimation of digital competence by the participants (see Table 16).

As indicated in the response to Research Question 1 results, subjective self-assessment is not an accurate measure of digital competence. The mean scores of the OAI and the SSAI and nonparametric comparisons indicated that the results of the objective OAI were below those of the subjective SSAI for all digital topic groups indicating that the levels of subjective self-assessment demonstrated notable leniency bias and thus did not accurately reflect digital competence levels among the participating preservice teachers.

Research Question 2: Is there a tendency toward leniency in subjective self-assessment of digital competence among different demographic groups of undergraduate preservice teachers?

All demographic groups of the participating preservice teachers demonstrated leniency bias in self-assessment of their digital competence. (see Tables 16 through 22).

Research Question 3: To what do the subjects attribute any differences between their subjective self-assessment and objective measurements of their digital competence?

The results of the qualitative explanatory survey results are explained in detail earlier in the chapter. However, two significant aspects of the preservice teacher perspectives and attitudes regarding digital competence indicated that they were blasé and somewhat disinterested in the significance of their inaccurate self-assessments. The

participants felt that they were adequate and sufficient in what they knew about the technologies they would be expected to integrate into their teaching practices

Summary

The quantitative side of this dissertation indicates that preservice teachers over-estimate their digital competence across all seven of the conceptual topic groupings except Web 2.0 as presented in the research study. The qualitative portion offers elementary explanatory data in the form of the respondent's perspectives and attributions for the leniency bias and over-estimation. Their commentary mildly suggests that male preservice teachers do not consider this gap important and that they think that their competence levels are sufficient "for them to get along."

Chapter 5: Discussion, Significance, and Future Research

This study was designed to determine if subjective self-assessment is a valid measurement of digital competence for preservice teachers. The results strongly indicate that it is not a valid or accurate means of making such a determination. The first section of this chapter discusses the results and offers an interpretation of the results.

The findings of this study reveal a significant subjective self-assessment leniency bias in respect to digital competence of undergraduate preservice teachers. Further, contrary to a significant body of earlier research, the tendency toward self-assessment leniency bias, under-estimation of their actual competence was no less or more evident among more experienced preservice teachers than among their less experienced peers. The study applied three separate measures to represent digital competence in distinct ways. The first measure was the Subjective Self-assessment Instrument (SSAI), composed of a finalized 33 five-level Likert items that were subjected to reliability and validity procedures including an extensive Confirmatory Factor Analysis. The second measure was the Objective Assessment Instrument composed of 47 finalized single answer multiple choice items that were also subjected to reliability and validity procedures. Both the SSAI and the OAI returned acceptable Cronbach alphas above .80 (SSAI alpha = .867 and the OAI alpha = .802, respectively) confirming their construct reliability. The SSAI required notable adjustments and elimination to provide an acceptable model as illustrated in Figure 6. The matrices for the SSAI CFA in Table 12 indicate covariance below 2.00, which as noted by Harrington (2009) is the acceptable cut off level. Five of the 265 possible covariance scores exceeded the 2.00 cutoff. A further readjustment or elimination of survey items would have materially damaged the structure of the survey. They were left in place.

Table 5 displays the mean scores of both the SSAI and the OAI. Superficially, it appears that the SSAI scores are simply higher than the OAI scores. However, the scores are measured on different scales, The SSAI is ordinal, and the OAI is binary. They cannot be compared as is. However, of interest is the OAI scores that are a percentage of correct answers compared to the total possible for each group. The SSAI survey does not have single correct answers. Observing the OAI scores, however, does illustrate that the preservice teachers scored below, 60% correct on all of the topic groups. Without the OAI being validated as a measure of digital competence on its own merit one cannot generalize regarding the poor scores. However, considering that the multiple-choice items were reviewed and approved for appropriateness by independent authorities, the poor performance does warrant further and deeper examination regarding simple digital competence among the preservice participants. An expanded version of the test, validated for content will certainly produce findings regarding the scope of preservice teachers' objective knowledge. The focus of this study was not the objective measure of digital skills and knowledge but rather whether self-assessment was accurate and valid. This was done by a comparison process.

There is an inherent problem in conducting comparisons between an ordinal based Likert survey and a binary multiple-choice survey. They are measurements based on different scales. The objective instrument is binary, for which there is only one correct answer. The SSAI being a subjective self-evaluation is ordinal based for which there may be a variety of acceptable and not necessarily correct answers. While such assessments can measure the same concepts they are usually not the same. As a result of this difference, a direct comparison is not meaningful. Simply stated the SSAI measures what

the participant thinks he or she knows and the Objective assessment demonstrates the skill or knowledge as correct or not. So attempting to discuss such a direct comparison is simply not possible.

A nonparametric comparison of mean rank scores levels the comparison playing field in a way that makes the comparison possible. The nonparametric comparison is accomplished by the Wilcoxon matched pair signed test. This test is unusual in the sense that it does not assume that the data are sampled from a normal distribution but rather it does assume that the data are distributed evenly around the median. Consequently, the p value does not reveal much about whether the median is different from the hypothetical value being compared. The Wilcoxon test operates on the idea that error values are independent. The term, “error” refers to the difference between each tested score or value and the median of the group.

The Wilcoxon signed rank test compares the ranked median values entered for a hypothetical population. In this study the Wilcoxon procedure compared the median values of each digital topic group against the median [population] for all of the totals of the combined groups median. SPSS then measures the difference between the two values, and the confidence interval of the difference. It subtracts the median of the topic group data from the hypothetical median. When the hypothetical median is higher than the observed topic group median, the result will be positive. When the hypothetical median is lower, the result will be negative. In this case the hypothetical group is the SSAI digital groups and the population group is the objective instrument scores.

The p value is dead zero when the hypothetical median value is equal to the median of the population. So, if the p value is large the hypothetical median is closer to

the population median. The larger it is, the closer to the population median it becomes. Where the issue of its importance enters is that all that can be concluded is that the hypothetical median is distinct from the population median and that the difference is due to chance. Conversely, if the p value is small, you *cannot* conclude that the data provides a basis for assuming that the hypothetical and population medians differ. This does *not* mean they are the same.

The Wilcoxon tests form the basis of the comparisons in this study. Table 15 is repeated here to illustrate the evaluation of the results. All of the p values are less than .01 strongly indicating a large difference between the hypothesized median and the mean ranked score from each of the comparisons between the SSAI and the OAI.

Table 15: Wilcoxon Test Statistics ^a - Z-scores for All Subjects and Variables (n=174)

	<i>Z Scores by Digital Topic Group</i>						
	<i>OGC - SGC</i>	<i>OEI - SEI</i>	<i>OPT - SPT</i>	<i>OSS - SSS</i>	<i>OWP - SWP</i>	<i>OW2 - SW2</i>	<i>ODB - SDB</i>
<i>Z</i>	-11.448 ^b	-11.444 ^b	-10.962 ^b	-10.768 ^b	-11.445 ^b	-7.907 ^b	-11.190 ^b
<i>Asymp. Sig. (2-tailed) P<.01</i>	0	0	0	0	0	0	0

All of the Wilcoxon comparisons, overall, gender, age, and one or more technology classes returned similar results. The Wilcoxon comparison returned a strong difference, all negative, indicating that the scores in each digital topic group from the subjective SSAI over-estimated their digital competence compared to the objective scores.

The outcome of these comparisons focuses on the leniency bias, over-estimation of their digital competence. But much more importantly is the converse findings based on the notion that poor performers over-estimate. In the approach from the other direction it is disturbingly apparent that the over-estimation indicates low-performance.

The preservice teachers appear to be weak performers with digital technology but naively think the opposite is true.

Furthermore, a re-examination of the mean scores in Table 5 will find that only three of the 42 objective groupings had (60%) or higher (none above 68.5%) , while six of the 42 scored below 21%. This indicates that only three groups, Digital Natives, Males, and those who completed one or more technology class barely passed the multiple-choice test on e-mail and the Internet. Databases were the lowest scoring by all groups with the below 21% scores, every group did poorly. While surface level inferences might be drawn based on this scoring profile further testing of objective and applied-to-education digital skills and knowledge is evidently warranted. Yet, with that caveat stated, the Wilcoxon comparisons paint a scarcely better profile of digital competence and an even worse version of self-assessed digital competence. With the commentary from the participants of the relative unimportance and the sense of apathy and not caring is coupled with these scores one might begin to suspect that the near horizon in education may see significant problems with unmet expectations of the new 21st century teacher.

Implications from the Findings

This study was developed from an academic interest fostered in a university level *Technology for Teachers in the Classroom* where the students indicated moderately high levels of self-assessed competence in digital technology. Yet they demonstrated appreciably lower levels of skill and knowledge on their objective performance on assignments. The situation in that classroom indicated that the gap may have been

significant and consequently may have an adverse effect on the programs of instruction of educational technology for preservice teachers.

Additionally, the participants of this study report no sense of importance or urgency when asked about the gap, indicating that first, they already knew enough to “get by” and that they would “pick up what they needed as they went along.” This is a sort of contradiction in that during this and previous class semesters many students remarked in the end of the semester assignments that they came to realize that they did not know as much as they assumed they did at the beginning of the semester and how surprised they were in discovering how much they did not know regarding technology for classroom use. Furthermore, during the course of casual conversations in the classroom regarding digital competence among the variety of students both dispositions and perspectives emerged that suggested that the students displayed an inaccurate understanding of competence and skills above what their performance and understanding was demonstrating in the classroom.

Possible Explanations for the Gap

This study set out to test the validity of subjective-self-assessment of digital competence and found that it is neither an accurate nor a valid means of assessing this competence with the small exception of mature participants and males accurately self-assessing their competence in the area of Web 2.0.

Overall, the study participants consistently over-estimated their digital competence. Throughout the literature those individuals with the lowest levels of expertise, whether from inexperience, lack of training, lack of prior knowledge, or just

poor performing individuals, consistently over-estimated their competence, skills, or knowledge.

The individual items in the objective multiple-choice instrument (OAI) were checked for content validity by qualified educational technology researcher who determined that they were appropriate and not overly arcane or too deeply technical in nature for the participant audience (preservice teachers) for which the items were intended.

Revisiting Tables 5 and 7 in Chapter Four reveals that overall the participants were low performing and did not demonstrate level competence in any of the OAI digital topic groups or overall. All OAI group mean scores fell at .60 or below. These scores are classically below passing levels indicating a conclusion that the participants are not competent in the context of the digital competence as tested by the OAI. This low-performing factor is consistent with the expectation of over-estimation and leniency bias in subjective self-assessment.

Additionally, notice that those digital topic groups that fall into the category of recreational or widely and commonly used (eg. e-mail & Internet, General Computer Knowledge, and Presentations), while still below passing, scored higher than those that are more clearly categorized as productivity technology (Database and Spreadsheets). This study was not designed as a means of determining if the OAI would suffice as a comprehensive or complete measure of digital competence but rather was designed as a matched comparison for participant responses on a subjective self-assessment instrument (SSAI) intended to determine the validity of subjective self-assessment. However, with that caveat, the distribution of scores by the topic groups is consistent with other studies

that found that those recreational type technologies scored higher than productivity type technologies (Underwood, Billingham, & Underwood, 1994). It might be suggested that recreational technologies may have a “coolness” factor that productivity simply does not have and is therefore less appealing and is perceived as boring to college students. The preservice teacher participants may have been basing their sense of competence on a few commonly used recreational type technologies in which they had an elevated sense of competence from continual use in their daily lives. This seemed consistent with the reports from the Pew Internet and American Life Project (Levin & Arafah, 2002 ; Zickuhr, & Smith, 2012) on technology in American life that college level students had reached a point of saturation with their use of certain technology devices and applications. They were, however, limited in expertise on many others. Among the devices and applications defined generally as recreational in nature are cellular devices, gaming, entertainment, and Internet communications and social networking. Based on the high level of possession and use [exceeding 90%], it is easy to see how the users would assume that since they are high-level and competent users of their recreational type devices that it would carry over to other more sophisticated and arcane productivity devices and applications. The study respondents are aware of the gap between what they use regularly in their daily lives and what may need to be applied to their teaching presentation in their future classrooms. When asked to what they attribute the gap, Tina, a Digital Native, stated, “my guess is that because people often use computers on a daily basis they think they’re experts when in reality they often times use the same programs [only and repeatedly].”

A second possible explanation of the gap may be attributed to a simple lack of exposure to productivity devices and applications by the preservice teachers due to their general youth and narrow band of professional experience. Due to the relative newness of Web 2.0 applications it is possible that the older participants were aware of how little they knew regarding the topic materials essentially due to a simple lack of exposure to elements typical of Web 2.0 (see Table 19). Meanwhile, the males also accurately self-assessed their competence regarding Web 2.0 only. This may be due to the males either actually being higher level performers with Web 2.0 type applications, such as gaming applications, or they were aware that they did not actually know the materials and accurately reported their sense of not knowing. This anomaly requires further research for definitive explanations.

Participant Attribution Regarding the Gap between Self-assessed and Objective Competence

There is a cloud over the preservice teachers facing teaching with technology. They either, do not know how much they do not know about the technologies that they will need to carry to their perspective classrooms, or they are aware of a gap without having an accurate understanding of its magnitude. Basing their self-assessments on recreational technology knowledge and not ever being told how measurably competent they are or are not, leaves them uninformed when entering preservice teacher programs.

The participants' responses to explanatory questions in the follow-up survey indicated that the subjects know that they do not know all of the digital technologies about which they were asked. They attributed their over-estimation on personal notions that they thought they knew more than they do. Their awareness appeared to stem from

them thinking that their expertise with their recreational digital devices and applications make them competent in all areas of things digital. However, while they did realize and express awareness that there was more to know, they also had strong sentiments that they were getting along well enough with what they did know. Two participants acknowledged that the narrowness of their knowledge base could be easily remedied by a bit of instruction and better training. No one commented that the lack of knowledge was in anyway extensive or significant. They did comment that they could and would pick up missing elements of their digital competence easily as they “went along.”

Specifically, Steve, a Digital Native, commented, “You call it an over-estimation. I think I’m fine.” Rose, also a Digital Native, “. . .didn’t think digital competence meant knowing as much as it does.” They based this perception on two major points. The first is that (all) technology is easy and can be quickly and easily assimilated as the individual “goes along.” The basis for this comes from the idea that they have always known enough “to get along.” This was expressed in terms that “they learn just enough to get by,” and from their use of a limited number of technologies on a daily basis. No one elaborated on which technology was easy to learn. Not surprisingly, they did not comment on having any extensive classroom type instruction in digital technology or what that class or those classes may have taught them.

The second notion emerged from their responses is that there exists a naiveté regarding the extent of what they, as individuals, do not know and how much exists in the unknown (to them) domain of technology. Alicia, a Digital Immigrant, said bluntly, “We don’t know what we don’t know.” Participating preservice teachers Steve, Betty, Francine, and Xavier each in slightly different words offered remarks with a common and

consistent thread that is summed up by Carla who said, “People [teachers] have an inflated view of their digital abilities because they do not realize that they only know the tip of the iceberg at times.” Not only did these participating preservice teacher not know that they did not know but they also did not have a sense regarding how much they did not know.

While aware of the apparent gap between what they commonly use and what they will need to adopt and utilize as teachers, what they think causes this divide may further illuminate what teacher educational programs may need to do to produce technologically savvy preservice teachers with appropriate digital knowledge.

Overshadowing these notions three respondents stated that the over-estimation is a direct result of “being taught to be and expected to be over-confident,” especially in career related digital abilities. Tina stated, “Being American. We’re taught to be over-confident in ourselves.” Male Digital Native, Xavier said “I think that people want to show that they are competent in areas that will affect their career. We are all taught from an early age that if we want to be successful, you need to be confident in what you are doing.” Carla, a Digital Immigrant, attributes the over-estimation to being embarrassed at not being competent with technologies that are in common use by her peers. Unfortunately, she was not afforded the opportunity to be set straight regarding the extent and pervasiveness of over-estimation among the preservice teacher participants in the study.

In reading the above there is yet another element involved in the responses. Making the estimate regarding their competence several respondents openly expressed a lack of concern for the gap between their self-assessment and their demonstrable

competence. Steve, the Digital Native, stated, “I know there is a lot I don’t know and don’t care to know.” Xavier, also a Native, commented that he viewed the expression of a lack of confidence as a perceived weakness. A final comment by Ed, a Digital Immigrant, noted that the over-estimation was attributable to “naiveté by some and stupidity” by the rest. While naiveté and blindness may be better suited as a comment, his point and perspective is noteworthy. Since they were only asked about the gap between the self-assessment and their matched score, they did not offer any comment on their objective assessment performance. They were not afforded access to their scores, but were informed only that the digital gap existed.

With probable lack of exposure and use of productivity technology the preservice participants might simply not know what they do not know and assume competence by association of one category of their technologies to the one with which they have little previous exposure. The differences between the two possible explanations are subtle but distinctly different.

While this error in self-assessing their digital competence might be perceived by the participants as somewhat unimportant to them, as they indicated in the follow-up responses, in their daily living and away from professional productivity applications, its significance increases dramatically when these preservice individuals are faced with the demands of credentialing and demonstrable competence with the digital technologies they are expected to integrate in their K-12 classrooms. This integration has been ensconced as a requisite for high-quality instruction.

Implications from the Study Results

The Issue of Integrating Technology.

Since 2006, the framework of Technological Pedagogical Content Knowledge (TPACK) has become one of the touchstones in reforming the definition of the highly qualified 21st century teacher. Technology has appeared as the vehicle of delivery and as an inseparable part of education. The significance of technology is heavily touted in the literature as being every bit as important in the image of the three legged-stool [or intersecting three-rings] metaphor as content and pedagogy. However, despite this wide-acceptance, two problems need to be resolved regarding the conceptual framework of TPACK.

First is the imbalance seen in the design of preservice programs. Preservice teachers are required to either bring with them a college degree in their content area or have a minimum of two years of study in the content area they intend to teach. Secondly, and similarly, they are required to have two years of pedagogy instruction prior to in-service teaching. Whether the two-year requirement holds as an absolute across all teaching areas is less significant than the need for them to definitively prove competence in the content and pedagogical arenas. Yet, there are instances where Technology for the Teacher classes have been eliminated and the use of technology integrated along with methods classes. In other programs, the preservice teachers are only required to successfully complete a one semester, three-unit class to meet graduation requirements. This imbalance alone is sufficient to place in question the preservice teachers' preparedness to integrate technology. In this context, Kruger and Dunning (1999) made it clear that students must develop a sense regarding their inexperience or incompetence to

become more competent and to develop requisite metacognition to know that they do not know. It seems that reducing instruction only compounds an already corrupted sense regarding their digital competence. Diluting their digital instruction in methods courses or eliminating it altogether can only widen the gap.

The second issue, evident as a questionable element of TPACK is the notion of *knowledge*. The assessments typically used to evaluate TPACK have been subjective self-assessment instruments that actually measure dispositions, opinions, and perspectives regarding the integration and use of technology and do not measure the actual knowledge regarding the technologies in question (Schmidt, et al., 2009). This inconsistency spawned the original questions for this study and begs much greater questions in asking if the individual teacher or preservice teacher is competent with the applicable digital skills and applications. Equally as important, how is it being measured? How can preservice teachers be rationally expected to adopt the conceptual framework and the integration of technology as demanded by TPACK if their expertise levels are inadequate or they are low-performers regarding the technology they need to use and effectively integrate? Based upon the results of this study that clearly invalidates subjective self-assessment as a means of accurately determining digital competence an alternative means is necessary. This questionable application of subjective self-assessment is not new. Stoner (1999) and van Braak (2004) are cases in point of making decisions and drawing conclusions based on improper methodology in this context.

It is imperative to note that subjective self-assessment is not without great value in the consideration of dispositions, perspectives, opinions, and attitudes regarding

integration, acceptance, confidence, and change. Subjective self-assessment should not be used to assess digital competence.

Relying on self-assessment as a means of stand-alone assessment is inappropriate. Further, the reliance of self-assessment as a means of determining the readiness for technology integration may be short-changing the preservice teacher students by denying them, through omission, the remedial instruction insuring digital competence before they have to integrate it in a K-12 classroom. Since self-assessment will not suffice as a sole determinate, educational programs must either conduct objective proficiency and placement testing for digital skills and knowledge to insure that the preservice teachers have the requisite foundation in technology or be forced to deal with the continuing and possibly widening gap in the integration and effective use of technologies in the classroom. Appropriate objective assessment instruments need to be created to this end. Alternatively, a combination of self-assessment and other means of determining the levels of digital competency needs to be developed so that a consensual means can reflect a preservice teachers digital competence in a meaningful and accurate way. Further research in this respect is also clearly warranted.

Further Research Opportunities

It would be reasonable to suggest a study that explores a deeper examination by cross testing by age and gender might offer some usable data regarding technology competence. For example, at a later time it may prove valuable to see how male Digital Immigrants perform when compared to female Digital Immigrants or how the male Digital Immigrants perform compared to Male Digital Natives. Additional demographic variables may assist in painting a clearer picture of the competence between groups.

A follow-up study that conducts a before and after methodology in conjunction with more extensive technology instruction for preservice teachers may provide better data regarding the use of self-assessment as a means of determining the readiness for integration and more accurate levels of digital competence. It may narrow gap between the subjective self-assessment and actual demonstrable competence. Consistent with the numerous reports regarding performance and expertise being inversely proportional to leniency bias the closing of the gap may indicate better performance among the preservice teacher group. This could contribute to better preparation for professional practice.

Considering the continued fuzziness of defining digital competence in the context of what is needed by K-12 teachers, research in developing a list of minimum skills and knowledge regarding specific devices and applications for teaching and education. Along with this, clear definitions should be established for preservice teacher education programs regarding exactly what technologies, skills, and knowledge a 21st century K-12 teacher needs to be successful. It would be a reasonable result to see a separation between definitions of digital literacy as an overarching framework with digital competence as the subordinate specific skill and knowledge set instituted under the umbrella of the literacy frame.

With this clarification of the definitions a sense of the need to learn may become more evident for the students in the programs. With this, the programs may work to create a realm in which the importance of the productivity technologies becomes prevalent, overtaking the more naïve sense of adequacy from the recreational

technologies use. Further, the “I know enough to get by” notions may fall away and an air of professionally appropriate demands will prevail.

The responses by the follow-up participants precipitated two relative questions. The first is to determine where and how preservice teachers actually acquired their digital skills and knowledge regardless of their competence levels. The second question, is to inquire if the preservice teachers think they have sufficient objectively measured digital competence with the appropriate and related productivity technologies as applied in the classroom? Further study is warranted approaching the digital competence topics based upon the effect of various demographic variable not addressed in this study. Socio-economic status (SES) may very well have an impact on both the degree and types of digital competence demonstrated in various strata in the SES spectrum.

Lastly, until further research is conducted regarding the evident gap between recreational, widely used, common technologies and productivity applications and how competence differs between them, how accurate and valid measurement can be conducted, educational programs will continue to operate in the dark regarding technology. Programs need to develop a means of assessing student needs accurately and efficiently. These assessments will provide a foundation for the program administrators and designers to make determinations for in-coming preservice teachers’ placement and remediation classes. Until then preservice teachers may suffer from not receiving appropriate and sufficient instruction of technology, or lack of it, in their teacher programs.

Limitations, Assumptions, and Design Controls

The first limitation of this study may arise from the sample participants who may have had a variety of inclinations regarding their levels and dispositions regarding digital competence. The respondents may have been a splinter of the larger body of preservice teachers in the pool who had more or less interest in technology than the others in the pool. This certainly deserves further examination in future studies of this nature. Certainly a notably larger participant sample would reduce the threats.

A major limitation in this and similar studies lies in the issue of the very nature of digital technology. That is, digital technology exists on so many levels and is subjected to the vagaries of brand platforms. Included in those vagaries is the expanse of the material available regarding levels of use in any given topic area. For instance, there exist several spreadsheet applications such as the obvious Microsoft Excel®, Open Office®, Google Documents®, and approximately another 34 specific names and brands of various types of spreadsheet software programs (Wikipedia, 2013). Notwithstanding the 35 specific brand names, most have multiple versions that bring the list to somewhere around 100 brand names. An experienced user in Microsoft Excel® may not be competent with QuattroPro® or Apple Works®. Given a test of one's ability to use Microsoft Excel® on a PC desktop when their experience lies with another platform they will appear to be competent in one and not in the other. This limitation extends to operating systems such as a Windows® based platform verses Apple® or Linux®. Further, it extends to machine platforms. Although very similar, the iconic machinations of a Mac® are not the same as those of a PC. Specific care in designing a measurement must consider these varied differences in construction of test items. These variations are incumbent within every

area of all digital topics. Therefore the very nature of the questions utilized in the survey while being specifically validated for content may have been slanted in a way that remains obscure posing threats to the overall validity. A wider variety of questions may produce different results. However, as noted before clear definitions as to the areas of requisite competency must first be established to make the determinations as to the specific questions that might be asked.

As a further limitation, the sheer complexity of a given topic area can include multiple layers of subtopics that can become very arcane and more and more remote to a classroom user. This technical matrix can become sublimely complicated. Consider the acronyms associated with e-mail and the Internet. Whether a student knows the actual meaning of the hypertext programming term, “WYSIWYG” (What You See Is What You Get) or how hypertext markup language translates code into a screen presentation may indicate complete incompetence in the application of programming language while signifying nothing regarding the user’s ability to determine the reliability of a website for accuracy and timeliness. Therefore, care must consider the depth of expected knowledge in the design of surveys to be utilized in the study.

A notable question to be considered in designing assessment items is where to stop in considering the extent and acceptable and accepted limits of what qualifies as digital competence. An online instrument, the European Computer Driving License (ICDL Foundation, 2011), a certificate program confirming digital competence much like a driver’s license suggests competence in operating an automobile, goes so far as to provide the test taking subjects with flow-chart and logic development items related to

the mechanics of programming. Such questions appear to go far beyond the scope of what may be practically expected of a typical United States K-12 classroom teacher.

Lastly, the use of instruments designed for other content domains would pose a serious limitation to the construct validity of the utilized testing instrument. That is, an objective test used for business applications would most probably have specific items directly associated with specifically related content area. For example the calculation of interest rates might certainly apply to business students, they have little bearing on chemistry assessment. Because of these possibilities, this study submitted the test items to review by qualified educational technology research colleagues to verify that the items are specifically appropriate for use with preservice teacher education.

Conclusion

The findings of this study have implications for preservice teacher educational programs. Due to the leniency bias of subjective self-assessment as demonstrated by the results of the nonparametric comparisons it is clear that it cannot be relied upon as a sole measure of digital competence. When utilized as the only measure of digital competence there is a strong possibility that it is inaccurate. While self-assessment may serve as an excellent means of collecting data on dispositions, perspectives and attitudes it should only be used in conjunction with other more objective means of assessment.

Secondly, the notable over-estimation by self-assessment of digital competence may strongly suggest that the individuals who over-estimate may indeed be low-performers who may require remedial classes or more extensive instruction in technology for teachers in the classroom. Program administrators and designers need to be aware of this to provide appropriate instruction and placements. Additionally, these

possible low performers may need to be subjected to objective digital competence assessment to determine relative levels of their competence and how they fare on the scale of where they stand in regard to performance levels.

Without clear and adequate digital skills and knowledge, the idea of integration of education based technology in teaching may be significantly impaired rendering the framework of TPACK seriously limited. Further exploration of the knowledge base regarding TPACK is immediately warranted.

One of the most notable results of this study came from the explanatory follow-up questions. There appears to be a misconception among preservice teachers that because their high levels of digital competence with recreational type technologies that all technology is easy to learn and use. While Digital Natives may be predisposed to comfort with digital technology, new and sophisticated productivity technologies require learning and practice.

Lastly, self-assessment of digital competence is neither accurate nor is it a valid means of measuring such competence and should not be used solely as a means of making determinations of any significance beyond measuring dispositions, attitudes, and perspectives.

Appendix A

Subjective Self-assessment Instrument, IRB Consent, and Instructions

Digital Competency Survey

INFORMED CONSENT UNIVERSITY OF NEVADA, LAS VEGAS COLLEGE OF
EDUCATION DEPARTMENT OF TEACHING AND LEARNING INFORMED
CONSENT

Department of TEACHING AND LEARNING TITLE OF STUDY: The Measurement of
Digital Competency: A Comparison Between Self-Assessment and Objective Testing

PRINCIPAL INVESTIGATOR(S): Shaoan Zhang Ph. D; Kendall Hartley, Ph. D.

CONTACT PHONE NUMBER: Dr. Zhang -- 702-895--5084

STUDENT INVESTIGATOR: Joseph A. Maderick

PURPOSE OF THE STUDY:

You are invited to participate in a research study. The purpose of this mixed methods study is to determine the validity of self-assessment as a measure of digital competency among undergraduate preservice teacher students and to determine if certain demographic characteristics influence the leniency in self-assessing digital competency among undergraduate preservice teacher students compared to the results from objective testing. Lastly, we seek to support the findings by inquiring with the respondents what they feel are determining factors for the difference between the self-assessment and the objective tests. With this data in hand the designers of curriculum and instruction may be better able to improve the integration of technology into the educational programs they present.

PARTICIPANTS:

You are being asked to participate in the study because you are currently enrolled as an undergraduate in a teacher education program and are enrolled in the EPY Experiment Management System Subject Pool.

PROCEDURES:

If you volunteer to participate in this study, you will be asked to do the following: Respond to a series of questions in a survey and questionnaire related to your knowledge of digital technology as applied to educational settings, a few basic questions regarding demographics about yourself as a participant, and to supply responses to open-ended qualitative questions that are intended to lend support to how you answered the earlier survey questions and possibly how you arrived at those answers. The total number of questions for the three sections will not exceed 120 in total. Over three sections the survey should only take a little more than an hour in total to complete.

BENEFITS OF PARTICIPATION:

There may not be direct benefits to you as a participant in this study. However, we hope to learn how we can improve the process and techniques of teacher education and technology. You will be credited with one research participation credit by the department for your participation in the study.

RISKS OF PARTICIPATION:

There are risks involved in all research studies. This study may include only minimal risks. Although we do not anticipate any significant risks, you may be uncomfortable answering some of the questions.

COST /COMPENSATION:

There will not be financial cost to you to participate in this study. The study will take 40 to 75 minutes maximum of your time and will be administered by e-mail survey. You will not be compensated for your time beyond receiving one research participation credit with the department.

CONTACT INFORMATION:

If you have any questions or concerns about the study, you may contact Shaoan Zhang Ph. D at 702-895-5084 or by e-mail at shaoan.zhang@unlv.edu or you may contact Joseph Maderick at 702-895-5084 or by e-Mail at: maderick@unlv.nevada.edu.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV Office for the Protection of Research Subjects at 702-895-2794.

VOLUNTARY PARTICIPATION:

Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with your classes or the university. You are encouraged to ask questions about this study at the beginning or any time during the research study.

PARTICIPANT CONSENT:

I have read the above information and agree to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

CONFIDENTIALITY:

All information gathered in this study will be kept completely confidential. No reference will be made in any written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for 3 (three) years after completion of the study. After the storage time expires the information gathered will be shredded and destroyed, electronic media will be erased and/de-identified.

A COPY OF THIS CONSENT FORM SHOULD BE DOWNLOADED, SAVED AND/OR COPIED FOR YOUR OWN RECORDS.

I am an enrolled participant in the EPY Experiment Management System Subject Pool.
At the end of the survey you will be asked for your name and class so you can be credited with your participation.

☐ YES

☐ NO

Have you received enough information about the study?

☐ YES

☐ NO

I acknowledge that my taking part is voluntary; I can withdraw from the study at any time and I will not be asked any questions about why I no longer want to take part.

☐ YES

☐ NO

I acknowledge that my words may be quoted in publications, reports, web pages, and other research outputs but my name will NOT be used unless I specifically request it.

☐ YES

☐ NO

By submitting this form I attest that I am eighteen years of age or older

☐ I so attest

☐ I do not attest

I consent to take part in the study described above.

☐ I consent to participate

☐ I decline to participate

Digital Competency Survey

Subjective Self-Assessment Instrument

INTRODUCTION

Technology is a very fast moving and dynamic system that changes frequently. It can encompass a wide spectrum of applications, materials, equipment, and developments. It may include everything from a digital clock to a super-computer. Typically, it might include a lap-top, desktop, e-tablet, cell phones, interactive white boards, PDA/ hand-helds or software. There are 45 short general questions in this section.

* Required

Technology Awareness

Please read each question carefully. Some are positive statements, some are negative statements. THEY ARE NOT ALL THE SAME. Please mark the button that best reflects your agreement or disagreement with the statement.

I feel comfortable installing new software. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I understand the concept of backups. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I understand the concept of file hierarchy organization. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I have a general understanding of how computers are used in the real world. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I have a broad appreciation of the requirement to protect personal information databases.

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I have a broad appreciation of the need for computer security. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

General Computer Literacy

The term "PEERS" herein means your fellow college/university students.

My spreadsheet skills are good. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a less experienced spreadsheet user than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My word processing skills are good. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a more experienced word processor user than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My database skills are poor. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a more experienced database user than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My e-mail skills are good. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a less experienced e-mail user than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My ability to use the Internet is good. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a more experienced Internet user than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My ability to use presentation software is good. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am a less experienced user of presentation software than most of my peers. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

E-Mail/Internet

I am comfortable composing communications with e-mail. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable retrieving a particular web page (e.g. Toyota.com or Amazon.com) *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel that I am competent using search engines (e.g. Google, Yahoo, Alta Vista). *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable sending e-mails with file attachments. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable embedding Flash animation on a website *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

Presentation Software

I am comfortable creating a computer based presentation. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel uncomfortable editing presentations (e.g. changing backgrounds, style layouts). *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable inserting objects into a presentation (e.g. pictures, graphs, videos) *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel comfortable using the help menu in presentation software *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

Spreadsheets

I feel comfortable saving spreadsheet files *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am not comfortable creating spreadsheet formulas (e.g. A1-B6+ B7) *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable using basic spreadsheet functions (e.g. AVG, SUM functions) *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel comfortable creating graphs within a spreadsheet. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

Word Processing

I am not comfortable creating tables. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am uncomfortable in the use of spell checker. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable setting up margins in a document *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable editing documents *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

Web 2.0

I am not comfortable in using RSS *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable entering voice-over audio files onto a Wiki project. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable posting my personal information onto social networking sites. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am not comfortable with the use of Second Life as a teaching tool. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable using Internet 2 to create graphics for classroom use. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am not comfortable with Web 2.0 because of its strict restriction of digital interaction with other people. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* Required

Databases

I feel comfortable generating queries in a database system *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel comfortable entering data into a database system. *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am comfortable generating a report in a database system *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I am not comfortable in developing a database from scratch *

I Strongly Disagree	I Disagree	Neutral	I Agree	I Strongly Agree
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Appendix B

Objective Assessment Instrument

Digital Competency Survey

Objective Assessment Instrument (OAI)

The following section will present a different kind of question regarding specific technologies. There are 48 multiple choices questions in this section. It is intended to give us a clearer picture for the development of designing technology classes. You are not expected to know every answer. Your candid and authentic responses will contribute to our effort to improve our class presentations. Please select the one correct or best answer for each question.

Please answer ALL of the questions.

If you do not know please mark the last choice (I do not know) .

PLEASE DO NOT GUESS.

* Required

General Computer Knowledge

The process of encoding data to prevent unauthorized access is known as *

- ☐ locking out
- ☐ encryption
- ☐ compilation
- ☐ password protection
- ☐ I do not know

A modem is *

- ☐ software that coordinates network communications
- ☐ a computer sub-system that links together two or more computers
- ☐ a hand-held device which, when moved around a desktop, moves a pointer
- ☐ a hardware device that converts digital data into analog signals that can be transmitted over wires.
- ☐ I do not know

Over the last two decades *

- ☐ bubble memory has surpassed flash drives in public usage
- ☐ computing power has gone up while cost per byte has dropped
- ☐ the World Wide Web has been replaced by personal WiFi
- ☐ dial-up modem technology has made a significant comeback
- ☐ I do not know

A computer program, designed as a prank or sabotage, that replicates itself by infiltrating other programs and carrying out unwanted and sometimes damaging operations is known as a *

- ☐ computer virus
- ☐ de-bugging infraction
- ☐ utility program
- ☐ loop interface
- ☐ I do not know

Social networking sites *

- ☐ cannot be hacked
- ☐ leave permanent records that can be later accessed by searching the net.
- ☐ prevent others from watching our personal activities
- ☐ are completely secure and safe
- ☐ I do not know

Moodle and Weka are free to download software applications and are edited by various users through a process known as *

- ☐ eduwiki
- ☐ open source
- ☐ freeze frame
- ☐ public interface engineering
- ☐ I do not know

Details of business transactions, which are unprocessed, would be classified as *

- ☐ information
 - ☐ bytes
 - ☐ data
 - ☐ files
 - ☐ I do not know
-

* Required

Word Processing

The procedure by which a word processor automatically moves a word to a new line if it cannot fit on the current line is called *

- ☐ a hard carriage return
- ☐ word wrapping
- ☐ an automatic line end
- ☐ line wrapping
- ☐ I do not know

The grammar and spell checker in a word processing program *

- ☐ can accurately determine the correct contextual use of homonyms like "there" and "their"
- ☐ can adjust a text by adding contractions to create informal writing
- ☐ can correct typing errors while you are typing
- ☐ can determine if a document is being written in APA, MLA or Chicago format and adjust text as it goes along
- ☐ I do not know

Fleisch-Kincaid Grade Level Test *

- ☐ adjusts the thesaurus and dictionary functions to meet the grade level needs of the writer
- ☐ reports the grade level of the writing in a document based on a mathematical formula
- ☐ records the number of low grade words used in each sentence
- ☐ writes questions to accompany a document being written for classroom use
- ☐ I do not know

The element that Abiword, Google Docs, and Open Office have in common that is significantly different from Microsoft Word and Word Perfect is that they *

- ☐ are only available on CDs
- ☐ are limited to black and white printing
- ☐ can only type in English
- ☐ can be legally downloaded at no cost
- ☐ I do not know

The facility within word processing which allows users to link letter documents with names and addresses in a list is known as *

- ☐ spell checker
- ☐ thesaurus
- ☐ mail merge
- ☐ database integrator
- ☐ I do not know

"Track Changes" defaults to *

- ☐ show grammar errors in balloons on the right margin and spelling errors on the left margin
- ☐ show in-line negative comments in red, positive comments in green, grammar errors in blue and spelling errors in yellow
- ☐ accept or reject changes on a one by one basis
- ☐ change all improper grammar errors to "bold red Arial Rounded font"
- ☐ I do not know

* Required

Spreadsheets

Spreadsheets cannot *

- ☐ transfer funds between bank accounts
- ☐ calculate the principle and interest on a mortgage
- ☐ do average, sums, percentages and standard deviations on a column of numbers then produce representative graphs
- ☐ determine how many days are left for planet Earth based on the December 21, 2012 end of the world scenario by subtracting dates from each other
- ☐ I do not know

The real power of a spreadsheet is its ability to *

- ☐ arrange numbers
- ☐ integrate data
- ☐ recalculate data
- ☐ search for specific data values
- ☐ I do not know

Spreadsheets are very effective for *

- ☐ editing color photographs
- ☐ producing digital videos
- ☐ creating grade books
- ☐ designing form letters
- ☐ I do not know

A spreadsheet may not include *

- ☐ objects and shapes
- ☐ multiple colored and sized fonts
- ☐ videos and images
- ☐ skip trace digital addressing formats
- ☐ I do not know

The process that a spreadsheet uses to automate calculations for values and results from previously entered or calculated numbers are called *

- ☐ data digitalizations
- ☐ macros
- ☐ virtual formulated calculations
- ☐ fundus mechanisms
- ☐ I do not know

The spreadsheet formula =AVERAGE(A4..A6) *

- ☐ is invalid due to a formula error
- ☐ calculates the average of cells A4 and A6
- ☐ creates entries in cells A4, A5, and A6
- ☐ computes the average of cells A4, A5, and A6
- ☐ I do not know

* Required

Databases

Collectively, a course number, course title, and course description would be called a *

- ☐ a record
- ☐ a field
- ☐ a file
- ☐ a database
- ☐ I do not know

Which of the following is NOT a recognized advantage of using a database system over using a non-database system *

- ☐ data duplication is minimized
- ☐ data sharing is reduced
- ☐ data becomes independent of the applications that use it
- ☐ data security will be enhanced
- ☐ I do not know

Which of the following is true of a database *

- ☐ some databases are often a part of the "hidden Internet"
- ☐ database records are limited to the number of rows in a spreadsheet
- ☐ a database's content is protected by the copyright laws of the United Nations
- ☐ alpha-numeric fields cannot exceed 10 digits in width
- ☐ I do not know

A person's last name is an example of a *

- ☐ record
- ☐ database
- ☐ field
- ☐ entity
- ☐ I do not know

Database data can *

- ☐ not be collected from social networking sites (MySpace and Facebook)
- ☐ be collected from government documents
- ☐ not be retrieved from shopping receipts and collection records
- ☐ not be collected without the expressed written consent of the Department of Homeland Security
- ☐ I do not know

Corporations and government agencies *

- ☐ can only maintain information permitted by law
- ☐ are not permitted to exchange or in any way access another organization's database
- ☐ can only access stored information for matters of national security
- ☐ maintain vast databases with extensive information on individuals and businesses without their permission
- ☐ I do not know

* Required

E-Mail/Internet

Hardware and/or software placed between an organization's internal network and an external network to specifically prevent outsiders from invading private networks is known as *

- ☐ an extranet
- ☐ a firewall
- ☐ an intranet
- ☐ an intrawall
- ☐ I do not know

Which of the following Internet activities is NOT a threat to your computer security? *

- ☐ phishing
- ☐ malware
- ☐ tagging
- ☐ worms
- ☐ I do not know

The Internet *

- ☐ is formally managed and organized in the USA
- ☐ began life as a function of the Internal Revenue Service
- ☐ is an international network of networks
- ☐ regulates the speed of most operating systems
- ☐ I do not know

It takes a very long time to download a file from the Internet. This is because *

- ☐ your ISP connection is very slow
- ☐ your disk drive is corrupted
- ☐ the information is not being properly translated to the analog third rail
- ☐ you have a VGA monitor
- ☐ I do not know

Spam *

- ☐ is a canned food product made in China
- ☐ is a means of transmitting unsolicited bulk messages
- ☐ is the electronic emergency notification system
- ☐ is a digital mail system that is available from the US Postal Service
- ☐ I do not know

When sending e-mail you enter the following details: John.Doe@unlv.edu. The part which reads "@unlv.edu" is known as *

- ☐ the URL
- ☐ the domain name
- ☐ the home address
- ☐ the destination address
- ☐ I do not know

A tool for locating specific sites or information on the Internet is known as *

- ☐ a web hosting service
- ☐ a search engine
- ☐ electronic clearinghouse
- ☐ a uniform resource locator (URL)
- ☐ I do not know

It is very highly probable that Internet sites are safe if their address ends with *

- ☐ .com
- ☐ .net
- ☐ .org
- ☐ .gov
- ☐ I do not know

RSS (Really Simple Syndication) is a subscription service that can *

- ☐ notify the subscriber every time a specific blog or publication is updated
- ☐ keep track of the publication of newspapers
- ☐ compile web site designer directories
- ☐ translate podcasting audio into multiple languages
- ☐ I do not know

* Required

Web 2.0

Web 2.0 allows individuals wide latitude in being able to *

- ☐ search the Internet
- ☐ print documents
- ☐ copy data more freely
- ☐ participate with others
- ☐ I do not know

The major philosophical difference between Web 1.0 and Web 2.0 *

- ☐ all applications are private endeavors
- ☐ personal privacy is supreme
- ☐ is that Web 2.0 is expensive
- ☐ interactivity is the primary operating principle
- ☐ I do not know

Blogging allows students to participate in *

- ☐ on-going discussions among the subscribers
- ☐ full color art design
- ☐ weather reporting and predicting
- ☐ archiving historical revisionism
- ☐ I do not know

Second Life is a Web 2.0 social networking site that *

- ☐ has only a few teaching and educational domains within its boundaries
- ☐ is a website owned and operated by the Vatican
- ☐ allows life like interactions among its users including death
- ☐ requires a cellular app for complete access
- ☐ I do not know

The most distinctive characteristic of a Wiki is that *

- ☐ it operates in two or more languages at once
- ☐ it is able to be edited by its users
- ☐ it was created to enhance television
- ☐ it is not able to utilize videos
- ☐ I do not know

Which of the following is NOT a Web 2.0 application *

- ☐ Facebook
- ☐ Wikipedia
- ☐ the White House blog
- ☐ Netscape
- ☐ I do not know

* Required

Presentation Software

Which of the following is NOT terminology typically associated with presentation software *

- ☐ design template
- ☐ smart art
- ☐ query design
- ☐ animation
- ☐ I do not know

A presentation page that has a "brick wall" as a background *

- ☐ requires that all objects must be cut and pasted to it
- ☐ will prevent hackers from accessing the presentation
- ☐ is used as the foundation for the presentation
- ☐ can be replaced with a background of sky and clouds
- ☐ I do not know

In compliance with best cognitive design practices properly done presentation pages *

- ☐ will use red text on a pink background to make reading easy
- ☐ will use a lot of color and motion to keep viewers attention busy
- ☐ cannot have a video and text on a single page
- ☐ can use 'canned' or originally created sound effects for entrances of text animations
- ☐ I do not know

Presentation pages can be made cognitively engaging for a lesson by *

- ☐ running at high speeds with flashing text
- ☐ using contrasting colors and minimal text passages
- ☐ animating many elements on each page
- ☐ using loud and alarming sound effects
- ☐ I do not know

Placing a video to run in place on a presentation slide is called *

- ☐ video enabling
- ☐ video embedding
- ☐ digital video display
- ☐ video encapsulating
- ☐ I do not know

The individual pages of a computer-based presentation are called *

- ☐ sheets
- ☐ slides
- ☐ shams
- ☐ grids
- ☐ I do not know

Appendix C

Demographic Questionnaire Instrument

Digital Competency Survey

Demographic Questionnaire Instrument (DQ)

* Required

Some information about you

There are only a few short questions here. Please provide the requested information about you. Authentic answers and accurate responses will help to determine a variety of design paths to improve preservice teacher education programs.

Untitled Question *

- ☐ Return to beginning
- ☐ Continue

DEMOGRAPHICS

Gender * Please choose the one that applies

- ☐ Female
- ☐ Male
- ☐ Decline to answer

Regarding EDU214 * Please choose the one that applies

- ☐ I have successfully completed this class
- ☐ I am currently enrolled in EDU 214
- ☐ I have not yet taken this class

What year were you born? *

Please enter the four-digit year. (yyyy; e.g. 1986)

Your year in the college/university? * Please choose the closest grade level

- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior
- ☐ Graduate
- ☐ Non Declared

Have you COMPLETED classroom practicum field work? This includes student teaching and observation. *

- ☐ Yes
- ☐ No

Are you currently teaching? *

- ☐ Yes
 - ☐ No
-

How many post-secondary classes related to Digital Technology have you completed? *

- ☐ 5 or more
- ☐ 4
- ☐ 3
- ☐ 2
- ☐ 1
- ☐ None

In which program are you enrolled? *

Please choose one, only.

- ☐ Elementary
- ☐ Secondary
- ☐ Special Education
- ☐ Education Leadership
- ☐ Sports Education
- ☐ Educational Psychology
- ☐ Higher Ed
- ☐ Pre K
- ☐ Counselor Ed

What is your teaching content area? *
Please choose one that fits best

- ☐ Art
 - ☐ Early Childhood
 - ☐ English/Language Arts
 - ☐ Foreign Language
 - ☐ Health
 - ☐ History
 - ☐ Math
 - ☐ Music
 - ☐ Science
 - ☐ Social Science
 - ☐ Sports/Coaching
 - ☐ Theater
 - ☐ Other:
-

Digital Competency Survey

Thank you for your participation and contribution.

We may have a few follow up questions regarding your opinions and perspectives on certain aspects of this survey. If we may beg your indulgence just a bit more we would like your permission to contact you in the near future to complete this study.

If you are willing to answer just a few more short questions please enter your REBELMAIL address in the box.

It will not be used for any other purpose and will be de-identified upon completion of the final section.

Appendix D
Qualitative Digital Competence Support Survey (QDCSS)

QUALITATIVE FOLLOW-UP

So, this is short and sweet as the adage goes. There are only a few questions. This is informal but remains confidential. This will conclude the study--no more questions.

Please read these results---- The original survey in which you so generously participated was intended to compare your personal sense of your own competency in digital technology and how well you performed on a test of the same topic areas. For example, one subjective question might have asked how you rated your ability to use a QWERTY keyboard while the objective question was to choose a multiple choice answer as to what came after QWERTY? Qwerty is the type of keyboard most computers and typewriters used as a letter pattern. See the upper left letters on the keyboard you are using.....so what comes next would be "U".

Basically we were seeking information on how well self-reporting and self-assessment matched what was actually demonstrated by students. This would offer us a means of choosing or adjusting assessments in determining the curriculum and design of classes to enhance the tools that preservice teachers could carry with them into their future classrooms.

The results all fell within normal curves and distributions. However, (this is the important part) with only very minor exceptions almost everyone who participated over-estimated their digital abilities compared to their actual scores on the multiple-choice test. So, there are few things that still need to be explored.....

* Required

Gender * Please identify your gender

☐ Male ☐ Female

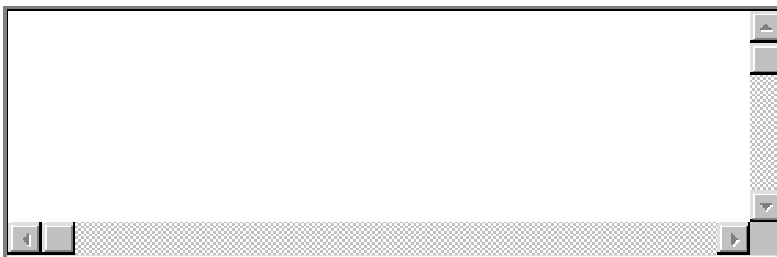
Age * When were you born?

As a general basis----on what did you judge your own digital ability? Tell me what you think.

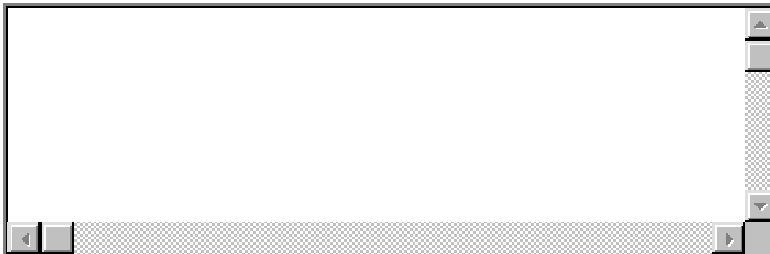
Based upon the results---what impact do you think this over-estimation has? What might this mean to you and/or to educating teachers?

A large, empty rectangular text box with a thin black border. It has a standard Windows-style scrollbar on the right side and a small icon in the bottom-left corner.

Overall---To what do you attribute this overestimation of digital competence? How would YOU explain it?

A large, empty rectangular text box with a thin black border. It has a standard Windows-style scrollbar on the right side and a small icon in the bottom-left corner.

Last one----Feel free to offer any opinions or comments you feel may be appropriate or significant.... Something else to consider????

A large, empty rectangular text box with a thin black border. It has a standard Windows-style scrollbar on the right side and a small icon in the bottom-left corner.

Never submit passwords through Google Forms.

Powered by [Google Docs](#) [Report Abuse](#) - [Terms of Service](#) - [Additional Terms](#)

Appendix E
E-Mail Invitation Script



Department of Teaching & Learning

February 5, 2012

Dear College of Education Student,

My name is Joseph Maderick. I am a doctoral student conducting a research study for completion of a dissertation.

As you know the University of Nevada Las Vegas is a high-ranking research institution dedicated to improving Education through research. As an undergraduate student in one of the College of Education programs you are being invited to participate in an important research study that seeks to explore facets of proficiency in technologies specifically applicable to learning and teaching. The study comes in the form of a two part survey. For participation in the study you will be afforded one research credit with the department.

The survey is comprised, in total, of less than 120 questions and can be completed quickly in a little more than a few minutes. Your responses are anonymous and in no way connected to your identity.

Please address any questions to maderick@unlv.nevada.edu

Please use this link to begin the survey.

[Digital Technology Survey](#)

The researchers wish to thank you in advance for your time and effort and to express appreciation for your participation.

Joseph Maderick, M. Ed.
Department of Teaching and Learning
Educational Technology

Shaoan Zhang Ph.D.
Assistant Professor
Teacher Education

Kendall Hartley Ph.D.
Assistant Chair Teaching & Learning
Educational Technology

Approved protocol # 1108-3898

Appendix F



IRB Protocol Approval Form
Social/Behavioral IRB – Exempt Review
Deemed Exempt

DATE: October 14, 2011

TO: **Dr. Shaoan Zhang**, Teaching & Learning

FROM: Office of Research Integrity – Human Subjects

RE: Notification of review by /Josi dos Santos/Ms. Josi dos Santos, CIP
Protocol Title: **A Study of the Validity of Self-Assessment by Undergraduate Preservice Teacher Education Students that Examines Demographic Variables By Comparing Self-Assessment with Objective Testing**
Protocol # 1108-3898

This memorandum is notification that the project referenced above has been reviewed as indicated in Federal regulatory statutes 45CFR46 and deemed exempt under 45 CFR 46.101(b)1.

PLEASE NOTE:

Upon Approval, the research team is responsible for conducting the research as stated in the exempt application reviewed by the ORI – HS and/or the IRB which shall include using the most recently submitted Informed Consent/Assent Forms (Information Sheet) and recruitment materials. The official versions of these forms are indicated by footer which contains the date exempted.

Any changes to the application may cause this project to require a different level of IRB review. Should any changes need to be made, please submit a **Modification Form**. When the above-referenced project has been completed, please submit a **Continuing Review/Progress Completion report** to notify ORI – HS of its closure.

If you have questions or require any assistance, please contact the Office of Research Integrity - Human Subjects at IRB@unlv.edu or call 895-2794.

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Vita

Graduate College
University of Nevada, Las Vegas

Joseph Andrew Maderick

Local Address:

5041 Cayman Beach Street
North Las Vegas, Nevada 89031
Email: Joseph.Maderick@Hotmail.com

Degrees:

Bachelor of Arts, English (with Honors)
California State University, San Bernardino (1999)

Master of Education/Curriculum & Instruction (with Honors)
University of Nevada, Las Vegas

Professional Certification:

Nevada Secondary School Credential –English
Arizona Secondary School Credential –English

Presentations:

Maderick, J., Zhang, S., and Hartley, K. (2010) *Shift in Self-Identification from Digital Student to Digital Teacher*. Presentation at ATE Kansas City, 2010;

Classes taught:

Technology for Teachers in the Classroom (Undergraduate Class)
Technology for Teachers in the Classroom (Graduate Class)
Digital Materials for Educators (Graduate Class)

Dissertation Examination Committee:

Co-Chairperson, Dr. Kendall Hartley, Ph.D.
Co-Chairperson, Dr. Shaoan Zhang, Ph.D.
Committee Member, Dr. Steve Grubaugh, Ph.D.
Committee Member, Dr. Gwen Marchand, Ph.D.
Graduate/Faculty Representative, Dr. Carolanne Kardash, Ph.D.