Information and communication technology (ICT) literacy: Refining a construct for assessment

Louis Michael Verusco
Information and Communication Technology (ICT) Literacy:
Refining a Construct for Assessment

by

Louis M. Ver dus co

Dissertation

Submitted to the College of Technology
Eastern Michigan University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY
Technology
Concentration in Technology and Education

Doctoral Committee:
John Dugger, Ph.D., Committee Chair
Konnie Kustron, J.D.
Tierney A. Orfgen, Ph.D.
Michael McVey, Ed.D.

February 9, 2016
Ypsilanti, Michigan
Dedication

This is dedicated to my wife and children that have supported and tolerated my academic efforts. I look forward to getting to know them again.
Acknowledgements

I would like to acknowledge my doctoral committee chair, Dr. John Chandler Dugger, for his research guidance and tolerance of my rouge moments, and Dr. Michael McVey for his encouragement to explore educational topics that helped frame this effort.
Abstract

This research effort conceptualized, developed, implemented, and examined the psychometric properties of an Information & Communication Technology (ICT) literacy assessment instrument designed for students entering college. This process began with the development of a working definition of the ICT literacy based on the literature and the input of a panel of experts regarding the proposed literacy sub-constructs and the individual test items. A pilot test was conducted to identify areas for improvement. Once these improvements were incorporated, the final assessment instrument was administered to the freshmen class at a private Midwestern comprehensive university with religious affiliation.

The psychometric aspects of the assessment instrument were analyzed based in the field test results. Four hypotheses were used to further examine the field test data. The first hypothesis tested the ICT literacy dimensions or sub-constructs that were derived from the literature and refined with assistance of the panel of experts. Three additional hypotheses examined assessment results through selected demographic aspects of the participants including gender, a socioeconomic indicator, and their self-reported high-school GPA.

The results of the field test indicated that ICT literacy may be complex, but it can be measured. The developed items that formed the assessment instrument fell within good psychometric bounds. This was not the case with the dimensions or sub-constructs, since they were not supported by the results of a confirmatory factor analysis or materialize through an exploratory factor analysis. This analysis did suggest different factors that have been included in the resulting proposed Digital Communication and Information Scale (DCITS).
The ICT Literacy assessment instrument field test scores were analyzed through the demographic information provided by the participants. The assessment results revealed that female participants performed better than male participants. The participants from lower socioeconomic levels, as indicated by eligibility for subsidized lunches, received lower assessment scores. And finally, the participants with higher GPAs received higher scores on the ICT literacy assessment.

This research effort has shown that ICT literacy assessment is possible and can provide insight for educators and guide future research. Suggested alternative dimensions were proposed (DCITS) that differed from those proposed in the related literature. Future iterations of this ICT literacy assessment instrument or development of similar instruments is warranted to continue to explore this important topic.
Table of Contents

Dedication ..................................................................................................................... ii
Acknowledgements...................................................................................................... iii
Abstract ........................................................................................................................ iv
Table of Contents ......................................................................................................... vi
List of Tables ................................................................................................................. x
List of Figures .............................................................................................................. xi
Chapter 1 - Introduction ............................................................................................. 1
  Problem Statement .................................................................................................... 5
  Significance of the Study .......................................................................................... 5
  Objective of the Research ....................................................................................... 10
  Research Questions and Hypotheses .......................................................................11
  Limitations .............................................................................................................. 12
  Delimitations ........................................................................................................... 12
  Assumptions ............................................................................................................ 12
Chapter 2 - Literature Review ..................................................................................... 13
  The Importance of ICT Literacy ............................................................................. 13
    ICT and Students................................................................................................ 14
    Teachers and ICT. ............................................................................................... 17
  A Brief Historical Review of Educational Technology .......................................... 21
  ICT Definitions and Descriptions .......................................................................... 24
    UNESCO............................................................................................................. 26
    United States. ...................................................................................................... 28
List of Tables

Table 1 - Assessment Readability Statistics ................................................................. 64
Table 2 - Readability Indices ....................................................................................... 65
Table 3 - Demographic Frequencies and Percentages ................................................... 68
Table 4 - Item Difficulty .............................................................................................. 73
Table 5 - Discrimination Index ................................................................................... 74
Table 6 - Proposed Model (Four Factor) Compared to Baseline Model ....................... 76
Table 7 - CFA Results Summary for Goodness of Fit Indices ...................................... 76
Table 8 - Factor Analysis - Rotated Factors ................................................................. 80
Table 9 - Digital Communication and Information Technology Scale .......................... 83
Table 10 - Tests of Normality Male/Female Participant Scores ...................................... 84
Table 11 - Tests of Normality Post Normality Test Post Two-Step ................................. 84
Table 12 - Weighed Gender Group Statistics for Normalized and Observed Scores ....... 85
Table 13 - Independent Samples Test Gender Weighted Scores ................................... 85
Table 14 - Group Statistics of Weighted Gender Scores ................................................. 86
Table 15 - Independent Sample T-Test of Weighted Gender ......................................... 87
Table 16 - Group Statistics of Reduced Lunch .............................................................. 89
Table 17 - Reduced Lunch T-Test ............................................................................... 90
Table 18 - Reduced Lunch ANOVA ............................................................................ 91
Table 19 - Correlations of Weighted GPA and Scores .................................................. 93
Table 20 - GPA (reported) Coding ............................................................................. 94
Table 21 - Results Summary for Research Questions and Hypothesis .......................... 95
List of Figures

Figure 1. Initial Proposed Framework of ICT Literacy ........................................................... 9

Figure 2. Panel of Experts Feedback ...................................................................................... 51

Figure 3. Item Structure (Wright, 2008, p. 185) ..................................................................... 52

Figure 4. Histogram of the total score (Pilot) ......................................................................... 65

Figure 5. Online Education Experiences ................................................................................ 69

Figure 6. Personal Reflection Questions of Technology Skill ................................................ 70

Figure 7. Field Test Score Distribution ................................................................................... 71

Figure 8. Box-Plot of Field Test Score Frequency ..................................................................... 71

Figure 9. EFA Scree Plot ........................................................................................................ 78
Chapter 1 - Introduction

Humans have used technology to advance their knowledge and skills throughout history. Kurzweil (2005) describes this use of technology as an information based progression where an ever increasing order builds upon itself. He proposes that technological advancement and societal evolution are symbiotic. As people advance technology, technology also advances people.

The history of the printing press is an example of the intimate relationship of technology and knowledge advancement. In 1041, China was the first to implement a movable-type of printing press (Ebrey & Schirokauer, 2008; Lerner, 2014). This allowed the same press to be reconfigured to generate different pages without the creation of a completely new plate. The letters were first created using baked clay and later wood. This technique was limited due to high cost (Ebrey & Schirokauer, 2008). Three centuries later in Europe, this technique was revolutionized by Johann Gutenberg in 1454 with the introduction of lead based movable-type (Lerner). This refined the process adding durable letters that improved the readability of books. This movable type not only improved the speed of book production, it also had a great impact on the dissemination of information. This greatly improved public literacy over the next hundred years as the written word moved into wide circulation (Vivian, 2007). In modern terms, this transition to a literate population could be compared to the foundational literacy transition referred to as emergent literacy (Woolfolk, 2012).

The formal concept of literacy began to emerge with the scientific testing of students with the formation of psychology and educational assessment. There was a desire to apply scientific measurement to "clarify, group, and track children" to determine academic achievement or intelligence. This U.S. psychology and educational testing movement was
influenced in the late 1800s by the work of Wilhelm Wundt and Sir Francis Galton in Europe (Wright, 2008, p. 42). Galton (1865), influenced by his cousin Charles Darwin, published the laws of heredity and their effect on individual differences. This was divergent thinking at the time because people were considered to have equal abilities and variances were due to "hard work and diligent effort" (Wright, 2008, p. 43). Galton concluded that greatness was an inherited ability (1865). This "greatness" would not be the same as current standard measures, but Galton's work became the genesis for educational and psychological testing that attempted to measure behavior and psychological attributes related to learning (Furr & Bacharach, 2013; Wright, 2008). These transformations dramatically increased the availability of information, which resulted in changes in literacy and the formation of educational practices. Again, this was possible in part based on the availability of printed materials.

The proliferation of printed material was augmented by other forms of media. In the early 1900s, lanterns were used to project photographic images from film to be used for educational purposes. Between the 1920s and 1940s advances in "sound recordings, radio broadcasting, and motion pictures with sound" provided opportunities to utilize audiovisual materials for instruction (Reiser & Dempsey, 2012, p. 2). This period became known as the visual instruction movement (Reiser & Dempsey, 2012). In addition, the term "communication" became associated with this audiovisual movement and in the 1950s television emerged as a tool for the delivery of educational content (Reiser & Dempsey, 2012). These early forms of media were the foundations of the various media that are available today.

Digital technologies were responsible for another major shift that affected education and literacy expectations. Personal computers were introduced in 1977 and were first adopted
in businesses in the 1980s (Grant & Meadows, 2008). Once computers entered into the equation, interactive media could be leveraged for educational purposes. By 1983, computers were being used for instructional purposes in over 40 percent of elementary and 75 percent of secondary schools (Reiser & Dempsey, 2012). But the linchpin for change was the connectedness the Internet provided. Tim Berners-Lee invented the current protocols that facilitate the Internet in 1989 while at CERN and by 1993 the Internet was opened to the public royalty-free (World Wide Web Foundation, 2015). As the Internet grew, additional possibilities from new forms of media became available such as streaming video, online communications, and even online classes. As digital information and communication technologies became central to society, the expectations of required skills and knowledge have transitioned from traditional analog media to the digital media (Livingstone, 2004).

Moving instructional methods into the digital world requires caution, and both the benefits and limitations should be recognized and understood. When software is created to facilitate various human activities, it cannot account for all the variations and possibilities; thus it is a truncated experience (Lanier, 2010). Lanier's idea of limitations can be illustrated in the example of a synchronous online class. When an instructor is teaching in a classroom, they have the benefit of being able to observe non-verbal communication from the students. This is lost in a synchronous online course because the instructor loses the broad view of the classroom of students. Moore extends this example with the Theory of Transactional Distance (M. G. Moore, 1997), which he described as a continuous variable that represents the difference and strength of the relationship between the educator and the learner. In addition, this relationship can be influenced by such items as, communication methods, course design, and teaching methods.
As new technology affects the educational environment, the literacy needs of students and teachers have changed. Literacy is defined as, "a person's knowledge of a particular subject or field" ("Dictionary.com Unabridged," n.d. Def. 1). Information and Communication Technology (ICT) literacy is necessary to participate in and understand our new digital world.

The description of literacies related to digital technology has changed and evolved (Axelson, 2005) and due to the dynamic nature of the ICT construct, assessment has been proposed in many forms. Several descriptions of digital literacy or ICT literacy exist (ICT Literacy Panel, 2002; Kramer, Walker, & Brill, 2007; Markauskaite, 2007; Seymour & Fourie, 2004; Tondeur, van Braak, & Valcke, 2007; Van Joolingen, 2004) but while attempting to detail a common construct, they contain variations of concepts that inhibit common understanding. These include concepts such as information, media, and visual literacies, but they are not consistent across the literature. In addition, researchers have proposed literacy assessments (Fillion, Limayem, & Laferrière, 2007; ICT Literacy Panel, 2002; Jamieson-Proctor, Watson, & Finger, 2007; Markauskaite, 2007; Tondeur et al., 2007; Vanderlinde, van Braak, & Hermans, 2009), but the assessments vary in the concepts addressed as well as format. These attempts to create assessments include three main methods; questionnaire style assessments (Markauskaite, 2007), task-based assessments (Mat-Jizat & McKay, 2011), and software simulations (Axelson, 2005; Educational Testing Service, 2005). The lack of a clear working definition of ICT and the varied assessment efforts have not clarified the construct or provided clear assessment goals for educators. One definition generated by Katz and the ICT Literacy panel "ICT literacy is using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society" (2002, p. 11), is used by multiple authors (Dede, Ketelhut, Whitehouse,
Problem Statement

The ICT literacy construct had not been adequately developed for use in post-secondary education. The lack of clear parameters to define the construct limited the creation of a meaningful and practical assessment instrument to measure ICT literacy. Although, the Educational Testing Service (ETS) has produced an assessment instrument, the cost may be a major barrier to its use along with accessibility and a limited attention to sub-construct factors, which negatively affects the usefulness of the test. Once the construct was adequately explored and described, an assessment tool was created with the goal of providing institutions a means to evaluate whether students are entering post-secondary education with the appropriate level of ICT literacy skills and knowledge. The objectives of this assessment instrument included minimizing cost, ease of administration, and to be an accurate reflection of the skills and knowledge of the ICT literacy construct.

Significance of the Study

New skills and knowledge are required to utilize the advances in technology and media, which could be described with the construct of Information and Communication Technology (ICT) literacy. ICT literacy has been described as a complex literacy construct composed of several groups of overlapping literacies or ICT categories (DG Communications Networks, 2013; Lankshear & Knobel, 2008; Oliver & Towers, 2000; Strong-Wilson, 2012). For example, these can include information, visual communication, computer, and media literacies. The ICT construct may be complex enough that it has posed challenges to both
assess and define. Multiple attempts have been made to describe this construct of multiple dimensions (ICT Literacy Panel, 2002; Tondeur et al., 2007). Many researchers have discussed ICT literacy but failed to operationalize a definition (Proctor, Watson, & Finger, 2004; Townsend & Bates, 2007). Technology is far from stagnant and ongoing developments have added to the challenge of defining ICT (Biagi & Loi, 2013). The more ICT skills required to participate in a modern society, the greater the importance of clearly identifying the experiences and skills required to develop students' ICT literacy (Livingstone, 2004).

Student ICT literacy is a critical issue for education and for educators teaching courses that use technology. Traditionally, student literacy has been thought of as reading, writing, and arithmetic. There are new categories of literacy concerns arising in the academic culture from the digital technologies (McDougall, 2010). ICT literacy is becoming the new concern for educators and society, and a value to a competitive workforce and an enabled population (Hobbs, 2010). The traditional literacies, such as reading and writing are a prerequisite because without basic literacies a person cannot truly achieve a functional ICT literacy level (Hobbs, 2010; ICT Literacy Panel, 2002).

Research in ICT literacy is becoming prevalent in education but the challenge is to identify, measure, and understand how these literacies enable the 21st century learner to become the critically enabled citizen who will have a positive effect on society (Biagi & Loi, 2013). Instruments have been developed to measure several dimensions of basic technology literacy, but attempts to measure ICT literacies have become a growing focus of research in recent years with the goal to identify performance indicators and assessment techniques (Kang, Heo, Jo, Shin, & Seo, 2010; Kules & McDaniel, 2010; Teske & Etheridge, 2010). The preliminary tools have not matured enough for them to transform into educational standards.
and currently there is a “lack of quality indicators on measuring digital literacy and skills” (UNESCO Institute for Statistics, 2009, p. 16). However, in the for-profit market, Educational Testing Service (ETS) produced a report that outlines the ICT framework (ICT Literacy Panel, 2002) that is utilized for the iSkills testing service that they offer for a fee (Educational Testing Service, 2015).

If these attempts are reviewed and future goals are examined, the beginning of unified standard indicators and assessment methodologies may be synthesized and leveraged by academia to enhance pedagogical methods. Based on the product of the working group formed by U.S. Department of Education Office of Educational Technology, Duncan has identified four major goals for transforming American education, which include the adoption of modern standards and assessments that prepare students for success in college and the workforce (National Educational Technology Plan Technical Working Group, 2010, p. 2). ICT literacy is a critical issue that deserves attention, as education is transformed by the rise in use of digital technology in society. The literacy requirements need to be periodically modified to reflect our changing societal reality. Increasing student access to materials and experiences through ICT technologies provides a "greater potential for learning more" (Lankshear & Knobel, 2008, p. 146). Consideration to the mode of skills, consumption, or production needed should be understood. For example, the skills required to locate a popular video on YouTube are different than the skills used to produce a research report. Using ICT skills to be productive requires not only thought and consideration, but also the technical knowledge to complete the task.

In 2010, the U.S. Department of Education through the Office of Educational Technology released expectations for the transformation of education through the use of
technology. This document established goals and expectations for the educational system to implement technologies and the opportunities that technologies provide to improve student outcomes. The technology goals were developed to achieve the Obama administration's objectives of high school graduates' readiness to succeed in college, and of 60 percent of the population holding a two or four-year degree (National Educational Technology Plan Technical Working Group, 2010). These types of changes require time to implement and operationalize (Townsend & Bates, 2007). Addressing the challenges of ICT literacy in education requires all involved to assist in developing our students, teachers, and institutional culture. This study compiled a common description of the Information and Communication Technology (ICT) literacy construct from the literature, identify categories of the literacy, and utilized them for the development of an ICT literacy assessment instrument.

The theoretical framework for this effort included: information, communication, computer, media, and visual. The relationships are illustrated in Figure 1 below.
Figure 1. Initial Proposed Framework of ICT Literacy.

An ICT literacy assessment instrument could be utilized to assess the level of a student's ICT knowledge and skill in preparation for either completing high school or entering higher education. It was envisioned that the scores from such a tool would allow secondary educational institutions to assess their curriculum and its effects on ICT literacy. In higher education, this instrument could be utilized to verify that students have the necessary ICT literacy skills for a successful college career. If it is determined that a student falls short of the expected knowledge and skills, a remediation plan could be established. Ensuring that students possess a certain minimum level of ICT knowledge and skills will not only make the students more academically successful, but also reduce barriers that may affect overall retention in the post-secondary academic programs.
Objective of the Research

The purpose of this research was to create an assessment instrument that could be used to measure ICT literacy achievement appropriate for entry-level post-secondary students. This assessment targets students during their transition from secondary to post-secondary education and assumes that students would be receiving ICT literacy experiences during their K-12 career. In order to address the purpose, a working definition of an ICT literacy construct was developed, the dimensions of the construct were identified, and finally an assessment instrument was developed that addresses the definition and sub-constructs. This type of criterion-referenced assessment is leveraged to measure students' ability and knowledge for a topic based on expectations for a specific stage of their education. For high school students, this could be used to determine whether the students in their senior year have acquired the expected technology skills through their educational experience. In the case of higher education, it could be used to determine if students entering their freshman year might require remediation prior to entering a technology-rich curriculum or possess the skills required for a successful college career.
Research Questions and Hypotheses

This study addressed the following research questions and hypotheses:

1. What is a usable definition of ICT literacy for use in post-secondary education settings?
2. What are the key dimensions of ICT literacy as applicable to student preparedness for post-secondary education?
3. What items can be used to address each sub-scale and assembled into an ICT literacy instrument?
4. What are the psychometric aspects of the developed ICT assessment?
5. Will a factor analysis of the assessment instrument field test results yield factors that are consistent with the proposed ICT dimensions?
   \( H_0.1: \) There will be no significant difference between the dimensions used to frame the items and the factors generated by factor analyzing the field test data.
6. Does gender, socioeconomic status, or self-reported high school GPA affect scores on the developed ICT literacy assessment instrument?
   \( H_0.2: \) There will be no significant difference between the ICT Literacy scores of males when compared to females.
   \( H_0.3: \) There will be no significant differences among the ICT Literacy scores that qualify for free-lunches when compared to those who received no lunch subsidies.
   \( H_0.4: \) There will be no significant relationship between self-reported high school GPA and assessment scores for those participating in the field test.
Limitations

- The assessment participants will not be a random sample, but will instead be recruited from the fall orientation at a private Midwestern university with religious affiliation.
- The results of this research is time sensitive, due to the nature of technology advancements.

Delimitations

- The target population of the study was limited to post-secondary education students with considerations to the published goals of the U.S. Department of Education.
- The assessment was limited to the assessment of ICT literacy and will not provide recommendations related to remediation of ICT skills.

Assumptions

- A common definition of the ICT Literacy construct could be developed from the literature and with the support of a panel of experts.
- There are multiple dimensions contained in the ICT Literacy construct.
- An objective assessment could be created to measure an individual's ICT literacy achievement, as that individual is preparing for or entering post-secondary education.
Chapter 2 - Literature Review

The purpose of this chapter is to summarize the current and historical literature related to ICT literacy and assessment of that literacy. The chapter is organized into the importance of ICT literacy, a summary of the history of educational technology, ICT definitions, psychological assessments, and a chapter summary.

The Importance of ICT Literacy

There are several aspects of ICT literacy that should be reviewed to understand the importance of the topic and its integration to the current educational system. Technology has been infiltrating education for decades. It has become part of the pedagogical practice, core to the educational infrastructure, a topic for research and debate, and a concern for educators and students. To provide context to the research, some of the concepts need to be defined.

Literacy is also a term that can be defined by context and author (Koltay, 2011). The standard definition is "a person's knowledge of a particular subject or field" (“Dictionary.com Unabridged,” n.d. Def. 1). Buckingham stated, "literacy is a phenomenon that is only realized in and through social practices of various kinds, and it therefore takes different forms in different social and cultural contexts" (2007, p. 44). In the context of this research, literacy is the knowledge and skills that are acquired over time and have resulted in changed behaviors, from prior to acquisition, in response to subject matter or field. It could also be stated that the person has acquired the expected knowledge in a specific field to be proficient.

The definition of technology can vary depending on the context. For example, the influence of moveable type led to wide circulation of printed material that produced an exponential increase in literacy and by 1490 at least one printing press was operating in major cities in Europe (Vivian, 2007). In this context, the technology of the printing press had a
great impression on society, but this was an analog technology. The technology that we are concerned with in the context of ICT literacy is digital technology. These digital technologies involve and are the result of the development of microprocessors (Molenda, 2008). These digital technologies brought about the personal computer and the Internet. In the context of this research, "technology" refers to digital technologies, unless otherwise indicated.

Educational technology is a specific use of technology and technology in education has transitioned from analog to digital (Buckingham, 2007; Molenda, 2008). The use of technology in education has increased in recent years and now has become the basis for many educational practices (Buckingham, 2007; Hobbs, 2010; Molenda, 2008; Strong-Wilson, 2012). Educational technology is more than the use of technology for educational purposes. It also includes the pedagogical practices, and theories associated with the use of technology. In this context educational technology is the selection, use, and analysis of technology in an educational context.

**ICT and Students.**

It is critical that educators are aware of students' ICT literacy. If students are entering college without even basic ICT skills, it could hinder their educational experience. In the Europe-wide survey of over 190,000 students and teachers it was determined that academic activities that required ICT skills were "still very rarely used by students during lessons" (DG Communications Networks, 2013, p. 10), in contrast over a third of the students considered themselves digitally "confident" based on their ICT skills acquired at home (2013, p. 15). In this situation some of the students are gaining the skills needed to compete in society and others are going to be at a disadvantage (Hobbs, 2010). This self directed or informal learning can be leveraged in the classroom (Hobbs, 2010; Spector, 2013), but it can be situational and
based on student interest that may not support learning (Johnson et al., 2013). Many developing countries view the improvement of students' ICT literacy as a socioeconomic issue to increase the country's ability to compete globally (Avgerou, 2010). Adopting a "laissez-faire" approach is flawed in that it assumes that students will acquire the needed skills on their own and they will adopt the ethical practices associated with using those skills (Clinton, Purushotma, Robison, Weigel, & Jenkins, 2006, p. 15). Education institutions need to be active participants in the development of students' ICT literacy.

Traditionally, student literacies have been thought of as reading, writing, and arithmetic. There are new literacy concerns arising in the academic culture. ICT literacy is becoming the new concern for educators and society, and a value to a competitive workforce and an enabled population (Hobbs, 2010). ICT literacy is a second tier literacy that is supported by basic literacies such as reading and writing, because without basic literacies a person cannot truly achieve a functional ICT literacy level (ICT Literacy Panel, 2002). Research in ICT literacy concerns is becoming prevalent in education, but the challenge is to identify, measure, and understand how these literacies enable the 21st century learner to become the critically enabled citizen that will have a positive effect on society.

Tools have been developed to measure basic technology literacies, but attempts to measure ICT literacies have been a growing focus of researchers in recent years in an attempt to identify performance indicators and assessment techniques (Kang et al., 2010; Kules & McDaniel, 2010; Teske & Etheridge, 2010). The preliminary tools have not matured enough to transform into educational standards, and currently there is a “lack of quality indicators on measuring digital literacy and skills” (UNESCO Institute for Statistics, 2009, p. 16). In the for-profit market, Educational Testing Service (ETS) produced a report that outlines the ICT
framework that is utilized for the iSkills testing service that they offer for a fee (ICT Literacy Panel, 2002). If these attempts are reviewed and future goals are examined, the beginning of unified standard indicators and assessment methodologies may be synthesized and leveraged by academia to enhance pedagogical methods. Former U.S. Secretary of Education, Arne Duncan, identified four major goals for transforming American education that would be driven by technology adoption that include:

1. States should adopt standards and assessments that prepare students to succeed in college and workplace and compete in the global economy
2. States should build data systems that measure student growth and success and inform educators about how they can improve instruction
3. States should recruit, reward, develop, and retain effective educators, especially in underserved areas where they are needed most
4. States should turn around their lowest achieving schools


ICT literacy is a critical issue that deserves attention. As education is transformed by the rise of technology in society, the literacy requirements need to be modified to reflect our changing societal reality. Increasing student access to material and experiences through literacy provides a "greater potential for learning more" (Lankshear & Knobel, 2008, p. 146).

The adaption of technology has caused students to develop ICT literacy skills to meet the demands of their education. Consideration to the mode of skills needed should be understood. For example, the required skills to locate a popular video on YouTube differ from the skills used to produce an informational video. Using ICT skills to be productive requires
not only thought and consideration, but also the technical knowledge to complete the task. This is the difference of using ICT for consumption versus production (Livingstone, 2004).

**Teachers and ICT.**

This adoption of technology is a literacy issue for not only students but faculty as well (Bristow, Shepherd, Humphreys, & Ziebell, 2011). All levels of educational technology are rapidly changing from the simple to the “more complicated, sophisticated, and engaging environments” (Nelson, Palonsky, & McCarthy, 2007, p. 316) and educators need to adapt and embrace emerging classroom technological change (McQuiggan, 2012). In 2011 Higher Education Research Institute (HERI) faculty surveys, 52.1 percent of faculty surveyed expressed “keeping up with technology” as a source of stress (Hurtado, Eagan, Pryor, Whang, & Tran, 2012), while 84 percent stated having sufficient technology support (DeAngelo et al., 2009). Practicing educators are utilizing technology to varying degrees depending on their situation, experience, and goals, but their use of technology is still limited (McQuiggan, 2012).

The majority of faculty report increased stress when attempting to keep up with technology as a tool to help facilitate instruction and increase their pedagogical effectiveness (Hurtado et al., 2012). These reasons include but are not limited to the lack of financial support, time restraints, general apathy, fear of the unknown or failure, misdirected application to instruction and the curriculum, and faculty preparedness and technology skills (Bristow et al., 2011; Kopcha, 2008; Mishra & Koehler, 2006). Some of these concerns may be addressed if the educator embraces the inclusion of technology in instruction (Strong-Wilson, 2012). Kopcha states, that the technology integration process is evolutionary and “technology skills slowly build upon each other and co-evolve as technology is introduced.
and assimilated into the school culture” (2008, p. 177). This evolutionary process requires periodic assessment of ICT literacy to ensure acquisition of skills and understand the advancement of these literacy skills.

There is great deal of discussion around technology with the majority of the conversation being about it being a tool that could increase business, rather than discussing the support or benefits that technology can provide teaching and learning efforts (Selwyn, 2007). The conversation should be shifted to the methodologies being developed, which use technology to innovate and increase the effectiveness of teaching (Djermanov et al., 2011), as opposed to training teachers to use the current technology that may become dated in the near future (Mishra & Koehler, 2006). Because educators are focused on traditional education methods they may overlook instructional practices that support what students consider important for their education (Hawisher, Selfe, Moraski, & Pearson, 2004).

In addition to technical logistic and communication concerns, faculty acceptance of teaching with technology is yet another and likely the greatest concern. “Organizational change is not easy to accomplish, and technological changes cannot be implemented without resistance,” and higher education is no exception (Gibson, Harris, & Colaric, 2008, p. 355). Gibson et al. (2008), also states that, technological change can raise concerns and fears of this change and the unknown. Faculty also have concerns that technology is causing students frustration, which may lead to poor student course evaluations. It was found that faculty less experienced with technology focused on ease of use and as technology experience increased the focus centered on perceived usefulness (Gibson et al., 2008; Strong-Wilson, 2012). There was little concerning motivation in these studies, and that may be another contributing factor. Educators may see themselves divided from students by technology skills and knowledge.
Marc Prensky wrote *Digital Natives, Digital Immigrants* in which he divided the population into the two categories, digital natives and digital immigrants. The disparity described in the text framed a communication breakdown of these two factions, specifically citing the student and teacher respectively in these roles (Prensky, 2001a). Prensky states, "Our students have changed radically. Today’s students are no longer the people our educational system was designed to teach" (Prensky, 2001a, p. 1). He described the differences in experiences of these two populations and the effects this difference have. He attested, "Children raised with the computer — think differently from the rest of us" (Prensky, 2001b, p. 3). Primarily, he asserts that students have shorter attention spans based on the use of video games, computers, and the variety of messaging service. The change requires that educators meet the students on their terms to have the greatest impact. For example, teaching students through video games. This idea has been elaborated on several times by authors and educators alike with both praise and criticism, but most recently by Prensky himself. He contends we must look forward and that digital technology can make us more intelligent (Prensky, 2009). He argues that technology enhances access to data, the ability to conduct deeper analysis, our ability to plan, our insight into others, and access to alternative perspectives. If we leverage technology, we can raise our ICT literacy and become "truly wiser" (Prensky, 2009, p. 1).

Another proponent of technology in the classroom, David Warlick, describes how information has become increasingly digital and networked, which can lead to being overwhelmed as people try to decide what information is useful and what should be ignored (Warlick, 2007). This influences the concept of literacy and the basic skills that are required. He describes the need to redefine literacy:
It means that students must know how to use appropriate tools to find information, decode it, evaluate the information to determine its value, organize the information to add meaning, process, analyze, synthesize, manipulate, mix and remix the information, and then express their findings in compelling ways using appropriate modes of communication (Warlick, 2007, p. 21).

Changing faculty "attitudes toward literacy is not a simple or easy task... Many faculty lack training in digital literacies, and many lack access to the technology and professional support systems that could help them feel more confident" (Hawisher et al., 2004, p. 677). Teacher training and technology investment may be stagnate in comparison to continually rising expectations of the institutions who are responsible for these educators (Lankshear & Knobel, 2008). Limited professional development may hinder faculty members' ability to overcome any hesitations and begin to integrate technology. Once this process begins, it may allow faculty to not only improve their pedagogical practice but also affect student outcomes (Mishra & Koehler, 2006; Strong-Wilson, 2012). This self-enlightenment was discussed in research focusing on the longitudinal examination of teachers' professional development and organizational change. “We found that positive changes in teacher identity led to pedagogical changes” (Strong-Wilson, 2012, p. 139). Strong-Wilson continued, “Changes in teacher practice generated greater student control over their learning” (p. 139). Strong et al., highlighted the benefits of ICT literacy for not just the educators, but also the effect that carried over to the students' learning. These educators took the time to define the meaning of ICT literacy for both themselves and the students, which resulted in an enhanced educational experience as a result of technology inclusion in the curriculum.
The ICT literacy of students and educators may be a challenge, but it deserves out attention. These skills take time to develop and it is important to include the both the "technical capabilities to use ICT tools" and the "cognitive ICT-related capabilities of problem solving and information processing" (Markauskaitė, 2007) in our ICT standards. This may not be a simple task, but our ICT literacy goals should reflect the idea of ICT literacy beyond the use of hardware and software (Bawden, 2008; Buckingham, 2008; Hobbs, 2010; Mishra & Koehler, 2006; Strong-Wilson, 2012).

A Brief Historical Review of Educational Technology

A review of ICT literacy should include a discussion of how technology has affected education. Educational technology has been transforming education for years, and will likely continue to effect change as it continues to advance. The advancement of educational technology is directly tied to the advances in media and technology (Reiser & Dempsey, 2012), but also has roots based in "philosophical, pedagogical, and psychological theories" (Spector, 2008, p. 5). This means instructional technology is not limited to the instructional media (computers, software, videos, etc.) that is utilized in teaching practice. Reiser defines instructional media as, "the physical means, other than the teacher, chalkboard, and textbook, via which instruction is presented to learners" (2001a, p. 55). To define educational technology Reiser (2012) refers to the Association for Educational Communications and Technology (AECT) definition. Richey reports the AECT's most current definition, "Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (2012, p. 1).
In the United States instructional media has a long history. Many movements comprise this history, based on the technologies available at the time. They included School Museums that provided portable exhibits for learning in the early 20th century (Reiser, 2001a); the Visual Instruction Movement that included films, slides, and photographs starting in the early 1900s (Molenda, 2008; Reiser, 2001a); the Audiovisual Movement including audio and visual mediums by the 1930s (Molenda, 2008; Reiser, 2001a; Reiser & Dempsey, 2012); and continuing to the digital media of present (Reiser & Dempsey, 2012). Starting during World War II, the media movements transitioned to include research on the effectiveness of instructional films (Molenda, 2008).

This research into instructional media effectiveness led to the use of theories to support the development and use of materials (Reiser & Dempsey, 2012). The first theories were related to the communication process and its effectiveness through audio and visual media (Molenda, 2008; Reiser & Dempsey, 2012). Studies that were carried out led to investment in educational television in the 1950s (Molenda, 2008; Reiser, 2001a) and to the advancement of more interactive material with the introduction of computers in the 1980s (Reiser & Dempsey, 2012). This investigation into the details of media development led to the Programmed Instruction movement, which prescribed ideas regarding the development of materials and delivery conditions to improve human learning. On the forefront of this movement was B.F. Skinner (Molenda, 2008; Reiser & Dempsey, 2012), who in *The Science of Learning and the Art of Teaching* describes the use of educational material and reinforcement techniques to improve learning (Skinner, 1999). These concepts that Skinner and others described for developing programmed instruction became the theoretical foundations for educational technology. These concepts included communication theory and
later instructional design models (Reiser & Dempsey, 2012; Spector, 2008). The theories that began to support the concepts of educational technologies and the design process continued to develop as research and practice contributed to our understanding of learning.

Many theories and systems developed throughout the years as research based on teaching and learning outcomes progressed. In 1958, Skinner continued to expand his theories on education by emphasizing the role that technology, such as "Teaching Machines," could be used to improve educational practice and outcomes (Skinner, 1999). This teaching machine would deliver material in a systematic way to optimize learning. The use of technology to deliver programmed instructional materials could be consistent and designed. Using Programmed Instruction, educational materials could still be delivered in a systematic manner with or without machines. "Programmed Instruction is based on several principles from Skinner’s operant conditioning theory, including shaping, priming and prompting, and transfer of stimulus control" (Lockee, Larson, Burton, & Moore, 2008, p. 189). Many of the concepts in Programmed Instruction can be found in the steps of instructional design models used today (Reiser & Dempsey, 2012).

The research on systems approaches to learning developed over the years and transformed into instructional design models. These models are used to "to facilitate and support human learning and performance" (Spector, 2008, p. 25). Psychologists and researchers that included Robert Gagné, Robert Glaser, and Leonard Silvern, offered structured systems approaches to instruction, which outline the process to develop instruction (Molenda, 2008; Reiser, 2001b; Reiser & Dempsey, 2012; Spector, 2013). These pioneers may have paved the pathway for many theoretical foundations used today, but there is always room for more investigation and research.
To review, there are two sides that comprise educational technology. First discussed was the "technology," which is tied to the advancements and availability of the technologies of the day. Then, a review of the "educational" aspects that include an abundant history of research in educational and psychological theories was included. These foundations will continue to expand as new technologies and "new areas of psychology are likely to impact instructional design research" (Spector, 2008, p. 57). The other side of technology, whether in education or everyday life, is how well we utilize it for productive means and that is where ICT literacy is needed.

**ICT Definitions and Descriptions**

Information and Communication Technology literacy is one of the major issues in education and society at large. It could be considered a fourth literacy goal after reading, writing, and arithmetic and woven into the various content areas to enable students to be more capable (National Educational Technology Plan Technical Working Group, 2010). This literacy is what will allow citizens to be productive in a society that has increased reliance on technology for daily activities. We should also be cautious not to confuse consumer centric activities as ICT literacy. The process of a person entertaining themselves with the assistance of technology uses a very basic level of ICT literacy, compared to using technology for productive purposes. For example, to be popular in a social media platform among social peers does not require the same effort and skill to analyze and develop a report based on a research question that involves the same group of peers.

Defining ICT literacy is a primary goal for developing assessment goals and tools, since without objectives to measure you cannot assess performance (Wiggins & McTighe, 2005). The primary literacies of reading, writing, and arithmetic are all assessed throughout
the primary and secondary educational experiences through the use of several milestone assessments to determine a student's progress against established standards. Suggested standards for ICT literacy have been established by U.S. and international organizations in recent years (National Educational Technology Plan Technical Working Group, 2010; Shaw et al., 1998; UNESCO Institute for Statistics, 2009; United Nations Educational, Scientific and Cultural Organization, 2011). United States Department of Education standards that have been established for ICT literacy are broad and assert the expectation that state governments are responsible to implement literacy programs and establish ICT assessments (National Educational Technology Plan Technical Working Group, 2010). Based on this recommendation, the federal government is assuming that state educational bodies have the resources and expertise to establish these assessments with federal guidance. This could be a challenge for states with restricted financial and human resources that are experiencing declining trends in enrollment, which may lead to further constrained funding (National Education Association, 2014a; 2014b) Considering the national trends and the broad scope of the federal guidelines, the research literature may provide some clarity and guidance to frame the national goals and suggest methods to achieve those goals.

One of the challenges with defining ICT literacy is that many research documents imply or lack a working definition (Lim, 2007; Song, Kim, Seo, & Kim, 2013; Vanderlinde, van Braak, & Dexter, 2012). Those that provide a working definition are quite often from a select few resources, such as the definition developed by the ICT Literacy Panel (ICT Literacy Panel, 2002) that was convened by Educational Testing Service (ETS) (Biagi & Loi, 2013; Caruso & Salaway, 2008; Mat-Jizat & McKay, 2011; Rockman, 2005). In addition, other documents that refer to ICT integration in education focus on the hardware, software,
policy, and infrastructure. The documents describe the computers and technologies that are required in an educational environment and provide limited consideration of the skills and knowledge required to use those technologies (DG Communications Networks, 2013; Jamieson-Proctor et al., 2007; Qablan, Abuloum, & Al-Ruz, 2009; Saltzman, Chatterjee, & Raman, 2008; UNESCO Institute for Statistics, 2009). These are all important topics to discuss, but just providing the technology rich environment does not create or even promote ICT literacy. If our educators are not equipped with the skills to leverage these environments then there will be no benefit for the students (Strong-Wilson, 2012). It would be a wasted investment, both financially and in human resources. In addition, technology is ever changing (Buckingham, 2008; Soby, 2008), which can weaken definitions that were established as recently as ten years ago when educators leveraged the technology of the day. For example, using the term "computer" omits the recent availability of tablet devices or smartphones that could be considered "computing devices" but not necessarily computers. Instead, definitions should center on human behavior and interaction with technology, the skills that are expected to be used with technology to be productive. This can minimize the time sensitivity of definitions and increase adaptability as technology evolves.

**UNESCO.**

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has provided hundreds of pages of recommendations based on the large international committees (UNESCO Institute for Statistics, 2009; United Nations Educational, Scientific and Cultural Organization, 2011). The goal is to provide an understanding and framework that is applicable internationally. This would allow for a global comparison of ICT resources and literacy. The question is whether this universal framework is applicable to all countries. National resources
and educational systems are going to be reliant on the wealth and advancements of a nation.
"Countries that are in the early stages of introducing ICT have different information needs
from countries that have longer experience with the technology" (UNESCO Institute for
Statistics, 2009, p. 21). This requires that the UNESCO create a broad framework that allows
for various national resources. The broad nature of the framework provides challenges when
developing ICT Literacy assessments.

The complexity of constructing good assessment instruments for indicators on
ICT in education is related not only to the complexity of this domain in general
but also to the current methods of international comparative assessments. It is
difficult to isolate the effects of ICT from other influences as there is a lack of
quality indicators on measuring digital literacy and skills needed to function
adequately in today's information society. (UNESCO Institute for Statistics,
2009, p. 16)

UNESCO's examination of ICT is a broad look at infrastructure, policy, support,
teacher preparedness, and student outcomes (UNESCO Institute for Statistics, 2009). The goal
was to develop indicators for measuring ICT that would identify areas of interest for
policymakers, and that includes domains of political commitment, public-private partnership,
infrastructure, teacher development, curriculum, usage, participation, outcomes and equity
(UNESCO Institute for Statistics, 2009, pp. 29-30). These are important indicators from a
national perspective to address the influence of investment and comparisons to other nations.
Where this process falls short is the applicability to the individual educator or institution.
Educators need tools to access ICT literacy on an individual and group level to determine
students' preparedness for courses and programs. This is of increasing importance in higher
education as technology is used to deliver online, hybrid, and even technology-enhanced courses. The traditional college course conducted in a classroom or lecture hall may not disappear any time in the near future, but it will not be the only method of educational delivery.

**United States.**

The U.S. Department of Education (DOE) published the National Educational Technology Plan in 2010. The goals outlined in this plan called for clear outcomes, redesigned structures and processes, monitoring and measuring performance, and accountability for progress and results (National Educational Technology Plan Technical Working Group, 2010). The DOE expressed the imperative need to incorporate technology into the learning environment, because technology touches all aspects of our lives.

Many students’ lives today are filled with technology that gives them mobile access to information and resources 24/7, enables them to create multimedia content and share it with the world, and allows them to participate in online social networks where people from all over the world share ideas, collaborate, and learn new things (National Educational Technology Plan Technical Working Group, 2010 p. x).

The technology integration into the learning environment was described as 21st century learning. State officials and educators were called upon to create the technology standards and assessments that would exemplify this 21st century learning. This report goes on to describe expectations for teaching, infrastructure, and productivity, and includes a call to immediate action by the states to embrace and carry out the goals of the plan.
Under the executive summary it is stated that the Obama administration would like to increase the two and four-year college graduation rates by 19 percent. This would be accomplished by utilizing technology to create efficiencies to make education more affordable and improve learning outcomes. "Technology-based learning and assessment systems will be pivotal in improving student learning and generating data that can be used to continuously improve the education system at all levels" (2010 p. ix). This transformation of education is referred to as the National Education Technology Plan 2010 (NETP). The NETP presents a technology-based model of learning that consists of five areas: learning, assessment, teaching, infrastructure, and productivity (see Appendix A, for a complete list of DOE goals and recommendations).

The national education technology plan is a very detailed document, but it also has a very broad scope. There is no specific focus on ICT literacy; instead there is a greater emphasis around conditions to aid in ICT literacy such as assessment, educator collaboration, and infrastructure and the environmental technology integration to enhance education. There are references citing recent research regarding learning processes and the importance of integrating technology with these new processes to support student outcomes, but the assessment details are left for schools to develop. Comparisons are made to the transformation in the business world in regard to educational reform.

What education can learn from the experience of business is that we need to make the fundamental structural changes that technology enables if we are to see dramatic improvements in productivity. As we do so, we should recognize that although the fundamental purpose of our public education system is the same, the roles and processes of schools, educators, and the system itself
should change to reflect the times we live in and our goals as a world leader. Such rethinking applies to learning, assessment, and teaching processes and to the infrastructure and operational and financial sides of running schools and school systems. (National Educational Technology Plan Technical Working Group, 2010 p. xiv)

The reform message is quite clear in the technology plan document and the expectations of the DOE are outlined for each item, but there are some questions. The comparison of education to business deserves some examination. The goal of a business is to produce the greatest profit possible. This can be accomplished with the elimination of excessive costs during the production of goods or in providing services that are purchased by the consumer. The primary goal of an educational institution is to successfully educate students. This is accomplished by creating an educational environment conducive to conducting educational experiences to facilitate student learning. While these two goals may have similar objectives to support them; they could not be more different. When we start examining educational institutions as profit and loss centers, the goal of education becomes secondary. Should teaching and learning be a secondary goal of our educational institutions?

Integrating technology into our educational environment should be done with careful consideration. The goals outlined in the DOE technology plan are admirable, but the supporting arguments sometimes lose sight of education's primary goal. One of the objectives of businesses is to effectively use their financial resources. There is no reason that education should not adopt that same objective, but once it interferes with facilitating the primary goal of education it has been taken too far. When finances have been reduced to the point that the operations of the educational institution are hindered, innovation may be lost to educators
trying to thrive in this environment (Strong-Wilson, 2012). It remains to be seen if states will be able to carry out the DOE plans, but there are institutions that have examined digital technologies and the ICT literacy skills required to use them.

The topic of *Learning* as described by NETP, is largely based on the premise that students' lives are filled with technology that gives them continuous access to information resources. This assumption leads to the proposed challenge that the educational system needs to use technology to mirror the students' daily lives and futures. Technology would support learning by providing "engaging environments and tools for understanding and remembering content" (National Educational Technology Plan Technical Working Group, 2010, p. 11). The issue with this concept is that technology does not provide these items. These items are created by educators that utilize the technology to create materials and experiences that support learning (Strong-Wilson, 2012; Trentin, 2006). It is also suggested that personalized and differentiated learning would be possible in this technology rich environment (National Educational Technology Plan Technical Working Group, 2010). Technology would provide students the ability to take ownership of their learning and maintain electronic portfolios that provide a record of their learning. Again, technology can assist with these goals but it would require training and personnel to facilitate these items. Experienced teachers can help personalize and differentiate learning with the help of technology, but we might fall short with technology alone solving these problems. The current education system described in the NETP does not include portfolio development, which means it would need to be integrated in a manner that would encourage this concept of students "taking ownership of their learning" (2010, p. 12).
The ideas presented in the *Learning* chapter, are supported by chapters in *Assessment, Teaching, Infrastructure, and Productivity*. *Assessment* is the next topic that is covered. It calls for more standardized assessments that measure new competencies and utilize the data to drive continuous improvements in education. With regard to *Teaching*, the DOE proposes a model of "connected teaching" where teachers can teach, collaborate, and continue professional development (National Educational Technology Plan Technical Working Group, 2010, p. 40). This connectedness would be supported by *Infrastructure* to enable access to students, peers, and resources. All of these concepts would lead to improved *Productivity*, which recognizes the business as the model to emulate.

We are still developing an understanding of what it means to be a 21st-century learner and how technology supports that learning. To define digital literacy in the support of learning, the NETP cites three major categories (2010, p. 13):

1. Information literacy - the ability to identify, retrieve, evaluate, and use information for a variety of purposes
2. Media literacy - that ability to consume and understand media, as well as communicate effectively using a variety of media types
3. Digital citizenship - the ability to evaluate and use technologies appropriately, behave in socially acceptable ways within online communities, and develop a healthy understanding of issues surrounding online privacy and safety.

These literacies would need to be integrated into the curriculum at all levels of education, which could assist students as they transition from primary to secondary, and finally into higher education. In view of the fact that higher education receives its student population from secondary education, the preparation of these students is an important issue
for consideration. The U.S. plan provides a general framework for states and districts to develop goals for student attainment of ICT literacy knowledge and skills, and if implemented would provide higher education the opportunity to leverage students' ICT abilities upon entrance of their freshman year.

**Educational Testing Service.**

ICT literacy has been defined as, "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society" (ICT Literacy Panel, 2002, p. 2). This panel was sponsored by Educational Testing Service (ETS), a non-profit company, that is known for assessments such as the Graduate Record Examination (GRE). This definition developed by the panel was the basis for creating a framework used to drive the development of an assessment.

ETS developed a simulation-based examination to assess ICT literacy. This is conducted on a computer where the individual is guided through a series of challenges. This is facilitated through a simulated interface that imitates software that would be used in a real-world environment. For example, if the assessment were related to use of a word processor then it would be designed to imitate a general word processor interface. The user would use this mock interface to solve the challenge or task that was presented to them (Educational Testing Service, n.d.). Simulation is used quite often in educational environments, but usually in preparation for the application of skills in a real-world environment.

ETS’s iSkills assessment is the first nationally available measure of ICT literacy that reflects the richness of that area through simulation-based assessment. Owing to the 2005 and 2006 testing of more than ten thousand
students, there is now evidence consistent with anecdotal reports of students’
difficulty with ICT literacy despite their technical prowess. (Katz, 2007, p. 4)

ETS has widely used the assessment for several years now and it has been used for
thousands of students. So, what would prevent educational institutions from adopting this
skills assessment? The cost can be over twenty dollars per student for testing (Educational
Testing Service, n.d.), which when considered in multiples of hundreds or thousands of
students may be difficult for institutions to finance. So the question is, has other research
produced other assessment products that are cost effective to administer and easy to use? To
begin to answer this question the various dimensions of ICT literacy need to be reviewed.

Additional Definitions.

Other authors explore the multidimensional approach to ICT literacy. Both Bawden,
and Calvani, Fini, and Ranieri extensively describe a framework of multiple literacies that
directly overlap and are explored in the next section (Bawden, 2008; Calvani, Fini, & Ranieri,
2009). In addition, Calvani et al. also provided a working definition of ICT as:

… being able to explore and face new technological situations in a flexible
way, to analyze, select and critically evaluate data and information, to exploit
technological potentials in order to represent and solve problems and build
shared and collaborative knowledge, while fostering awareness of one’s own
personal responsibilities and the respect of reciprocal rights/obligations
(Calvani et al., 2009, pp. 160-161)

Hobbs (2010) on behalf of the Aspen Institute Communications and Society Program
and the John S. and James L. Knight Foundation provides a broad definition and describes the
importance to ICT literacy to developing productive members of society. ICT is defined as: "a
constellation of life skills that are necessary for full participation in our media-saturated, information-rich society. These include the ability to do the following:

- Make responsible choices and access information by locating and sharing materials and comprehending information and ideas
- Analyze messages in a variety of forms by identifying the author, purpose and point of view, and evaluating the quality and credibility of the content
- Create content in a variety of forms, making use of language, images, sound, and new digital tools and technologies
- Reflect on one’s own conduct and communication behavior by applying social responsibility and ethical principles
- Take social action by working individually and collaboratively to share knowledge and solve problems in the family, workplace and community, and by participating as a member of a community (Hobbs, 2010 p. vii-viii)

Markauskaite developed a definition that leveraged the ETS definition concepts and other ideas to propose the definition: "ICT literacy is the set of capabilities required for the successful completion of cognitive information and ICT-based tasks. ICT literacy, therefore, is an interaction of two kinds of capabilities: (a) general cognitive and (b) technical. Both capabilities cover similar areas of problem solving and other generic activities. The main areas of ICT literacy and the descriptions of their corresponding technical and general cognitive capabilities" (Markauskaite, 2007, p. 550).
Calvin described ICT Literacy as "an umbrella framework for a number of complex and integrated sub-disciplines – or 'literacies' – comprised of skill, knowledge, ethics and creative outputs in the digital network environment" (2009, p. 154).

The New Media Consortium defined these modern literacies as: "21st century literacy is the set of abilities and skills where aural, visual and digital literacy overlap. These include the ability to understand the power of images and sounds, to recognize and use that power, to manipulate and transform digital media, to distribute them pervasively, and to easily adapt them to new forms" (2005, p. 2).

Oliver simply defined ICT literacy as, "the set of skills and understandings required by people to enable meaningful use of ICT appropriate to their needs"(2000, p. 4).

The International Society for Technology in Education (ISTE) produces technology standards for both students and teachers. These standards describe six technology based cognitive categories for students and five for educators. The standards are not labeled as ICT standards, but they mirror many of the other descriptions and definitions described in the literature. These standards outline goals and objectives that are designed for classroom implementation (International Society for Technology in Education, 2007).

Locating working definitions in the literature can be difficult. As already mentioned some authors just refer to ICT literacy without defining the construct. Other authors recognize multiple definitions but avoid commitment to any one definition (Spector, 2013) or use a term such as "however defined"(Biagi & Loi, 2013, pp. 28-31) and other authors rely on the ETS definition (Goldhammer, Naumann, & Keßel, 2012; Seymour & Fourie, 2004). Vanderlinde et al. (Vanderlinde et al., 2012) utilized a list of different aspects of ICT based on role; student, teacher and school leadership and then by different aspects of infrastructure.
ICT Literacy and Dimensions

ICT literacy has been described and explained by many researchers and academics, but there is no common understanding with regard to a standard definition (Livingstone, 2004). Due to this lack of common understanding an attempt to further describe this literacy follows. It can include various overlapping literacies or dimensions, which can cause confusion and ambiguity. For the purposes of this discussion, ICT literacy included a consolidated description of the dimensions that may differ among authors. Even the term ICT literacy has been used interchangeably with other labels.

To illustrate the use of multiple terms in the literature, here are examples of ICT terms that are often used. Digital literacy is often interchanged with media literacy but frequently when examining the description of these terms, it is ICT literacy (Soby, 2008). “Media literacy provides a means of connecting classroom uses of technology with the 'Techno-popular culture' that increasingly suffuses children leisure time” (Buckingham, 2008, p. 87). Buckingham spent a whole chapter defining media literacy and quite often references ICT research interchangeably to support the argument for a more developed integration of digital literacy concept inclusions within the educational curriculum (2008).

All of these literacy constructs describe multiple dimensions of the required skill set to be a competitive and productive member of modern society (Bawden, 2008; Buckingham, 2007; Hobbs, 2010). Without these skills one can and will be considered ICT illiterate, or deficient, resulting in a minimized person, which will limit his or her role in society. Educators are no exception to the need for ICT literacy, by any name, and this adoption can change the self image of the faculty (Strong-Wilson, 2012). ICT literate educators can utilize
a "multiliteracies approach" and "improve educational opportunities through the integration of ICT in student learning" (Hesterman, 2011, p. 351).

**Information Literacy.** Information Literacy has long been defined by the American Library Association (ALA) (*Information literacy competency standards for higher education*, 2000). The Association of College and Research Libraries (ACRL), a division of the ALA, has defined and published standards for information literacy. "Information literacy is a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (The Association of College and Research Libraries, 2000, p. 4). This definition is further explained by a list of outcomes that would demonstrate an adult in higher education would be deemed information literate:

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one’s knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally (The Association of College and Research Libraries, 2000, p. 4)

The ACRL cites the critical need for these abilities to enable lifelong learning. Information skills not only support but also work intimately with other literacies to create an ICT literate person. Our consumption of mass media and online resources requires our society to be able to evaluate and assess the validity of information throughout all aspects of life, particularly as a lifelong learner. While the ALA separates information literacy and
information technology skills, they also realize that they are not separable. "Increasingly, information technology skills are interwoven with, and support, information literacy" (Information literacy competency standards for higher education, 2000). This cannot be emphasized enough: As digital technology integrates into our societies we are required to understand the intricacies of information process and formats of this digital world.

**Media Literacy.** Many educators champion Media or New Media Literacy as a broad literacy. "Authors who explore media literacy practices at the University level in this volume demonstrate that critical thinking about media analysis, reception, and production has moved beyond communications studies programs at the university level" (Tyner, 2010, p. 5). The New Media Literacy (NML) project at Massachusetts Institute of Technology maintains there is another set of skills that should be included: play, performance, simulation, appropriation, multitasking, distributed cognition, collective intelligence, judgment, transmedia, navigation, networking, and negotiation (Jenkins, Purushotma, Weigel, Clinton, & Robison, 2009). The NML skill categories descriptions include observable skills that are associated with higher order thinking skills and provide a broad reach for this definition. Media literacy traditionally did not include the creation of media, which has taught us to be consumers rather than producers (Livingstone, 2004). As hardware and software tools become more affordable and accessible this will need to change to avoid this consumerism, which will advance "the furthering the rights of self-expression and cultural participation" (Livingstone, 2004, p. 13).

**Communication Literacy.** This was traditionally taught in a forum such as a speech class, but with computer mediated technologies this literacy has become increasingly more complex. If we start the traditional communication class presentation, they now include digital slides and can even be delivered online to a synchronous or asynchronous audience
(Grant & Meadows, 2008). Presenting ideas is only half of the equation as communication models involve both a sender and receiver (Vivian, 2007). This means that communication literacy involves consideration of both the transmission of the message, and then how it is received and interpreted.

Another challenge of learning with technology is communication, which has been examined in a few studies. Hall (2003) studied co-operative learning to determine the necessary items for a positive online learning experience and found three required components: places of engagement (learning spaces); materials and experiences (learning tasks) with which to build an identity, and ways of making their actions matter (learning partnerships).

If educators are to promote a sense of belonging within a course of study, then they need to start by recognizing that individual students exist within varied and variously overlapping contexts. So key to such promotion is the ability to generate meaningful learning opportunities for all, and to identify learning outcomes that can best be achieved by mutual interaction. (Hall, 2003, p. 157)

Working in groups online can also produce periods of group withdrawal due to the feeling of loss of individuality or personal recognition (Smith, 2005). Smith also concluded, “Reworked sense of identity: A few participants described changes in their perceptions of themselves as learners and group members. They began to renegotiate their individualized learning preferences and themselves as learners and group members” (2005). These studies describe many issues that would appear in a traditional classroom and this illustrates that online education faces some very traditional challenges when conducted properly.
**Visual Literacy.** To understand our world, we need to understand the visual information embedded in various forms. This literacy originated from art critique and education (Martin, 2008), but now entails the understanding and use of the messages and instructions that appear in graphical form (Aviram & Eshet-Alkalai, 2006). Prime examples would be interpreting a user interface on a competing device or producing a presentation with strong visual support for the message to be communicated. The increased ability of tools to enhance the visualization of data have increased the importance to be able to encode, decode, and determine credibility of data in a visual context (Johnson, Levine, & Smith, 2008).

**Information Technology (Computer) Literacy.** Information technology is often associated with computer hardware or computer science and described as a lesser or rote literacy. In addition, computer literacy has been used as a label to describe the use of efficient computers to accomplish tasks, but it could be inclusive of computing devices that include mobile computing devices (smartphones, tablets, etc.). The association with computing hardware is exemplified in references to this literacy. For example the ALA states: "'Fluency' with information technology may require more intellectual abilities than the rote learning of software and hardware associated with 'computer literacy,' but the focus is still on the technology itself" (Information literacy competency standards for higher education, 2000, p. 3). The ALA was concerned that "Information Literacy" would be confused with "Information Technology." The dictionary states a rote description: "the development, implementation, and maintenance of computer hardware and software systems to organize and communicate information electronically" (American Heritage Dictionary, 2011). Both references limit the scope of information technology but this literacy is more than computer skills. Computing technologies provide a platform for information and communication technology, and
understanding how data traverses computing systems is an important skill to harness the use of that data (Buckingham, 2008).

There are dimensions of ICT literacy that are discussed in the literature, but there are other names for the dimensions previously discussed. Another consideration, however, recurred quite often in the literature. Educators should teach responsible use of ICT technologies or digital citizenship (Hobbs, 2010; National Educational Technology Plan Technical Working Group, 2010). For example, the use of communication and collaboration tools in a responsible manner to avoid such things as cyber-bullying. The social and ethical aspects of ICT literacy are a concern because they provide additional opportunities, compared with non-digital environments, to violate social norms or practices (Erstad, 2008; Lankshear & Knobel, 2008). This requires additional consideration to encourage positive and responsible use of ICT skills. In addition, these additional ethical concepts should be considered when developing assessments.

**A Working Definition**

A working definition should consider the concepts and dimensions described as aspects of ICT literacy. Because of the overlapping concepts consolidation may occur, but care needs to be taken not to omit critical ideas that reduce integrity of the definition. It should also build on the basis of the accomplishments of previous works. Many authors have spent time on similar tasks, which include the work completed by the ICT Panel (ICT Literacy Panel, 2002).

Several descriptions have been presented thus far to describe ICT literacy and its dimensions, and three labels may provide another point of view or additional clarity. The first would be *technical skills* that are used to operate digital tools that would include hardware and
software resources. The hardware can be audio/visual equipment, computers, tablets, or personal response systems (clickers). Software would include computer operating systems, mobile interfaces, Internet browsers, and general purpose software. The second is a social aspect of technology that includes communication skills. This would include the ability to communicate through multiple technological means such as email, discussion boards, and instant messaging. Communication would also encompass the collaboration through digital means to be productive, such as composing a presentation. The third would be a cognitive or critical thinking category that would represent the higher-order thinking as described in Bloom's Taxonomy (Chapman & King, 2011). This critical thinking would include thinking beyond the basic use of technology, and an understanding of the societal, ethical, and extended use of technology. An example to the social and ethical would be the understanding the impact of illegal file sharing on society and the authors of the content contained in the file, whether it be music, video, or software. Extending the use of technology would include moving beyond a single technology and combining multiple technologies to be productive. It could also be described as moving beyond the technology, where the technology becomes a background process, not at the forefront of our thoughts or a point of stress. The 2004 annual meeting of the International Association for Educational Assessment proposed similar labels: Cognitive, Ethical, and Technical (Zapata et al., 2004). This conference report became the basis of the ETS definition, although these labels do not appear in such an explicit form in later publications by ETS (Educational Testing Service, 2005; ICT Literacy Panel, 2002; Katz, 2007; Katz et al., 2008).

The ICT definitions and dimensions presented illustrate the complexity of the subject. There is no simple method to define a construct this complex. Another perspective that may
be considered is that information and communication rest on digital technology. In this manner, technology helps us facilitate our information and communication goals, or we learn technology to interact with information and communicate with people.

Based on the literature, a proposed starting definition of ICT literacy is the knowledge and skills to define, identify, apply, analyze, manage, and evaluate information and communication methods through a variety of current technologies in a competent and ethical manner.

To review, a working definition that is to be used for higher education should be based on the literature that includes ideas presented by the U.S. Department of Education. The dimensions may help frame the concept of ICT literacy and provide structure for assessment. In addition to the dimensions, there are other considerations for the ICT literacy construct, such as ethical practices. The prospect of an assessment instrument targeting college freshmen should expect a minimum level of ICT literacy and attempt to measure developmentally appropriate knowledge and skills.

**Assessments**

Psychological assessments have been used for diagnosis of many forms, but here the focus was for educational purposes. Educational testing is usually used to measure the status of one dimension, whereas assessments are designed to measure multiple dimensions (Wright, 2008). Assessment may be low-stakes educational measures, such as a unit test. High-stakes assessments are measures that have significant consequences for failure or low scores such as ACT, SAT, or other academic determinate assessments. "Educational accountability requires that all students be assessed to quantify what they have learned and what skills they have developed" (Wright, 2008, p. 5). There may be debate on the volume, effectiveness, and
necessity of assessments, but they can provide valuable information to students, educators, and institutions when used correctly.

Robbins and Zhou (2007) examined two computer literacy tests, the Computer Skills Placement (CSP) and the Prentice Hall Train & Assess IT (TAIT), to determine if there were any correlation between scores for the two exams. The CSP is a multiple choice questions (MCQ) test that consists of 70 questions, ten questions each for seven software topics. The TAIT requires students to answer Microsoft Office simulation questions. A sample of 132 students took both assessments in succession and they determined that there was a significant relationship between the two test scores. While different situations may indicate preference for one assessment method over another, MCQ versus simulation, this indicates that similar results can be obtained with the different testing formats.

Biagi and Loi (2013) reviewed the results of the Programme for International Student Assessment (PISA) survey where students were asked to self-assess their computer proficiency on certain tasks and express their attitudes toward computer use. When analyzed, the questions were categorized into four groups; gaming activities, communication, technical operations, and content creation and problem solving. The comparison of student scores and country found that only gaming indicated a positive coefficient between test scores and use intensity. All other categories indicated the inverse to be true. This could be the result of many factors, including students' interests and faculty training.

Gross and Latham (2011) collected data from first-year college students that included demographic and self-assessment of their information literacy skills. The Information Literacy Test (ILT) developed by Cameran, Wise, and Lottridge (2007) was used as the assessment instrument. In addition, pre- and post-surveys were delivered to participants (Gross &
Latham, 2011). The pre-survey was utilized to gather demographic information and a self-estimate of the students' performance. The post-survey was used to gather a second self-assessment of performance on the ILT to determine if completing the ILT had an effect on their self-view and have the students estimate their performance compared to their peers. The results indicated that students' mean scores mean that they were not prepared with the correct information literacy skills. In addition, the students had a tendency to overestimate their performance. Students that were considered proficient were more likely to correct their performance estimate in the post survey, which was not true of those with a below proficient performance. It was determined that diagnostic assessments such as this one are needed to ensure student preparation and that competence should not be assumed.

Instrument development is an integral part to assessment and should be conducted with the assessment goals in mind (Wright, 2008). Mat-jizat and McKay (2011) reported on a process for ICT literacy instrument development. The report provided results of the first phase of the research, which consisted of two-part Delphi analysis. The panel of experts was engaged to recommend ICT literacy indicators that were identified from previous research. The indicators included: "plan/define, access, integrate, evaluate, manage, create, assess, communicate/collaborate, reflect/judge, utilize basic ICT tools, analysis and production with ICT, and navigation and search" (p. 554). The panel confirmed the indicator and added assessment of student learning that was based on the target population of Malaysian trainee teachers. It was also suggested that self-assessment was not sufficient and a series of tasks be created to assess ICT literacy.

One of two research projects, similar in the goals and methods to this current project was conducted by Markauskite (2007), which explored the nature of pre-service teachers' ICT
literacy. A modified version of the ETS definition was used to define ICT literacy; but two additional dimensions to reflect the technical and cognitive ICT capabilities were also included. These technical and cognitive constructs were also leveraged for the construction of the assessment instrument. An exploratory factor analysis was performed that provided indication that the cognitive and technical capabilities measured different aspects of ICT capabilities, and to further explain the factor relationships a confirmatory factor analysis was performed. The core technical components were related to "Basic ICT capabilities" and the two other dimensions captured the other components that were "problem solving" and "communication, networking and metacognition" (p. 566). The analysis indicated that the trainee teachers (undergraduate students) were generally confident with their ICT skills. But this confidence and their abilities were not interconnected, based on the analysis. Recommendations from the study included improved ICT curriculum integration that includes authentic experiences, and further research into ICT literacy.

The second was conducted by Davies, Szabo, and Montgomerie in which there was an attempt to measure the ICT literacy of incoming undergraduate student (Davies, Szabo, & Montgomerie, 2002). An online assessment was developed and delivered as a pre-test and post-test to a computer skills course. The sample size was limited to 35 education students. Improvements were made between the pre-test and post-test to improve the validity and reliability of the assessment. Satisfied with the positive results, the assessment was delivered to students starting in the fall of 2000, which was approximately 1000 students.

These assessments illustrate that it is possible to measure ICT literacy. The question is whether this assessment can be packaged in a convenient and affordable manner, and produce meaningful results for educators.
Summary

Technology's influence on education is evident from the literature, and this effect will continue as technology advances. It is important that students acquire the knowledge and skills to be considered ICT literate, which can improve their education experiences and their life beyond formal education. In order to ensure that students are acquiring the requisite knowledge and skills, opportunities to learn and produce with ICT are required, but assessment is needed as well. Our educators need to be prepared to produce and deliver educational material and lessons that support this technology-rich student learning.

Based on this review of the literature, it should be apparent that this is a complex subject with many facets. It is an important topic for education from the viewpoint of both educators and learners. And while the symbiotic relationship of technology and education is not new, the pace of technology advancement has caused some disruption. Educators may have difficulty keeping up with technology and incorporating it into their teaching, which may lead to technology avoidance. They can choose the technologies that best support their pedagogical style, subject matter, and students' needs. If educators are providing the environment, then students should be able to improve their own ICT literacy.

Educational institutions should be providing the ICT infrastructure to support a technology-rich curriculum. But there also needs to be institutional plans to assess the students' ICT literacy if the students are expected to reach full potential. This assessment can be woven into the curriculum or delivered in the form of a standardized assessment. Technology will continue to advance and change education, and it is time to ensure that our students are prepared to succeed in today's reality and tomorrow's environment.
Chapter 3 - Methods

This chapter outlines the methods used to develop this descriptive study for the purposes of identifying an ICT literacy working definition, the literacies contained in the ICT construct, and the construction of a corresponding assessment instrument. This effort utilized quantitative methods (Leedy & Ormorod, 1989), but this type of project is also referred to as Design and Development Research (Ross et al., 2008). This chapter includes sections describing a literature review, the development of definitions and construct dimensions, instrument development, population and sample, a description of the data collection and analysis of the pilot test and field test, and a summary. (See Appendix B, for methods general overview)

Literature Review

This project utilized a literature review to identify the ICT literacy construct definition and dimensions. The identified definition served as the working definition for this project. The identified dimensions of the ICT construct were used to create the items contained in the created assessment instrument. The refinement of the ICT literacy construct was imperative to the development of the assessment instrument. Operational definitions were required to measure working memory for "theoretical concepts as hypothetical constructs or latent variables," which cannot be directly observed and include items such as "learning, intelligence, self-esteem, dreams, attitudes, and feelings" (Furr & Bacharach, 2013, p. 5). The exploration of the ICT literacy construct through a review of the literature was required for the creation of the assessment instrument.

Constructing the working definition started with a review of the definitions and concepts of ICT literacy described by others. Even though multiple definitions and
descriptions can be found in the literature, several recurring categories or dimensions were utilized to construct a working ICT literacy definition. The most promising working definition of the ICT literacy construct, which included a brief of the literature, was presented by the researcher to the panel of experts. The panel was asked to critique the definition and provide suggestions for improvement. The suggestions from the panel were then incorporated into the working definition.

**Panel of Experts**

The panel of experts (PoE) was used to provide feedback and recommendation to the researcher regarding items developed from the literature. They were selected based on fields of expertise that support the research goals of the project. The expertise represented on the panel includes: ICT literacy, educational or psychological assessment, and psychometric subject matter experts. The feedback from the panel was used to support construct validity by guiding refinement of the final working definition of ICT literacy (Association, 2006; Furr & Bacharach, 2013). (See Appendix C, for specific panel member list and Figure 2 below)
**Figure 2. Panel of Experts Feedback**

**Definition and Dimensions**

A working definition of ICT literacy was developed by the researcher. The PoE was asked to critique and provide suggestions regarding the definition, and the researcher facilitated the coordination of responses. The feedback was used to modify and improve the working definition. A final working definition was achieved with the incorporation of the feedback from the panel.

The dimensions or sub-constructs from the literature, identified in Chapter 1 and described in Chapter 2, were used for the project. These included; Information, Media, Communication, Visual, Computing (Information) Technology literacies. The sub-constructs were provided to the PoE to again provide feedback and suggestions to guide the final sub-
construct usage. The cycle of feedback and improvement continued until consensus was reached. The sub-concepts translated into the different dimensions of the assessment instrument. These dimensions were used to develop item sets that formed the literacy assessment instrument.

**Instrument Development**

The working definition and the dimensions were used by the researcher to develop categorical items for the instrument. A minimum of 15 items were targeted per dimension and provided through an online survey for panel to review. The items consisted of a stem, key (or correct answer), and distractors. All items were developed with consideration for clarity and assessment targets.

**Figure 3. Item Structure (Wright, 2008, p. 185)**

To address content validity (Wright, 2008) and published standards (Association, 2006), these items were presented to the PoE with no dimensional identification to allow the panel members to assign them. In addition, they were asked to provide alternative item phrasing or wording of the items, or vote to strike the item completely. This process assisted in the elimination of construct-irrelevant content that might threaten content validity (Furr & Bacharach, 2013). This complete process supported content validity by reviewing instrument items to ensure they reflect important aspects of the targeted dimensions. The final number of
items per dimension was based on the direction of the panel dimensional assignments, with considerations to avoid construct underrepresentation and the reality of the testing situation (Furr & Bacharach, 2013, p. 205). Ideally, the instrument items would provide an appropriate sample of measurement for the intended concepts. This requirement led to the assembly of a representative number of items per dimension that would be a reflective measure of the intended topic. Once this was complete, the assessment was assembled for deployment by loading the items into the delivery software, development of instructions, and coding the items. The results of this process thus far addressed research questions 1, 2, and 3 that were identified in Chapter 1.

**Human Subjects Approval.** Human Subjects Approval was sought in accordance with IRB standards of Eastern Michigan University. An informed consent form was presented to the participants prior to the assessment delivery to inform them of their rights, confidentiality, and anonymity within this study. All participant information will be kept confidential and will only be published in aggregate form; no one person's individual responses will be identified or published. In addition, Human Subjects Approval was also sought at the host institution where the assessment was delivered, and processes were developed to manage participation by subjects that may be under the age of consent in coordination with the institution administration.

**Population and Sample**

The target population was college freshmen entering private four-year institutions. The sample was students from a private Midwestern four-year university with religious affiliation. This institution is located in an urban setting and has an over one hundred and twenty-five year history. The sample for this assessment instrument field test consisted of incoming
freshmen in the fall of 2015, which was about four hundred students. It was anticipated that
the majority of the students would be available to participate in the assessment. The
assessment was conducted during orientation week, which is prior to the start of classes. The
results were stratified based on national totals for private four-year institutions as by reported
by the National Center for Educational Statistics. The stratification matched the national
averages of the sex and race of participants to simulate the national average of "first-time
degree/certificate-seeking" students attending four-year private institutions as reported in
Tables 232 and 264 (National Center for Educational Statistics, 2013). The stratification was
used to limit the sample bias that may occur (Leedy & Ormrod, 1989).

Pilot Test

The pilot test was used to support validity (Fives, Huebner, Birnbaum, & Nicolich,
2014; Haynes, Richard, & Kubany, 1995; Song et al., 2013) and identify assessment items
that should have been omitted or revised (Association, 2006; Wright, 2008). Online software,
The Readability Test Tool (Simpson, n.d.), was used to estimate the grade reading level
equivalency, with a target of eighth grade readability, to maximize clarity and understanding
of the items (Flesch, 1948).

The pilot test was administered to a sample group of 20 participants from the host
institution. To fill the role of the sample group, students from education disciplines were
recruited to provide feedback and create sample assessment data. To address face validity in
the instrument, the participants were provided an opportunity to indicate items that were
difficult to understand the apparent meaning or that may have seemed irrelevant to the
assessment. Face validity is critical from a psychometric perspective, but it may affect the
perceptions of the participant and their motivation to answer in an honest manner (Furr &
Bacharach, 2013). Negative item responses from the pilot participants were considered, but elimination was not automatic.

The results from the pilot test were examined using descriptive statistical methods to guide further refinement. A difficulty index was examined for the items based on the result of an Item Response Theory (IRT) analysis (D. Harris, 1989; Mislevy, Almond, & Lukas, 2003). The target score for the instrument was a difficulty index of 0.50 to maximize the differences seen between students (Wright, 2008). In addition, a distractor analysis was conducted on any item scoring < .30 to improve item effectiveness. The results from the analysis were incorporated into the assessment to generate the final instrument for a field test.

To examine further reliability and provide a secondary item analysis, Cronbach’s alpha (coefficient alpha) was conducted to measure the internal consistency or average correlation of items (Furr & Bacharach, 2013; Wright, 2008). This statistical estimation would not provide reliability information regarding the dimensions, but would provide item-level and overall instrument analysis (Furr & Bacharach, 2013). The process consisted of calculating item level variance of scores and the covariance between each pair of items to review for potential issues with internal consistency. Once the items were reviewed, the sum of the item-pair covariances provided a general reflection of the degree that all items are consistent with each other. The final step was to compute the reliability estimates (coefficient alpha) of the instrument with a target of greater than .70.

Field Test

The field test was administered, using the refined assessment instrument that resulted from the pilot test, to the sample group of freshmen entering their first-year of college at a private Midwestern university. The instrument was administered in two large classrooms
during student orientation. Staggered start times were used to allow the researcher to instruct the participants. Student leaders, that acted as guides during the orientation, assisted the researcher with proctoring of the participants during the event. The Scantron system was used as the platform for assessment delivery. The system provided the capability to deliver assessment to the large group in a timely manner. The duration of the assessment time used was based on the pilot testing participation.

Using the Scantron system to capture student responses helped reduce the possibility of transcription error with item responses and composite scores. To facilitate the statistical analysis all demographic data and items were coded and, if appropriate, a correct answer was indicated. Instructions for the assessment were provided for participants through the deployment prior to the assessment delivery (Association, 2006). In addition to the directions for the participants, an informed consent disclaimer was provided as a cover sheet on the assessment to indicate participation in the research study. The final instrument collected demographic data such as gender, self-reported high-school GPA, and a socioeconomic indicator. The data was coded for statistical analysis of the participants' demographic information, individual scores, and dimensional scores. Once the assessment was completed the data was scanned into the Scantron system, and then exported for statistical analysis and review.

Data Analysis of Field Test Results

The section describes data processing for the relevant quantitative research questions posed in Chapter 1. While research questions 1-3 were addressed with the creation of the construct definition, identification of dimensions, and development of the assessment instrument, the remaining questions required analysis.
First, the results of the sample data were stratified as described in Population and Sample. Descriptive statistics were produced for each aspect of the assessment instrument. These included the demographic data of participants, item analysis, dimensional scores, and overall assessment scores. For these items, measures of central tendency and variability were calculated such as: frequency, mean, median, range, and standard deviation were applicable. In addition, normality of the distribution was reviewed for symmetry to determine any skewness of the distribution. This was used to give a general overview of the participants and the general results of their assessment scores.

A second IRT analysis was conducted using the same parameters as the pilot test, that included item difficulty and item discrimination. Item difficulty describes the proportion or percentage of students that answered the item correctly. Item difficulty can range from 0.0 to 1.0. The lower proportion of incorrect answers produces the lower score and a higher proportion of correct answers will result in a higher score on the scale. A 0.6 to 0.8 average level of difficulty will be the target for this assessment. If an item fell below a 0.25, the item was checked to ensure that it is keyed correctly. If it is correctly keyed, it would be considered for omission in the future with the assumption that there is an error in the item construction.

Item discrimination was utilized to discriminate between students with higher and lower levels of knowledge and skills. Point-biserial correlation is an index of item discrimination that reflects the degree of relationship between scores on the item and the total test scores. The item discrimination index ranges between -1 and 1, and a target of greater than 0.2 was used. This produced a positive score if the students answered the item correctly and scored well overall on the assessment, and a negative score would result if the opposite occurs. Item difficulty influences discrimination, and item discrimination is maximized when
item difficulty is close to 0.5 (Furr & Bacharach, 2013; Wright, 2008). To examine for item bias, the IRT technique known as differential item functioning (DIF) was used (Wright, 2008). The items were examined based on participants' demographic categories of gender, socioeconomic status, and self-reported GPA. This allowed a review to the item functionality for the different groups to determine potential bias.

As in the pilot test, a Cronbach's alpha was used as a secondary measure of consistency. The same process was conducted and a coefficient alpha target of greater than .70 was utilized, as in the pilot test.

**Questions 4 & 5.** In this section the null hypotheses from research questions 4 and 5 are addressed individually. First the null hypothesis is listed, and then the corresponding procedures are directly following.

*Question 4:* Will a factor analysis of the instrument yield factors that are consistent with the ICT dimensions?

\[H_0:1\] There will be no significant difference between the dimensions used to frame the items and the factors generated by factor analyzing the field test data.

A Confirmatory Factor Analysis (CFA) was conducted using the ICT dimensions to test for dimensionality or internal structure (Furr & Bacharach, 2013). CFA is utilized when a specific set of dimensions or factors are proposed either resulting from an Exploratory Factor Analysis (EFA) or proposed by the researcher through instrument development.

First the measurement model was specified in preparation for statistical analysis. The model identified the hypothesized dimensions as factors and mapped the associated items to the appropriate factor. Each item was linked to only a single factor, as designed in the development phase, with the understanding that items may influence other factors.
Once the model was prepared, the actual statistical computations, which consisted of four sequential steps, were conducted based on the model specification. The first step was to compute the variances and covariances among the items. Next, the parameter estimates were produced based on the results of the first step. Then, the implied variances and covariances were computed and used to examine the degree of discrepancy between the variances and covariances, and implied variances and covariances. This comparison led to the last step, in which the comparison was used to determine if the proposed model is a good fit. The possible indicators for goodness of fit include: chi-squared values that indicates a negative fit, goodness-of-fit index (GFI), comparative fit index (CFI), and Tucker-Lewis index (TLI). As a result of the quality of the model fit, alternative models were explored.

A CFA can be used as a tool to provide indications of validity and reliability. The nature of the process describes validity based on the internal structure of the instrument related to the factor or dimension and the links to the items. An estimation of the reliability of the different dimensions can then be compared to the coefficient alpha.

**Question 5:** Does gender, socioeconomic status, or self-reported high school GPA affect scores on the developed ICT assessment instrument?

**H_{02}:** There will be no significant difference between the scores of males when compared to females.

A t-Test was performed to compare the mean of the assessment scores between male and female participants and to determine if they were significantly different from each other (Leedy & Ormorod, 1989). A $p < .05$ from the results was required to reject null hypothesis.
H₃: There will be no significant differences among the students' scores that qualify for free lunches when compared to those who qualify for reduced lunches or to those who received no lunch subsidies.

An ANOVA was used to compare the result of the socioeconomic indicator (Leedy & Ormorod, 1989). This indicator asked the participants whether they received financial assistance for their high school lunch. This consisted of two levels, subsidized lunch and not subsidized. A $p < .05$ from the results was required to reject null hypothesis.

H₄: There will be no significant relationship between self-reported high school GPA and assessment scores for those participating in the field test.

The correlation coefficient was calculated to determine the relationship between GPA and assessment results (Leedy & Ormorod, 1989). If the correlation coefficient is zero, there would be no linear relationship between the GPA and assessment results. Otherwise, the null hypothesis would be rejected and the distance from zero within the range of -1 to 1 would indicate the strength of the relationship. A positive number would indicate a positive relationship and a negative would indicate the opposite. The positive relationship would mean that as one variable increased the other would increase. A negative relationship would indicate the inverse, as one increased the other would decrease.

To examine any possible effects of gender, socioeconomic status, or GPA on the assessment results, an analysis of variance (ANOVA) was used (Leedy & Ormorod, 1989). An ANOVA was conducted for each demographic item to produce a $p$ value to determine the probability that the NULL hypotheses are true. The demographic items were compared to the participants' raw assessment scores to identify any effect.
Summary

The last step in the process was to summarize the results of the development and design of the ICT literacy assessment instrument. The outcomes of the statistical analysis were reviewed and summarized. The final dimensions were described and the results of the field test were provided for review. This included any additional recommendation for improvement for future ICT literacy assessment instruments and the feasibility of implementing this type of instrument in an educational environment. The resulting assessment instrument was reviewed to determine the practicality for general-purpose use and reviewed for additional considerations that may be required for implementation of future versions of the assessment instrument.
Chapter 4 - Results

The results of using the methods outlined in Chapter 3 are reported in this chapter. The stages of instrument development process including interaction with the panel of experts and use of the pilot test is followed by a description of the execution of the ICT literacy assessment instrument field test, reports of the resulting psychometric aspects, descriptive analyses, and finally the results of hypothesis testing.

ICT Panel

The interaction with the panel was facilitated through the online survey software, Lime Survey. The software was used to deliver information and receive feedback from the members. The first interaction with the panel focused on the developed working definition of ICT literacy and the identified dimensions. Both the initial working definition and dimensions were developed based on a literature review. Feedback from the panel included specifics regarding basic strengths, weaknesses, readability, and alignment and applicability of the working definition and dimensions.

The panel offered several suggestions and recommendations for the definition and dimensions. The feedback included several constructive suggestions, but also some conflicting suggestions. The feedback for the working definitions was utilized to edit it for clarity. The definition developed for the purposes of this study follows:

*ICT Literacy is the knowledge and skills to define, identify, apply, analyze, manage, and evaluate information and communication methods through a variety of current technologies in a purposeful and ethical manner.*

Panel recommendations for the dimensions included relabeling of one and the exclusion of another. The dimension originally labeled "Computer" was relabeled to
"Information Technology." The Computer label was originally used to avoid confusion with the "Information" dimension, but the panel suggestions implied that the Computer label may be more confusing. Also, the "Visual" dimension was rated as the least discreet dimension and that this topic was represented by the other dimensions. Based on this feedback, the “Visual” dimension was excluded from the final proposed dimensions and consideration during item development (see Appendix E for details of the dimensions). The final dimensions included:

1. Communication
2. Media
3. Information Technology
4. Information

The assessment items were developed based on previous literature and the feedback from the ICT panel. The four remaining dimensions and working definition were used as a basis to guide this development. The items were then presented to the ICT Panel for feedback and dimension assignment. The items were presented in a printable format for reference while using the online form to assign dimensions and supply feedback. Some of the items were unanimously assigned to a single dimension by the panel members but others were divided. When there was a clear assignment by the panel it was used as the dimension assignment. If the assignment was divided, where there was not a majority, the primary researcher provided a dimension assignment to create a majority. This interaction with the panel resulted in dimension assignment for the items and editing of assessment items for clarification. The working definition, and an expanded description of the dimensions is located in Appendix E, and the items can be found in Appendix F.
Pilot Test

To facilitate the assessment instrument pilot test, individual items were entered into the Lime Survey software. While this software is primarily used for surveys, options in the software allowed the delivery of an educational assessment. Once the items were entered into the software, programming was completed to allow for the appropriate scoring of the assessment. Additionally, the system allowed for randomization of the questions and answers.

A group of undergraduate education students from the host institution were utilized to pilot the assessment. The participants were offered an opportunity to submit feedback on the assessment. This pilot test also provided a review of the intended data collection method and its viability. The results of the participation in the pilot test were analyzed using the methods described below.

First, the readability was examined using two different methods. The Readability Test Tool (RTT) (Simpson, n.d.), and Microsoft Word were used to examine the assessment as indicated in Tables 1 and 2. These two analyses produced different scores of readability: RTT rated the assessment at a 5.2 grade reading level, and MS Word rated the assessment at a ninth-grade reading level. The target was eighth-grade readability for the assessment, and considering the two scores, it appears that the assessment was within an acceptable range.

Table 1

<table>
<thead>
<tr>
<th>Assessment Readability Statistics</th>
<th>Pilot</th>
<th>Field</th>
<th>Pilot</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flesch Kincaid Reading Ease</td>
<td>66.9</td>
<td>67.2</td>
<td>48.2</td>
<td>48.9</td>
</tr>
<tr>
<td>Flesch Kincaid Grade Level</td>
<td>5.2</td>
<td>5.1</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Gunning Fog Score</td>
<td>7.2</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMOG Index</td>
<td>5.6</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coleman Liau Index</td>
<td>10.1</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automated Readability Index</td>
<td>1.9</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2

*Readability Indices*

<table>
<thead>
<tr>
<th></th>
<th>Pilot</th>
<th>Field</th>
<th>Pilot</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sentences</td>
<td>421</td>
<td>398</td>
<td>72</td>
<td>82</td>
</tr>
<tr>
<td>No. of words</td>
<td>2102</td>
<td>2012</td>
<td>1757</td>
<td>1798</td>
</tr>
<tr>
<td>No. of complex words</td>
<td>359</td>
<td>346</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of complex words</td>
<td>17.08%</td>
<td>17.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average words per sentence</td>
<td>4.99</td>
<td>5.06</td>
<td>10.3</td>
<td>10.5</td>
</tr>
<tr>
<td>Average syllables per word</td>
<td>1.59</td>
<td>1.59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Classical Test Theory (CTT) and Item Response Theory (IRT) analyses produced conflicting results. First, the CTT included a Cronbach's alpha score of 0.556 calculated from the participant's total assessment score, where \( N=20 \). The mean score was 68.3 out of 103 possible points and a median of 68 and a \( SE \) (standard error) of 1.42. The range was 21 with a minimum of 60 to and a maximum 81 as illustrated in Figure 4 below.

![Figure 4. Histogram of the total score (Pilot)](image-url)
The pilot was administered as planned using online Limesurvey software (Schmitz, 2015), and the IRT analysis was conducted using R programming language (Hornik, 2015) and supporting statistical packages including psych (Revelle, 2015), CTT (Willse, 2014), and ltm (Rizopoulos, 2006).

The survey software allowed items that included long lists of response options and multiple answers to be included. This format is inconsistent with the dichotomous scoring used in IRT (Rizopoulos, 2006). This resulted in some limitations of the statistical analysis. The small sample size also limited the IRT analysis to a Rasch (One-parameter logistic model or 1PL) model processing (Furr & Bacharach, 2013). Due to this limitation in the Rasch analysis, the preliminary difficulty and discrimination that were calculated for the items but produced limited actionable information.

Based on the statistical analysis of the pilot test data and feedback from the individual pilot participants, modifications were made to the assessment items. The feedback from the pilot participants was used to edit some items for clarity and readability. The Likert-type or array style items were reformatted to conform to a format that allowed for improved statistical analysis to be conducted in the field test. Because these items contained a greater number of options than the standard multiple choice or multiple answer questions, the usability of the statistical analysis was reduced. In cases where items contained greater than five response options, they were reduced to maximum five options for the field test. Lastly, a simplified item coding system was adopted for the field test and, combined with the other changes, this resulted in a reduced number of items for the overall instrument.
Field Test

The field test of the ICT assessment was originally intended to be delivered in the same manner as the pilot test. The intention was to utilize the online software for data collection in a computer lab environment. This environment would have allowed student participation to be managed during the field test that included during the Fall semester student orientation. Just prior to the planned student orientation, it was determined that computer lab space was not available to house the entirety of the students who would be participating in the ICT assessment. To accommodate this challenge, the assessment format was adjusted to fit a Scantron delivery method. This allowed large classroom space to be utilized for field testing and omitted the requirement of computer access for all participants.

First, Scantron forms were pre-filled with participant identification numbers. Then items were revised for the new delivery and most of items transferred without modification to the five-option limit of the Scantron formant. Two items that required reformatting were the matching style questions with 9 and 20 prompts, and 15 and 30 options respectively. These were converted into individual items for each prompt. The nine-option matching item was converted to three groups of three items with three corresponding groups of five options. The twenty items were also individualized into five groups of four items with five corresponding groups of five options (refer to items 16-35, 62-70 found in Appendix F).

The assessment was administered to the incoming freshmen students who attended orientation. Based on the timing tests and time required for the pilot study, forty-five minutes were allowed for the assessment with ten minutes for setup and administration, for a total duration of fifty-five minutes. Students were allowed to opt-out or exit the assessment at any point. A total of 326 students attended the fall orientation and were present for the field test.
Initially, 309 Scantron forms were collected from active participants and this number was reduced to 292 upon examination of the forms. Incomplete forms were considered an opt-out by the participant. The completed forms were digitized using the Scranton system software ParScore. This software was used for initial statistical reports and the data were then exported for statistical analysis.

Table 3

*Demographic Frequencies and Percentages*

<table>
<thead>
<tr>
<th>Label</th>
<th>Freq.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>125</td>
<td>42.8</td>
</tr>
<tr>
<td>Female</td>
<td>167</td>
<td>57.2</td>
</tr>
<tr>
<td>Reduced Lunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64</td>
<td>21.9</td>
</tr>
<tr>
<td>No</td>
<td>228</td>
<td>78.1</td>
</tr>
<tr>
<td>GPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>198</td>
<td>67.8</td>
</tr>
<tr>
<td>3.0-3.4</td>
<td>72</td>
<td>24.7</td>
</tr>
<tr>
<td>2.5-2.9</td>
<td>19</td>
<td>6.5</td>
</tr>
<tr>
<td>2.0-2.4</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>9</td>
<td>3.1</td>
</tr>
<tr>
<td>Asian</td>
<td>30</td>
<td>10.3</td>
</tr>
<tr>
<td>Black/African American</td>
<td>28</td>
<td>9.6</td>
</tr>
<tr>
<td>White</td>
<td>223</td>
<td>76.4</td>
</tr>
<tr>
<td>Hispanic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>260</td>
<td>89.0</td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>11.0</td>
</tr>
</tbody>
</table>

The participants were asked general demographic questions to enable the researcher to profile the sample (N = 292). There were 125 (42.8 percent) male and 167 (57.2 percent) female respondents. As a socioeconomic indicator participants were asked if they had received reduced or free lunch during their previous educational experiences and 21.9 percent or 64 participants responded positively. With regard to race, two questions were used that were similar to items found in the U.S. Census questions (U.S. Census Bureau, 2009). From the participants, 32 individuals or 11 percent indicated Hispanic heritage. The remaining
indicators were 3.1 percent American Indian, 10.3 percent Asian/African American, and 76.4 percent White. The White category also includes those of middle eastern decent and the likely portion of the 11 percent that indicated Hispanic. Self-reported GPA was skewed to the high end with 76.6 percent reporting in the range of 3.5 - 4.0, and then 24.7 between 3.0 - 3.4, 6.5 percent between 2.5 - 2.9, 1 percent between 2.0 - 2.4 and none reporting below a 2.0 GPA.

Figure 5. Online Education Experiences

Participants were also asked about their technology experiences related to classes and their impression of their own technology skills. A majority of participants (90.8%) reported using technology in previous courses for some form of online participation. The question
regarding having participated in a completely online course produced a drop down to 32.2 percent, which suggested that about two-thirds of the participants have had limited online course experiences (see Figure 5). In addition, participants were presented three Likert-scale items, with a five-point agreement scale from strongly agree to strongly disagree, to provide insight regarding the participant’s perception of their limitations or concerns related to their current technology skills (see Figure 6 below).

Figure 6. Personal Reflection Questions of Technology Skill

Psychometric Aspects

The psychometric aspects of the participant's assessment scores were analyzed using aspects of both Classical Test Theory (CTT) and Item Response Theory (IRT). The field test raw scores ranged from 12 to 74, which is a total range of 62 with a possible high score of 82 where \( N=292 \) (refer to Figure 7).
Figure 7. Field Test Score Distribution

The raw mean score was 45.5 with a standard deviation of 15.5, as illustrated in the box-plot. The mean is indicated by the red diamond and standard deviation is indicated with red arrows.

Figure 8. Box-Plot of Field Test Score Frequency

Reliability Coefficient. Classical Test Theory (CTT) includes Cronbach's alpha coefficient and Standard Error of Measurement and indicators of internal consistency and
reliability. As an indicator of internal consistency, higher coefficient alpha scores are more desirable and the scores can range within 0 to 1 (Furr & Bacharach, 2013). For this specific assessment tool, a score of .94 was calculated using a Cronbach's alpha coefficient, or reliability coefficient. CTT assumes when all factors that might affect a participant's observed score are removed, the result is the true score. The variance from the observed score and the true score is referred to as the standard error of measurement (SEm) (Furr & Bacharach, 2013; Wright, 2008) and is an indicator of reliability. The standard error of measurement can be calculated using the alpha coefficient and standard deviation of the mean score (Wright, 2008).

\[ \text{SEm} = \text{standard deviation} \times \sqrt{1 - \text{alpha coefficient}} \]

Using this formula to estimate the standard error of measurement resulted in an SEm = 3.8. This is the difference between observed scores and true scores. A participant's true score can be calculated within a range of +/- 3.8 of the observed score, assuming a confidence interval of two standard errors with a 95 percent likelihood. For example, if the participant's observed score was 65 their true score would have an estimated range of 61 to 69.

**Item Difficulty.** The item difficulty is a measurement that expresses the portion of participants that answered the item correctly. When developing the items for the assessment tool, a target of .50 was used as the intended target for item difficulty. This target is a mid-line indicator of difficulty on a 0 to 1 scale. The majority (66) of the items fell into the medium difficulty range of greater than .30 and less than .80. The 16 items that were outside these
bounds were reviewed for either modification or elimination (Furr & Bacharach, 2013; Wright, 2008).

Table 4

<table>
<thead>
<tr>
<th>Item Difficulty Ratings for Each Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q01</td>
</tr>
<tr>
<td>Q02</td>
</tr>
<tr>
<td>Q03</td>
</tr>
<tr>
<td>Q04</td>
</tr>
<tr>
<td>Q05</td>
</tr>
<tr>
<td>Q06</td>
</tr>
<tr>
<td>Q07</td>
</tr>
<tr>
<td>Q08</td>
</tr>
<tr>
<td>Q09</td>
</tr>
<tr>
<td>Q10</td>
</tr>
<tr>
<td>Q11</td>
</tr>
<tr>
<td>Q12</td>
</tr>
<tr>
<td>Q13</td>
</tr>
<tr>
<td>Q14</td>
</tr>
<tr>
<td>Q15</td>
</tr>
<tr>
<td>Q16</td>
</tr>
<tr>
<td>Q17</td>
</tr>
<tr>
<td>Q18</td>
</tr>
<tr>
<td>Q19</td>
</tr>
<tr>
<td>Q20</td>
</tr>
<tr>
<td>Q21</td>
</tr>
<tr>
<td>Q22</td>
</tr>
<tr>
<td>Q23</td>
</tr>
<tr>
<td>Q24</td>
</tr>
<tr>
<td>Q25</td>
</tr>
</tbody>
</table>

Note: <.30 = High Difficulty*, >.30 and <.80 = Medium Difficulty, >.80 = Low Difficulty**

**Discrimination Index.** The Discrimination Index is a point-biserial correlation and serves to differentiate between students with higher and lower levels of knowledge related to this assessment topic. The discrimination Index can range between -1 and 1, although positive
numbers greater than .20 are desirable. Discrimination is influenced by the Item Difficulty and is maximized when the Item Difficulty is close to .50 (Furr & Bacharach, 2013). A total of 72 items were indexed with a score of greater than .20.

Table 5

<table>
<thead>
<tr>
<th>Item</th>
<th>Discrimination Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q01</td>
<td>-0.05*</td>
</tr>
<tr>
<td>Q02</td>
<td>.33</td>
</tr>
<tr>
<td>Q03</td>
<td>.11*</td>
</tr>
<tr>
<td>Q04</td>
<td>.29</td>
</tr>
<tr>
<td>Q05</td>
<td>.33</td>
</tr>
<tr>
<td>Q06</td>
<td>.48</td>
</tr>
<tr>
<td>Q07</td>
<td>.49</td>
</tr>
<tr>
<td>Q08</td>
<td>.49</td>
</tr>
<tr>
<td>Q09</td>
<td>.37</td>
</tr>
<tr>
<td>Q10</td>
<td>.12*</td>
</tr>
<tr>
<td>Q11</td>
<td>.30</td>
</tr>
<tr>
<td>Q12</td>
<td>.50</td>
</tr>
<tr>
<td>Q13</td>
<td>.13*</td>
</tr>
<tr>
<td>Q14</td>
<td>.53</td>
</tr>
<tr>
<td>Q15</td>
<td>.58</td>
</tr>
<tr>
<td>Q16</td>
<td>.55</td>
</tr>
<tr>
<td>Q17</td>
<td>.50</td>
</tr>
<tr>
<td>Q18</td>
<td>.47</td>
</tr>
<tr>
<td>Q19</td>
<td>.54</td>
</tr>
<tr>
<td>Q20</td>
<td>.59</td>
</tr>
<tr>
<td>Q21</td>
<td>.32</td>
</tr>
<tr>
<td>Q22</td>
<td>.64</td>
</tr>
<tr>
<td>Q23</td>
<td>.70</td>
</tr>
<tr>
<td>Q24</td>
<td>.35</td>
</tr>
<tr>
<td>Q25</td>
<td>.55</td>
</tr>
<tr>
<td>Q26</td>
<td>.68</td>
</tr>
<tr>
<td>Q27</td>
<td>.70</td>
</tr>
<tr>
<td>Q28</td>
<td>.56</td>
</tr>
<tr>
<td>Q29</td>
<td>.35</td>
</tr>
<tr>
<td>Q30</td>
<td>.10*</td>
</tr>
<tr>
<td>Q31</td>
<td>.70</td>
</tr>
<tr>
<td>Q32</td>
<td>.69</td>
</tr>
<tr>
<td>Q33</td>
<td>.64</td>
</tr>
<tr>
<td>Q34</td>
<td>.75</td>
</tr>
<tr>
<td>Q35</td>
<td>.52</td>
</tr>
<tr>
<td>Q36</td>
<td>.37</td>
</tr>
<tr>
<td>Q37</td>
<td>.33</td>
</tr>
<tr>
<td>Q38</td>
<td>.40</td>
</tr>
<tr>
<td>Q39</td>
<td>.46</td>
</tr>
<tr>
<td>Q40</td>
<td>.33</td>
</tr>
<tr>
<td>Q41</td>
<td>.49</td>
</tr>
<tr>
<td>Q42</td>
<td>.69</td>
</tr>
<tr>
<td>Q43</td>
<td>.33</td>
</tr>
<tr>
<td>Q44</td>
<td>.07*</td>
</tr>
<tr>
<td>Q45</td>
<td>.16*</td>
</tr>
<tr>
<td>Q46</td>
<td>.54</td>
</tr>
<tr>
<td>Q47</td>
<td>.58</td>
</tr>
<tr>
<td>Q48</td>
<td>.18*</td>
</tr>
<tr>
<td>Q49</td>
<td>.31</td>
</tr>
<tr>
<td>Q50</td>
<td>.19*</td>
</tr>
<tr>
<td>Q51</td>
<td>.28</td>
</tr>
<tr>
<td>Q52</td>
<td>.29</td>
</tr>
<tr>
<td>Q53</td>
<td>.57</td>
</tr>
<tr>
<td>Q54</td>
<td>.38</td>
</tr>
<tr>
<td>Q55</td>
<td>.51</td>
</tr>
<tr>
<td>Q56</td>
<td>.63</td>
</tr>
<tr>
<td>Q57</td>
<td>.46</td>
</tr>
<tr>
<td>Q58</td>
<td>.46</td>
</tr>
<tr>
<td>Q59</td>
<td>.63</td>
</tr>
<tr>
<td>Q60</td>
<td>.52</td>
</tr>
<tr>
<td>Q61</td>
<td>.20</td>
</tr>
<tr>
<td>Q62</td>
<td>.62</td>
</tr>
<tr>
<td>Q63</td>
<td>.60</td>
</tr>
<tr>
<td>Q64</td>
<td>.48</td>
</tr>
<tr>
<td>Q65</td>
<td>.34</td>
</tr>
<tr>
<td>Q66</td>
<td>.44</td>
</tr>
<tr>
<td>Q67</td>
<td>.53</td>
</tr>
<tr>
<td>Q68</td>
<td>.51</td>
</tr>
<tr>
<td>Q69</td>
<td>.63</td>
</tr>
<tr>
<td>Q70</td>
<td>.37</td>
</tr>
<tr>
<td>Q71</td>
<td>.43</td>
</tr>
<tr>
<td>Q72</td>
<td>.32</td>
</tr>
<tr>
<td>Q73</td>
<td>.54</td>
</tr>
<tr>
<td>Q74</td>
<td>.61</td>
</tr>
<tr>
<td>Q75</td>
<td>-0.11*</td>
</tr>
<tr>
<td>Q76</td>
<td>.46</td>
</tr>
<tr>
<td>Q77</td>
<td>.42</td>
</tr>
<tr>
<td>Q78</td>
<td>.52</td>
</tr>
<tr>
<td>Q79</td>
<td>.42</td>
</tr>
<tr>
<td>Q80</td>
<td>.49</td>
</tr>
<tr>
<td>Q81</td>
<td>.32</td>
</tr>
<tr>
<td>Q82</td>
<td>.22</td>
</tr>
</tbody>
</table>

Note: Target Index Score of ~.50, Items > .20 is generally considered in acceptable range (* indicates < .20)

A review across both Tables 4 and 5 allows for the identification of items that need removal or editing. For example, items Q01 and Q75 scored .30 and .19 on the difficulty
index, and - 0.05 and - 0.11 scores for discrimination. The scores for these items place them outside the preferred bounds as described in each table and were obvious choices for editing or elimination. These indicator scores should be utilized to critically examine each specific item in greater detail prior to future use.

The majority of the instrument items were in an acceptable range of difficulty, but including consideration of the discrimination index it is clear that some of the items should be reviewed for modification or replacement. For example, item Q01 scored a borderline acceptable .30 for difficulty and a score of -0.11 for discrimination, which indicates that the item is not valid for use in its current form. Out of the 82 items 72 are less than .20, which indicates that 10 items at a minimum should be reviewed for modification or replacement. The low preforming items are indicated in Tables 4 and 5, with a key located in the note of the tables.

Hₐ1: Proposed Factors (4) = Confirmatory Factor Analysis, Goodness of Fit Indicators

There will be no significant difference between the dimensions used to frame the items and the factors generated by factor analyzing the field test data.

A summary of the model findings based on the Confirmatory Factor Analyses (CFA) are provided in Tables 6 and 7. The CFA analysis was conducted using R programming language (Hornik, 2015) and supporting statistical packages that included psych (Revelle, 2015), lavaan (Rosseel, 2012) and CTT (Willse, 2014).
Table 6

*Proposed Model (Four Factor) Compared to Baseline Model*

<table>
<thead>
<tr>
<th></th>
<th>292</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of observations</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Estimator:</strong></td>
<td>ML</td>
</tr>
<tr>
<td><strong>Minimum Function Test Statistic</strong></td>
<td>6002.39</td>
</tr>
<tr>
<td><strong>Degrees of freedom</strong></td>
<td>3233</td>
</tr>
<tr>
<td><strong>P-value (Chi-square)</strong></td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Model test baseline model:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum Function Test Statistic</strong></td>
<td>11290.5</td>
</tr>
<tr>
<td><strong>Degrees of freedom</strong></td>
<td>3321</td>
</tr>
<tr>
<td><strong>P-value</strong></td>
<td>0.000</td>
</tr>
</tbody>
</table>

**User model versus baseline model:**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comparative Fit Index (CFI)</strong></td>
<td>0.653</td>
</tr>
<tr>
<td><strong>Tucker-Lewis Index (TLI)</strong></td>
<td>0.643</td>
</tr>
</tbody>
</table>

The information was reviewed for a goodness of fit for the hypothesized model with four factors and a single factor model that contained all the items. The four factor model was based on the dimensional assignments developed with the assistance of the panel of experts. The single factor model included all assessment instrument items for comparison to the proposed model (see Appendix G).

Table 7

*CFA Results Summary for Goodness of Fit Indices for One and Four Factor Models*

<table>
<thead>
<tr>
<th></th>
<th>X²</th>
<th>Df</th>
<th>RMSEA - [90%]</th>
<th>SRMR</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-factor</td>
<td>6002.395</td>
<td>3233</td>
<td>.054 [.052 - .056]</td>
<td>.079</td>
<td>.653</td>
<td>.643</td>
</tr>
<tr>
<td>1-factor</td>
<td>6250.074</td>
<td>3239</td>
<td>.056 [.054 - .059]</td>
<td>.076</td>
<td>.622</td>
<td>.613</td>
</tr>
</tbody>
</table>

Note: RMSEA = root mean-square error of approximation, SRMR = standardized root mean square, CFI = comparative fit index, TLI = Tucker Lewis Index
A review of the goodness of fit table revealed that none of the models are a good fit. Between the four factor and one factor model, the four factor is statistically slightly better but just marginally. The $X^2$ is a ~248 difference but there are only 6 degrees of freedom difference between the two models. These differences indicate a minimal difference between the one and four factor models.

The preferred CFA goodness of fit indicators are also listed in Table 7. Both RMSEA and SRMR goodness of fit indices are indicated by lower numbers, and the CFI and TLI goodness of fit indices are indicated by higher numbers. For example, the RESEA scale lower bound is 0 and the upper bound is model dependent, but scores closer to 0 indicate a good fit (Furr & Bacharach, 2013). CFI and TLI have a scale of 0 - 1.0 and larger numbers are indicators desirable, values larger than .90 are considered good fitting models (Furr & Bacharach, 2013). Considering these measures produced from the CFA, both models lack evidence supporting either being a good fitting model (see Table 7).

An Exploratory Factor Analysis (EFA) was conducted to using principle component analysis extractions and a Promax rotation with a four factor limitation (refer to Appendix I and Figure 9). To improve the factor analysis, the low performing items (see Tables 4 and 5) were removed from the factor analysis. The list of excluded items contained: Q01, Q03, Q10, Q13, Q30, Q44, Q45, Q 48, Q50, Q71, Q75, Q78, and Q82.

The Kaiser-Meyer-Olkin measure of sampling adequacy was .607 (above the commonly recommended value of .6) and Bartlett’s test of sphericity was acceptable, where $p$ = .000, to conduct a factor analysis. The four factors explained ~43 percent of the variance, with initial Eigen values of 3.4 or greater. After the initial four factors the Eigen values started
at ~2.6 and continued down to ~1 for the next 15 factors. The remaining factors all fell below 1 (see Appendix I).

Reviewing the scree plot factor 5 and 6 are negligibly higher than the following factors, but there is a slight visual differentiation compared to the linear trend of the remaining 61 factors. It could be argued that there are five factors when reviewing the scree plot. A factor analysis was conducted extracting five factors, but the fifth factor contained only eight items and of those only two items scored greater than the correlation for the same items in other factors. It was determined that the fifth factor was not strong enough to remain. The factor analysis was then set for a four factor extraction.

![Scree Plot](image)

**Figure 9.** EFA Scree Plot
A review of the rotated factor solution illustrates the factor loading for the four factor analysis (see Table 8). To improve readability, correlations below .30 were omitted. This represents the clearest model of several factor analyses. The strongest loadings in factor 1 are for items that represent icon identification. These included items Q27, Q23, Q26, Q34, Q31, Q20, Q25, Q22, Q19, Q16, Q28, and Q32 in descending order of correlation. Factor 1 included an additional 13 items that represent communication and media topics, which contributed to the strength of the factor. The second factor contained a total of 16 items. The items in the second factor consisted of four prompts that were related to identification of file extensions and the remaining were communication, information, and media prompts. The third and forth factors contained 13 and 14 items respectively. The third factor consisted of one icon item and one file extension identification item with the remaining items relating to communication and computer prompts. The forth factor contained four file extension identification items, two icon items, and the remaining information and computer related prompts. All the factors contained items that were combinations from the original dimension item assignments and lacked discrete representation of the original proposed topical dimensions.
<table>
<thead>
<tr>
<th>Q02</th>
<th>.324</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q04</td>
<td></td>
</tr>
<tr>
<td>Q05</td>
<td>.634</td>
</tr>
<tr>
<td>Q06</td>
<td>.388</td>
</tr>
<tr>
<td>Q07</td>
<td>.316</td>
</tr>
<tr>
<td>Q08</td>
<td>.476</td>
</tr>
<tr>
<td>Q09</td>
<td>.526</td>
</tr>
<tr>
<td>Q11</td>
<td>.557</td>
</tr>
<tr>
<td>Q12</td>
<td>.400</td>
</tr>
<tr>
<td>Q14</td>
<td>.415</td>
</tr>
<tr>
<td>Q15</td>
<td>-.337</td>
</tr>
<tr>
<td>Q16</td>
<td>.336</td>
</tr>
<tr>
<td>Q17</td>
<td>.431</td>
</tr>
<tr>
<td>Q18</td>
<td>.302</td>
</tr>
<tr>
<td>Q19</td>
<td>.739</td>
</tr>
<tr>
<td>Q20</td>
<td>.816</td>
</tr>
<tr>
<td>Q21</td>
<td>.599</td>
</tr>
<tr>
<td>Q22</td>
<td>.804</td>
</tr>
<tr>
<td>Q23</td>
<td>.887</td>
</tr>
<tr>
<td>Q24</td>
<td>.602</td>
</tr>
<tr>
<td>Q25</td>
<td>.807</td>
</tr>
<tr>
<td>Q26</td>
<td>.880</td>
</tr>
<tr>
<td>Q27</td>
<td>.901</td>
</tr>
<tr>
<td>Q28</td>
<td>.720</td>
</tr>
<tr>
<td>Q29</td>
<td>.421</td>
</tr>
<tr>
<td>Q31</td>
<td>.839</td>
</tr>
<tr>
<td>Q32</td>
<td>.671</td>
</tr>
<tr>
<td>Q33</td>
<td>.548</td>
</tr>
<tr>
<td>Q34</td>
<td>.393</td>
</tr>
<tr>
<td>Q35</td>
<td>.495</td>
</tr>
<tr>
<td>Q36</td>
<td>.541</td>
</tr>
<tr>
<td>Q37</td>
<td>.454</td>
</tr>
<tr>
<td>Q38</td>
<td>.486</td>
</tr>
<tr>
<td>Q39</td>
<td>.566</td>
</tr>
<tr>
<td>Q40</td>
<td>-.453</td>
</tr>
<tr>
<td>Q41</td>
<td>.386</td>
</tr>
<tr>
<td>Q42</td>
<td>.498</td>
</tr>
<tr>
<td>Q43</td>
<td>.371</td>
</tr>
<tr>
<td>Q46</td>
<td>.588</td>
</tr>
<tr>
<td>Q47</td>
<td>.440</td>
</tr>
<tr>
<td>Q49</td>
<td>.342</td>
</tr>
<tr>
<td>Q51</td>
<td>.318</td>
</tr>
<tr>
<td>Q52</td>
<td>.397</td>
</tr>
<tr>
<td>Q53</td>
<td>.674</td>
</tr>
<tr>
<td>Q54</td>
<td>.523</td>
</tr>
<tr>
<td>Q55</td>
<td>.559</td>
</tr>
<tr>
<td>Q56</td>
<td>.465</td>
</tr>
<tr>
<td>Q57</td>
<td>.320</td>
</tr>
<tr>
<td>Q58</td>
<td>.654</td>
</tr>
<tr>
<td>Q59</td>
<td>.543</td>
</tr>
<tr>
<td>Q60</td>
<td>.366</td>
</tr>
<tr>
<td>Q61</td>
<td>.479</td>
</tr>
<tr>
<td>Q62</td>
<td>.324</td>
</tr>
<tr>
<td>Q63</td>
<td>.666</td>
</tr>
<tr>
<td>Q64</td>
<td>.402</td>
</tr>
<tr>
<td>Q65</td>
<td>-.304</td>
</tr>
<tr>
<td>Q66</td>
<td>.754</td>
</tr>
<tr>
<td>Q67</td>
<td>.592</td>
</tr>
<tr>
<td>Q68</td>
<td>.696</td>
</tr>
<tr>
<td>Q69</td>
<td>.368</td>
</tr>
<tr>
<td>Q70</td>
<td>.440</td>
</tr>
<tr>
<td>Q72</td>
<td>.319</td>
</tr>
<tr>
<td>Q73</td>
<td>.666</td>
</tr>
<tr>
<td>Q74</td>
<td>.441</td>
</tr>
<tr>
<td>Q76</td>
<td>.787</td>
</tr>
<tr>
<td>Q77</td>
<td>.532</td>
</tr>
<tr>
<td>Q79</td>
<td>.520</td>
</tr>
<tr>
<td>Q80</td>
<td>.684</td>
</tr>
<tr>
<td>Q81</td>
<td>.441</td>
</tr>
</tbody>
</table>

**Note:**

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 9 iterations.
These dimensions developed from the literature are mentioned repeatedly throughout the academic discussions of ICT Literacy (Bawden, 2008; Buckingham, 2008; Hobbs, 2010; Information literacy competency standards for higher education, 2000; Livingstone, 2003; Tyner, 2010). The results of the confirmatory factor analysis (CFA) or the factor analysis (FA) results did not support the proposed topical dimensions identified in review of the literature and affirmed by the panel of experts, and the CFA lacked significance in the goodness of fit indices (see Tables 6 and 7). Thus, H₀₁ (Proposed Factor (4) = CFA GFI) must be rejected based on a review of the confirmatory factor analysis and factor analysis results.

The factor analysis produced factors loading (see Table 8) that deviated from the original proposed factor model. An analysis of the item prompts reaffirmed the misalignment with the original proposed dimension. Further review of the factor loadings and the items prompts suggested alternate factor labels, which are the new labels proposed for the ICT literacy dimensions (see Table 9). Factor one contained the majority of the icon identification prompts and other items related to personal communication topics. The second contained prompts that are broader media and communication interpretation items. The third factor has items with computer and information prompts that focused on knowledge required for actions using computing devices. The last factor contained file extension prompts that are Internet file formats and information interpretation prompts. Based on the item composition within the factors, new dimension labels are suggested below.
Table 9

*Digital Communication and Information Technology Scale*

<table>
<thead>
<tr>
<th>Fact or</th>
<th>Label</th>
<th>Description - Knowledge and Skills to…</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intrapersonal Digital Communication</td>
<td>Understand and reception of communication in a digital environment.</td>
</tr>
<tr>
<td>2</td>
<td>Interpersonal Digital Communication</td>
<td>Understand and interact with others in a digital environment from individuals to mass media.</td>
</tr>
<tr>
<td>3</td>
<td>Personal Information &amp; Technology</td>
<td>Understand the basics of information and information technology, primarily related to interaction with a computing device</td>
</tr>
<tr>
<td>4</td>
<td>Networked Information &amp; Technology</td>
<td>Understand the broader information and information technology, primarily related to interaction with the Internet</td>
</tr>
</tbody>
</table>

H₀₂: \( \bar{x}_{\text{Male}} = \bar{x}_{\text{Female}} \)

*There will be no significant difference between the scores of males when compared to females.*

To test the assumption of normality for the participants' assessment scores the descriptive statistics and Shapiro-Wilks test (Shaprio & Wilk, 1965) were conducted. Contained in the 292 participants, the frequencies were males, \( N = 125 \) and females, \( N = 167 \). Each group was tested for normality independently. First, the males were slightly platykurtic with a value of -1.327. Other values of skewness and kurtosis were not as extreme and under a value of 1. From the Shapiro-Wilks test, where \( \alpha = .05, p = 0 \) (Sig.) for the male scores and \( p = 0.00 \) (Sig.) for the female scores. Based on this information it was concluded that the assessment scores are not normally distributed. Therefore, the assumption of normality was not met.
To achieve statistical uniformity, the Two-Step process was used to transform the participant scores. In this process the observed variables are transformed toward uniformity using a percentile rank. The ranking is used to achieve normality and accurately represent the original values (Templeton, 2011).

The assumption of normality tests were repeated with the transformed variable. The skewness for male was -.135 and for females was .188. The kurtosis was .225 for males and .375 for females. The skewness and kurtosis were within expected limits. The Shapiro-Wilks test, were $\alpha = .05$, both male and female $p$ (Sig.) values were significant. This indicated that the normalized participant scores were normally distributed and the assumption of normality had been met.

Table 11

Tests of Normality Post Normality Test Post Two-Step

<table>
<thead>
<tr>
<th>Gender</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
</tr>
<tr>
<td>ScoresNorm</td>
<td>Male</td>
</tr>
<tr>
<td></td>
<td>Female</td>
</tr>
</tbody>
</table>

a. Lilliefors Significance Correction
With the assumption of normality addressed, an independent-samples t-test was conducted to compare the participant scores of males and females (see Table 13 below). The data were weighted to simulate the population proportions for gender and race (see Appendix H). The test of equality of variances was not met with a \( p \) (Sig.) value .000 of where \( \alpha = .05 \). The data results associated with "Equal variances not assumed" must be used because the assumption of homogeneity of variance was not met. Although, the interpretation of the result would be the same for either option.

Table 12

<p>| Weighed Gender Group Statistics for Normalized and Observed Scores |
|-------------------------|--------|--------|-------------|-------------|</p>
<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>Male</td>
<td>112</td>
<td>-.1699</td>
<td>1.11465</td>
</tr>
<tr>
<td>Norm</td>
<td>Female</td>
<td>158</td>
<td>.1426</td>
<td>.68475</td>
</tr>
<tr>
<td>Participant</td>
<td>Male</td>
<td>112</td>
<td>42.43</td>
<td>17.554</td>
</tr>
<tr>
<td>Score</td>
<td>Female</td>
<td>158</td>
<td>48.96</td>
<td>11.861</td>
</tr>
</tbody>
</table>

Table 13

<p>| Independent Samples Test Gender Weighted Scores Both Normalized and Observed |
|-----------------------------|--------|--------|-------------|-------------|-------------|-------------|
| Levene's Test for Equality of Variances | t-test for Equality of Means |</p>
<table>
<thead>
<tr>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>44.159</td>
<td>.000</td>
<td>-2.848</td>
<td>268</td>
<td>.005</td>
<td>-.31249</td>
</tr>
<tr>
<td>Norm</td>
<td>≠</td>
<td>-2.635</td>
<td>169.743</td>
<td>.009</td>
<td>-.31249</td>
<td>.11858</td>
</tr>
<tr>
<td>Participant</td>
<td>= 45.954</td>
<td>.000</td>
<td>-3.651</td>
<td>268</td>
<td>.000</td>
<td>-6.536</td>
</tr>
<tr>
<td>Score</td>
<td>≠</td>
<td>-3.425</td>
<td>181.071</td>
<td>.001</td>
<td>-6.536</td>
<td>1.908</td>
</tr>
</tbody>
</table>

The results of the t-test were the same for both the normalized scores and the observed scores (Participant Score). The t-test revealed a statistically significant difference between the mean of male and female observed assessment scores where \( \alpha = .05 \). Based on
the t-test results, the null hypothesis (Ho2: \( \mu_{\text{Male Scores}} = \mu_{\text{Female Scores}} \)) is rejected. The observed scores are provided in Tables 12 and 13 for reference and comparison. These observed scores illustrate the actual mean of male (42.53) and female scores (48.92) out of a possible 82 points.

The scores of the proposed dimensions included in the ICT literacy assessment development were also evaluated. The means and standard deviation for both normalized and observed scores were processed for comparative purposes (see Tables 14 and 15).

Table 14

<table>
<thead>
<tr>
<th>Group Statistics of Weighted Gender Scores, Normalized and Observed for Proposed Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>C_Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Comm Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>M_Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Media Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>I_Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Info Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>IT_Score</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>Info Tech</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>F</td>
</tr>
</tbody>
</table>
The results of the t-tests are similar for both the normalized scores and the observed scores (Comm Score, Media Score, Info Score, and Info Tech Score) for the proposed dimensions. The t-test revealed a statistically significant difference between the mean of male and female observed dimension assessment scores and the overall assessment scores where $\alpha = .05$. Based on the t-test results for the proposed dimensions and the overall assessment scores, the null hypothesis ($H_0: \mu_{Male \ Scores} = \mu_{Female \ Scores}$) was rejected.
Female participants performed overall better in all dimensions and the composite assessment scores. The score range was also smaller for the female participates. This illustrates that as a group the female participants performed more consistently than the males. The assessment items related to productive style technology facilitated tasks, but the female performance indicators are interesting from the aspect that technology industries and STEM (Science, Technology, Engineering, and Math) jobs are often considered male dominated (Dickey, 2013; Rosner, 2015). An 8 percent greater mean over the male participants could be specific to the sample, but it could be the result of new role models. There are female role models that are actively encouraging girls and young women to engage in more STEM centered ventures, such as Rosner, so maybe this encouragement is having an effect (2015).

**Ho3: \(\bar{x}_{\text{Non-subsidies}} = \bar{x}_{\text{Subsidies}}\)**

*There will be no significant differences among the students' scores that qualify for free-lunches when compared to those who received no lunch subsidies.*

A t-test was conducted on the weighted data to compare the socioeconomic indicator of reduced lunch. The weighted participants (270) were composed of 21.6 percent that had received subsidized lunch.
Table 16

*Group Statistics of Reduced Lunch*

<table>
<thead>
<tr>
<th>Reduced Lunch</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scores</td>
<td>Yes</td>
<td>48</td>
<td>-.0218</td>
<td>.85933</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>222</td>
<td>.0205</td>
<td>.91037</td>
</tr>
<tr>
<td>Norm</td>
<td>Yes</td>
<td>48</td>
<td>-.1699</td>
<td>.91155</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>222</td>
<td>.1087</td>
<td>.89762</td>
</tr>
<tr>
<td>C_Score</td>
<td>Yes</td>
<td>48</td>
<td>-.0070</td>
<td>.87572</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>219</td>
<td>.0624</td>
<td>.86667</td>
</tr>
<tr>
<td>M_Score</td>
<td>Yes</td>
<td>48</td>
<td>.0604</td>
<td>.98566</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>222</td>
<td>.0408</td>
<td>.97150</td>
</tr>
<tr>
<td>IT_Score</td>
<td>Yes</td>
<td>48</td>
<td>-.0462</td>
<td>.89074</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>222</td>
<td>.0312</td>
<td>.95827</td>
</tr>
<tr>
<td>I_Score</td>
<td>Yes</td>
<td>48</td>
<td>-.0462</td>
<td>.89074</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>222</td>
<td>.0312</td>
<td>.95827</td>
</tr>
</tbody>
</table>

The normalized scores test of equality of variances was not met, with a $p$ (Sig.) value of .008 where $\alpha = .05$. The analysis results associated with "Equal variances not assumed" must be used because the assumption of homogeneity of variance was not met. A negative $t$ (-.306) value was obtained with a Sig. ($p$) value of .76 greater than the alpha ($\alpha = .05$); thus the null hypothesis was rejected based on this indicator.
Table 17

**Reduced Lunch T-Test**

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Scores</td>
<td>= .008</td>
<td>.930</td>
</tr>
<tr>
<td>Norm ≠</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C_Score</td>
<td>= .244</td>
<td>.622</td>
</tr>
<tr>
<td>Norm ≠</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_Score</td>
<td>= .165</td>
<td>.685</td>
</tr>
<tr>
<td>Norm ≠</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT_Score</td>
<td>= .621</td>
<td>.431</td>
</tr>
<tr>
<td>Norm ≠</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_Score</td>
<td>= 1.766</td>
<td>.185</td>
</tr>
<tr>
<td>Norm ≠</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The t-test scores for the proposed dimensions provided similar results to the normalized scores (refer to Table 17). For all dimensions, the test of equality of variances was met and equal variances were assumed. Most of the dimensions produced large Sig. \((p > .05)\) values with the exception of the Communication dimension (C_score) \((p = .053)\). These indicators further support the initial indicator of the normalized score that the null hypothesis would be rejected. The dimensions all had negative t scores with the exception of the Information Technology (IT_Score) score. Considering all analyses, it was concluded that those that did not receive reduced priced lunches performed better than those who did; thus the null hypothesis \((H_0: \bar{x}_{Non-subsidies} = \bar{x}_{Subsidies})\) was rejected.
Table 18

Reduced Lunch ANOVA

<table>
<thead>
<tr>
<th>Scores</th>
<th>Between Groups (Combined)</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.071</td>
<td>1</td>
<td>.071</td>
<td>.087</td>
<td>.768</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.071</td>
<td>1</td>
<td>.071</td>
<td>.087</td>
<td>.768</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.071</td>
<td>1</td>
<td>.071</td>
<td>.087</td>
<td>.768</td>
</tr>
<tr>
<td></td>
<td></td>
<td>217.856</td>
<td>267</td>
<td>.816</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>217.926</td>
<td>268</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C_Score</td>
<td>Between Groups (Combined)</td>
<td>3.067</td>
<td>1</td>
<td>3.067</td>
<td>3.772</td>
<td>.053</td>
</tr>
<tr>
<td>Norm</td>
<td></td>
<td>.190</td>
<td>1</td>
<td>.190</td>
<td>.252</td>
<td>.616</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.190</td>
<td>1</td>
<td>.190</td>
<td>.252</td>
<td>.616</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200.097</td>
<td>265</td>
<td>.755</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>200.287</td>
<td>266</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_Score</td>
<td>Between Groups (Combined)</td>
<td>.015</td>
<td>1</td>
<td>.015</td>
<td>.016</td>
<td>.899</td>
</tr>
<tr>
<td>Norm</td>
<td></td>
<td>.015</td>
<td>1</td>
<td>.015</td>
<td>.016</td>
<td>.899</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.015</td>
<td>1</td>
<td>.015</td>
<td>.016</td>
<td>.899</td>
</tr>
<tr>
<td></td>
<td></td>
<td>254.248</td>
<td>267</td>
<td>.952</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>254.263</td>
<td>268</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_Score</td>
<td>Between Groups (Combined)</td>
<td>.237</td>
<td>1</td>
<td>.237</td>
<td>.264</td>
<td>.608</td>
</tr>
<tr>
<td>Norm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.237</td>
<td>1</td>
<td>.237</td>
<td>.264</td>
<td>.608</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.237</td>
<td>1</td>
<td>.237</td>
<td>.264</td>
<td>.608</td>
</tr>
<tr>
<td></td>
<td></td>
<td>240.215</td>
<td>267</td>
<td>.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>240.452</td>
<td>268</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ho4: \( r(\text{Scores}) \leq \alpha \)

*There will be no significant relationship between self-reported high school GPA and assessment scores for those participating in the field test.*

A Pearson coefficient correlation analysis was conducted to measure the strength and direction of the linear relationship between the two variables. Specifically, to examine if there was a correlation between the participants' reported GPA and their observed scores. A weighted analysis of the correlation coefficient for GPA and the normalized scores was reported as \( r (-.297) \) indicating a possible negative relationship where \( \alpha = .05, p = 0 \) (Sig.); thus the null hypothesis can be rejected for this aspect. Continuing to review the proposed dimension similar results were produced from the correlation test (see Table 19). All proposed dimensions reported a negative relationship where \( \alpha = .05, p = 0 \) (Sig.). Based on these analyses, the null hypothesis (H₄: \( r(\text{Scores}) \leq \alpha \)) was rejected on the overall and individual sub-scales of the ICT literacy assessment scores.
Table 19

*Correlations of Weighted GPA and Scores*

<table>
<thead>
<tr>
<th></th>
<th>GPA (reported)</th>
<th>Scores Norm</th>
<th>C_Score Norm</th>
<th>M_Score Norm</th>
<th>IT_Score Norm</th>
<th>I_Score Norm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
<td>270</td>
<td>267</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>Scores</td>
<td>Pearson</td>
<td>- .297**</td>
<td>1</td>
<td>.744**</td>
<td>.768**</td>
<td>.918**</td>
</tr>
<tr>
<td>Norm</td>
<td>Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
<td>270</td>
<td>267</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>C_Score</td>
<td>Pearson</td>
<td>- .255**</td>
<td>.744**</td>
<td>1</td>
<td>.616**</td>
<td>.573**</td>
</tr>
<tr>
<td>Norm</td>
<td>Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
<td>270</td>
<td>267</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>M_Score</td>
<td>Pearson</td>
<td>- .262**</td>
<td>.768**</td>
<td>.616**</td>
<td>1</td>
<td>.597**</td>
</tr>
<tr>
<td>Norm</td>
<td>Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>267</td>
<td>267</td>
<td>267</td>
<td>267</td>
<td>267</td>
<td>267</td>
</tr>
<tr>
<td>IT_Score</td>
<td>Pearson</td>
<td>- .215**</td>
<td>.918**</td>
<td>.573**</td>
<td>.597**</td>
<td>1</td>
</tr>
<tr>
<td>Norm</td>
<td>Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
<td>270</td>
<td>267</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>I_Score</td>
<td>Pearson</td>
<td>- .346**</td>
<td>.796**</td>
<td>.531**</td>
<td>.584**</td>
<td>.634**</td>
</tr>
<tr>
<td>Norm</td>
<td>Correlation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>270</td>
<td>270</td>
<td>270</td>
<td>267</td>
<td>270</td>
<td>270</td>
</tr>
</tbody>
</table>

Note: **. Correlation is significant at the 0.01 level (2-tailed).
Additionally, the negative correlation between indices does not indicate that as GPA went up scores went down. The GPA were reported in the ranges of but coded inversely (See Table 20); thus as the reported GPA rose there was a corresponding rise of assessment scores across the score dimensions. In effect, the inverse coding and negative r scores indicate a positive relationship between the reported GPA and assessment scores.

Table 20

**GPA (reported) Coding**

<table>
<thead>
<tr>
<th>Label</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5-4.0 (1)</td>
<td>187</td>
<td>69.1</td>
<td>69.1</td>
<td>69.1</td>
</tr>
<tr>
<td>3.0-3.4 (2)</td>
<td>63</td>
<td>23.2</td>
<td>23.2</td>
<td>92.2</td>
</tr>
<tr>
<td>2.5-2.9 (3)</td>
<td>16</td>
<td>5.8</td>
<td>5.8</td>
<td>98.1</td>
</tr>
<tr>
<td>2.0-2.4 (4)</td>
<td>5</td>
<td>1.9</td>
<td>1.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>270</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Results Summary

A table consisting of a concise summary of the analyses results is presented below.

The results of addressing the research questions and testing the hypotheses are provided as well.

Table 21

Results Summary for Research Questions and Hypothesis

<table>
<thead>
<tr>
<th>Research Question or Hypothesis</th>
<th>Development or Statistical Process</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1: Working Definition</td>
<td>Literature Review</td>
<td>Developed a working definition for the purposes of this project</td>
</tr>
<tr>
<td></td>
<td>Panel of Experts</td>
<td></td>
</tr>
<tr>
<td>RQ2: Key Dimensions</td>
<td>Literature Review</td>
<td>Proposed sub-constructs that were used to group the test items</td>
</tr>
<tr>
<td></td>
<td>Panel of Experts</td>
<td></td>
</tr>
<tr>
<td>RQ3: Items based on dimensions</td>
<td>Literature review</td>
<td>Developed items based on proposed dimensions with a about an eighth grade reading level</td>
</tr>
<tr>
<td></td>
<td>Panel of Experts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Readability Review</td>
<td></td>
</tr>
<tr>
<td>RQ4: Psychometric aspects</td>
<td>Cronbach’s Alpha</td>
<td>Acceptable alpha coefficient</td>
</tr>
<tr>
<td></td>
<td>Discrimination index &amp; Difficulty index</td>
<td>Identified strength and weakness of instrument items. Majority of items were within good parameters</td>
</tr>
<tr>
<td>Ho1: No significant difference between the dimensions used to frame the items and the resulting factors.</td>
<td>CFA</td>
<td>Null Rejected: The proposed factor (dimensions) were not supported</td>
</tr>
<tr>
<td>Ho2: No significant difference between the scores of males when compared to females.</td>
<td>EFA*</td>
<td>EFA suggested alternative factors, DCITS proposed</td>
</tr>
<tr>
<td>Ho3: No significant differences among the students' scores that qualify for free-lunches when compared to those who received no lunch subsidies.</td>
<td>Student’s t-test</td>
<td>Null Rejected: The female participants scored higher for both the assessment and individual dimensions</td>
</tr>
<tr>
<td>Ho4: No significant relationship between GPA and assessment</td>
<td>Student’s t-test ANOVA</td>
<td>Null Rejected: Those of lower socioeconomic status performed poorer on the assessment</td>
</tr>
</tbody>
</table>

NOTE: *Not part of the original research design
Chapter 5 - Conclusions, Implications, and Suggested Research

The results of this first iteration of an ICT literacy assessment instrument illustrated that it is a feasible concept. This proof of concept has confirmed the general idea of an ICT literacy assessment, but also failed to support one proposed aspect of the project, the initial dimensions. This project has provided insight that can potentially reduce ambiguity associated with measuring ICT literacy and an instrument that can be used in other settings and modified to improve applicability and usefulness.

Conclusions and Implications

The first three research questions from this project focused on the development of a usable definition, the identification of key dimensions, and the use of these dimensions to frame the development of appropriate individual test items. Based on a literature review and interactions with a panel of experts, a working definition was developed and used within the project. It was concluded that the working definition appears to be effective for future use by either expanding this work or supporting other projects. The initial proposed dimensions used within this project were not supported by a confirmatory factor analysis. It is recommended that the initial proposed dimensions not be used in the future when analyzing factors for ICT literacy assessments, but they could be utilized as subject matter development guides for item construction.

The fourth research question was addressed by analyzing the psychometric aspects of the developed ICT literacy instrument based on the field test results. The proposed dimensions were used to develop the assessment items contained in the instrument. It was concluded that this assessment instrument was generally reliable and effective. Reliability was based on the Cronbach's alpha (.94) from the field test results and the psychometric aspects that were
reviewed, which included the Item Discrimination and Difficulty indexes. These analyses provided useful guidance for improving the instrument by highlighting low performing items. Once the lower performing items are removed, the remaining items could be used for future assessments of ICT knowledge and skills of students transitioning from secondary education to higher education (see Appendix J for the modified assessment). For any future iterations of this instrument, it is recommended that the psychometric analyses discussed should be utilized to ensure the quality of the assessment instrument. In addition, the difficulty index target of .50 was used in this project for the convenience of establishing an initial difficulty index. Using this project as a basis, any future versions should be developed with a difficulty index target of .70, which is more customary for summative assessment (Furr & Bacharach, 2013; Wright, 2008).

The last two research questions were addressed by testing four hypotheses. The first hypothesis examined the proposed dimensions. As stated previously, a Confirmatory Factor Analysis failed to confirm the proposed dimensions. An Exploratory Factor Analysis was conducted to further explore this aspect of the assessment instrument. The low performing items did not support the proposed dimension based on factor loadings, and these items were removed to continue the analysis. The original dimensions were still not confirmed, but alternate factors were suggested based on the factor loadings for the items. These new proposed dimensions (see Table 9) form the suggested Digital Communication and Information Technology Scale (DCITS). This new scale has two topical categories: communication and information technology. Then each of the categories has two concentrations that are either discrete or connected skills and knowledge for that topic. These categories and concentrations form the four dimensions of the scale. It is recommended that
the DCITS be used to provide a framework for further investigations involving measuring ICT literacy.

The last three hypotheses examined the participants' performance during the field test based on demographic indicators. First, it was determined that female participants performed better than male participants. The females scored higher than males on this overall instrument and the range of the female scores was smaller than the males.

Next, it was concluded that there may be a socioeconomic disadvantage reflected in ICT literacy assessment scores. This socioeconomic indicator could not be considered conclusive as a single factor, but it implies that further investigation is warranted to address the effects of socioeconomic status on ICT literacy. Lastly, it was determined that the higher the assessment scores, the higher the GPA of the person completing the assessment. Based on this, it was determined that low academic performance was an indicator of low ICT literacy assessment scores. Students that perform better academically may be more engaged in their education or have had a stronger educational experience that may result from greater access and engagement with technology and may account for this correlation.

It is recommended that educators remain conscious of these indicators and situations that may affect students' academic performance. The gender difference could be addressed in secondary education with both male and female students receiving purposeful exposure to ICT based assignments or earlier testing to determine if remediation is required prior to high school graduation. The performance disadvantage may be greater in economically challenged communities and might indicate where possible interventions could be targeted to reduce disadvantages for students of families from these communities. In addition, students with lower GPAs may require ICT literacy remediation to improve academic performance in a
higher education environment. The three demographic indicators suggest that educators should be mindful of students with these characteristics because they may require additional opportunities to gain ICT skills and knowledge that would help them be successful in a post-secondary educational environment. Educators should also be cognizant that this project was conducted at a private Midwestern university and this fact should be considered when acting on the conclusions and recommendations.

**Suggested Research**

The results of this project suggest that it is possible to measure ICT literacy, and universities are encouraged to use this test or build their own. Future research could extend the work of this project by exploring the largest proposed implication. The Digital Communication and Information Technology Scale (DCITS) derived from this project could be leveraged for future assessment instruments. This would require the development of new items and the refinement of existing assessment items to further test the proposed DCITS. It would also involve continued testing and analysis of the assessment items to explore their support of both the DCITS and appropriate psychometric parameters.

Another possible project could focus on item development to create pools of items that are rated on difficulty and discrimination indicators. This would allow the development of randomized pools of items that produce scores that could be standardized once an adequate number of participants were assessed. A specific number of items could be delivered to each participant for each dimension, creating an equivalent difficulty rating from pools. This would provide an assessment that is more robust and allow items to be included over time without diminishing established effectiveness.
Lastly, the development of remediation or additional ICT experiences as an academic intervention for students that may require additional support would be recommended as an area of exploration for ICT literacy. This project has indicated that certain students may benefit from additional support efforts to improve their possibility of success in higher education. For example, socioeconomically disadvantaged students could be provided with a series of workshops to improve ICT skills and knowledge. Conducting a pre-test and post-test research project that included this intervention could provide insight to the effectiveness of the workshops for these students.

In conclusion, the developed working definition and assessment instrument items have contributed to the ICT literacy knowledge base. The development of an assessment instrument further explored the underlying details within the construct, contributing to greater understanding of this complex topic by suggesting underlying factors involved. These factors form the proposed Digital Communication and Information Technology Scale. A key challenge of measuring ICT literacy is the ambiguity that has been produced by the broad overlapping concepts driven by multiple perspectives in the literature. This project illustrates that it is possible to not only define the ICT literacy construct, but also with modest effort to assess the associated knowledge and skills in a university environment.
References


http://doi.org/10.5860/crl.68.3.229


http://doi.org/10.1002/asi.21681


http://doi.org/10.1300/J025v24n0111


McQuiggan, C. A. (2012). Faculty development for online teaching as a catalyst for change. *Journal of Asynchronous Learning Networks.*


Oliver, R., & Towers, S. (2000). Benchmarking ICT literacy in tertiary learning settings (pp. 381–390). Presented at the Learning to choose: Choosing to learn ….


http://doi.org/10.18637/jss.v048.i02


http://doi.org/10.1016/j.is.2007.10.001


http://doi.org/10.1111/j.1365-2729.2006.00204.x


http://doi.org/10.1023/A:1022539822660


http://doi.org/10.1007/s11423-009-9126-9


http://doi.org/10.1037/h0071291


education (pp. 1–31). Presented at the Annual Meeting of the International Association for Educational Assessment, Philadelphia, PA.
**Appendix A - NETP Goals and Recommendations**

### 1.0 Learning: Engage and Empower

All learners will have engaging and empowering learning experiences both in and out of school that prepare them to be active, creative, knowledgeable, and ethical participants in our globally networked society.

1.1 States should continue to revise, create, and implement standards and learning objectives using technology for all content areas that reflect 21st-century expertise and the power of technology to improve learning.

1.2 States, districts, and others should develop and implement learning resources that use technology to embody design principles from the learning sciences.

1.3 States, districts, and others should develop and implement learning resources that exploit the flexibility and power of technology to reach all learners anytime and anywhere.

1.4 Use advances in learning sciences and technology to enhance STEM (science, technology, engineering, and mathematics) learning and develop, adopt, and evaluate new methodologies with the potential to inspire and enable all learners to excel in STEM.

### 2.0 Assessment: Measure What Matters

Our education system at all levels will leverage the power of technology to measure what matters and use assessment data for continuous improvement.

2.1 States, districts, and others should design, develop, and implement assessments that give students, educators, and other stakeholders timely and actionable feedback about student learning to improve achievement and instructional practices.

2.2 Build the capacity of educators, education institutions, and developers to use technology to improve assessment materials and processes for both formative and summative uses.

2.3 Conduct research and development that explores how embedded assessment technologies, such as simulations, collaboration environments, virtual worlds, games, and cognitive tutors, can be used to engage and motivate learners while assessing complex skills.

2.4 Conduct research and development that explores how Universal Design for Learning can enable the best accommodations for all students to ensure we are assessing what we intend to measure rather than extraneous abilities a student needs to respond to the assessment task.

2.5 Revise practices, policies, and regulations to ensure privacy and information protection while enabling a model of assessment that includes ongoing gathering and sharing of data on student learning for continuous improvement.
3.0 Teaching: Prepare and Connect
Professional educators will be supported individually and in teams by technology that connects them to data, content, resources, expertise, and learning experiences that enable and inspire more effective teaching for all learners.

3.1 Expand opportunities for educators to have access to technology-based content, resources, and tools where and when they need them.

3.2 Leverage social networking technologies and platforms to create communities of practice that provide career-long personal learning opportunities for educators within and across schools, preservice preparation and in-service education institutions, and professional organizations.

3.3 Use technology to provide all learners with online access to effective teaching and better learning opportunities and options especially in places where they are not otherwise available.

3.4 Provide preservice and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling assignments for students that improve learning, assessment, and instructional practices.

3.5 Develop a teaching force skilled in online instruction.

4.0 Infrastructure: Access and Enable
All students and educators will have access to a comprehensive infrastructure for learning when and where they need it.

4.1 Ensure students and educators have broadband access to the Internet and adequate wireless connectivity both in and out of school.

4.2 Ensure that every student and educator has at least one Internet access device and appropriate software and resources for research, communication, multimedia content creation, and collaboration for use in and out of school.

4.3 Support the development and use of open educational resources to promote innovative and creative opportunities for all learners and accelerate the development and adoption of new open technology-based learning tools and courses.

4.4 Build state and local education agency capacity for evolving an infrastructure for learning.

4.5 Develop and use interoperability standards for content and student-learning data to enable collecting and sharing resources and collecting, sharing, and analyzing data to improve decision making at all levels of our education system.

4.6 Develop and use interoperability standards for financial data to enable data-driven decision making, productivity advances, and continuous improvement at all levels of our education system.
5.0 Productivity: Redesign and Transform

Our education system at all levels will redesign processes and structures to take advantage of the power of technology to improve learning outcomes while making more efficient use of time, money, and staff.

5.1 Develop and adopt a common definition of productivity in education and more relevant and meaningful measures of outcomes, along with improved policies and technologies for managing costs, including those for procurement.

5.2 Rethink basic assumptions in our education system that inhibit leveraging technology to improve learning, starting with our current practice of organizing student and educator learning around seat time instead of the demonstration of competencies.

5.3 Develop useful metrics for the educational use of technology in states and districts.
Appendix B - Methods

Key Methodological Items
ICT Literacy Assessment Design and Development

- Literature Review
- Construct Working Definition of ICTL
- Identify Possible Dimensions
- Item Development
- Assemble Instrument

ICT Panel Review

Statistical Analysis A
- Descriptive Statistics
- Dimension Scores Analysis
- Item Response Theory (IRT) Analysis

Revise

Field Test Instrument

Statistical Analysis B
- Repeat Statistical Analysis A
- Cronbach’s (alpha)
- CFA Factor Analysis

Summarize Results

Pilot Test Instrument

Human Subjects
Appendix C - Panel of Experts

Marcia M. Ditmyer - Ph.D., M.S., M.B.A., M.C.H.E.S.
Vice President, AAL Group

Joslen Letscher - Ph.D., M.A., M.A., B.S.
Associate Professor, University of Detroit Mercy

Nelson Maylone - Ph.D., M.A., B.A.
Professor, Eastern Michigan University

Jason Siko - Ph.D., M.Ed., M.S., B.S.
Assistant Professor, Grand Valley State University

Doctoral Committee Representative

Associate Professor, Eastern Michigan University
University of Detroit Mercy - Institutional Review Board  
Department of Psychology  
Reno Hall, Room 216  
4001 W. McNichols, Detroit, MI  48221  
office (313) 578-0405  fax (313) 578-0507 

MEMORANDUM  

To: Louis Verduco  
From: Dr. Elizabeth M. Hill, Chair  
UDM Institutional Review Board  
Date: Monday, June 15, 2015  
Subject: IRB Approval Notification - Protocol # 1415-82

IRB Protocol Number: 1415-82  
Project Title: Information and Communication Technology Literacy (ICT): Refining a Construct for Assessment  
Protocol Approval Date: June 15, 2015

In accordance with DHHS Regulations for Protection of Human Subjects (45 CFR 46.110), the human subjects application for this project underwent Exempt review and was approved as minimal risk to subjects. The project was approved June 15, 2015. Exempt projects are not subjected to continuation review.

The IRB wishes you the best of luck in the completion of your project. Should you have further comments and/or questions please do not hesitate to contact me at your earliest convenience.

Sincerely,

Elizabeth M. Hill, Ph.D.  
Chair, Institutional Review Board

NOTE: Updated via email response Aug 2015
Appendix E - ICT Literacy – Working Definition

**Definition**

the knowledge and skills to define, identify, apply, analyze, manage, and evaluate information and communication methods through a variety of current technologies in a purposeful and ethical manner

**Definition Examined**

This definition attempts to capture a broad concept and present it in a basic form. The term “literacy” has traditionally been associated with reading, writing, and numeracy. Here literacy is being used in the “broader” sense to indicate the “complex set of critical skills” required to for one to accomplish tasks and goals that leverage technology (United Nations Educational, Scientific and Cultural Organization, 2005). The “cognitive” domain of Bloom’s Taxonomy was used to develop the action verbs to represent the levels of the taxonomy. “Information and communication methods” highlights the literacy is based on human action and solely technologies.

“Purposeful” is used to indicate that a reasoned approach is used, that technology is not just used for technologies sake. “Ethical” indicates that persons should not use these knowledge and skills to undermine legal and ethical boundaries related to the use of technology such as plagiarism or copyright infringement. This working definition was an attempt to frame the construct in a useful form based on the current literature, which also revealed dimension contained within ICT literacy.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>The ability…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information. (Information literacy competency standards for higher education, 2000, p. 4)</td>
</tr>
<tr>
<td>Communication</td>
<td>to communicate ideas and information to others using technology to leverage multiple formats and work collaboratively with others through technology</td>
</tr>
<tr>
<td>Information Technology</td>
<td>to use computer hardware and software to productively solve problems and accomplished tasks.</td>
</tr>
<tr>
<td>Media</td>
<td>to locate, evaluate, and analyze mass media resources (such as news sites, blogs, or social media) to determine creditability and usefulness.</td>
</tr>
</tbody>
</table>


Appendix F - ICT Assessment Questions

Informed Consent/Assent Form

Purpose of the Study:
This study of ICT (Information & Communication Technology) literacy assessment is being conducted by L. Mike Verdusco, in fulfillment of dissertation requirements. The purpose of this study is to examine the possibility of ICT assessment in higher education settings.

What will be done:
To participate you will complete an assessment, which will take about 30 minutes to complete. The assessment includes questions intended to measure ICT literacy. You will also be asked for some demographic information (e.g., gender, high-school GPA) so that we can accurately describe the general traits of the participants in the study.

After you complete the questionnaire, you may submit your email address (optional) only if you wish to receive a summary document that results from this research study. This will not be associated with your responses and will only be used for distribution related to this research study.

Benefits of this Study:
While this research will not provide any direct benefit to the individual participants, the results will be contributing to knowledge about the possibility of assessing ICT literacy. This information may benefit educational institutions by providing a better understand of the skills and knowledge of their student population.

Risks or discomforts:
No risks or discomforts are anticipated from taking part in this assessment. If you feel uncomfortable with a question, you can skip that question or withdraw from the study altogether. If you decide to quit at any time before you have finished the questionnaire, your answers will be recorded up to the point of your exit.

Confidentiality:
Your responses will be kept completely confidential. Upon completion you will be offered opportunity to enter a drawing to receive an iTunes/Amazon gift card. The drawing will require name and email be entered but it will not be associated with your assessment results. Only the researcher will see your individual assessment results and only aggregate response information will be published.

After the drawing participants have been notified and received their award the list of participants’ e-mail addresses will be destroyed and the address will NOT be used for any other purpose.

Decision to quit at any time:
Your participation is voluntary; you are free to withdraw your participation from this study at any time. If you do not want to continue, you can simply leave this stop. You also may choose to skip any questions that you do not wish to answer.

How the findings will be used:
The results of the study will be used for scholarly purposes only. The results from the study will be presented in educational settings and possibly at professional conferences, and the results might be published in a professional journal in the field of education or technology literacy. No names of individuals or institutions will be used in any presentation form of this study.

Contact information:
If you have concerns or questions about this study, please contact L. Mike Ver dusco (mike@verdusco.com), the researcher or Dr. John Dugger, dissertation committee chair. By beginning the assessment, you acknowledge that you have read this information and agree to participate in this research, with the knowledge that you are free to withdraw your participation at anytime without penalty. If you have questions about your rights as a research volunteer, you may contact Eastern Michigan University's Office of Research Development, http://ord.emich.edu/, at 734.487.3090, or ord_dept@emich.edu.

By continuing you agree to informed consent based on the information above.
Demographic Questions

Instructions: Please darken the response that corresponds to the best response for each of the following questions. There are not right or wrong answers to these questions. Provide honest answers to each question.

1. What is your sex/gender?
   a. Male
   b. Female

2. Did you ever receive reduced cost lunch during your previous school years?
   a. Yes
   b. No

3. What was your high school cumulative (overall) GPA?
   a. 3.5-4.0
   b. 3.0-3.4
   c. 2.5-2.9
   d. 2.0-2.4
   e. < 2.0

4. Are you Hispanic or Latino? (A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race.)
   a. No, not Hispanic or Latino
   b. Yes, Hispanic or Latino

5. How would you describe yourself?
   a. American Indian or Alaska Native (A person having origins in any of the original peoples of North and South America (including Central America), and who maintains a tribal affiliation or community attachment.)
   b. Asian (A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.)
   c. Black or African American (A person having origins in any of the Black racial groups of Africa – includes Caribbean Islanders and other of African origin.)
   d. Native Hawaiian or Other Pacific Islander (A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.)
   e. White (A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.)

6. Have you participated in a class that required online activities (such as, using the Internet to research or assignment submission) to complete your assignments?
   a. Yes
   b. No

7. Have you participated in a completely online class?
   a. Yes
   b. No
Please state your agreement with the three following statements using the 5-point scale below.

A. Strongly disagree | B. Disagree | C. Neutral | D. Agree | E. Strongly Agree

8. I am concerned that my lack of technology skills may limit my educational opportunities.
9. I dislike having to use technology to complete an assignment.
10. My use of technology allows me to be more productive.

*Note: Technology in the above questions refers to digital hardware and software tools used for productivity and communication. For example: computers, Microsoft Office, email, and forums/discussion boards.*
Information & Communications Technology Assessment

ICT Questions

Please choose the most appropriate answer for each question. Those that have multiple answers are indicated.

11. The communication process requires the receiver of the message to __________.
   a. Decode the message
   b. Accept the message
   c. Know the message
   d. Respond to the message

12. Consider the following scenario: Your class assignment is to prepare a PowerPoint presentation. There are important guidelines that you should consider when using the PowerPoint program. General effectiveness rules for creating a presentation include: (select all that apply)
   a. Include as much text as possible for clarity
   b. Add images to emphasize the message
   c. Keep text to the point and minimal
   d. Always include your name on the slide
   e. Use complementarity colors that are not distracting

13. Which statements best describes a blog?
   a. A website that includes discrete post in reverse chronological order.
   b. A website that enables various users to post messages related to specific topics.
   c. A website that allows users to set up and collectively create content.
   d. A website that is sponsored by a corporate entity.

14. Social Networks (such as Facebook and Twitter) receive revenues through __________.
   a. User Fees
   b. Corporate sponsors
   c. Grants
   d. Advertising

15. Headlines of online news articles are always representative of the content of the article.
   a. True
   b. False

16. Digital Footprint refers to
   a. The data that you leave behind on the Internet
   b. The data that is contained in your Facebook profile
   c. The storage space need to save your documents
   d. The energy that you consume to use the Internet

17. News shared on social media ___________. (check all that apply)
   a. Can be biased in nature
   b. Can represent variety of topics
   c. Is always factual and accurate
   d. Is sponsored by the government
18. In which time period did all fruit sales increase?

a. February to March
b. January to February
c. March to April
d. April to May

19. Online communication methods require the same exact set considerations as face-to-face communications.
   a. True
   b. False

20. Which application is limited to 160 characters for communicating with others?
   a. Twitter
   b. Email
   c. Facebook
   d. SMS (Texting)

21. Online communication may be best received and understood, if you are __________.
   a. clear and detailed
   b. unfamiliar to the audience
   c. Positive and outgoing
   d. Cheerful and to the point

22. Discussion boards or forums are used for which action?
   a. Exchange ideas on a specific topic with a group
   b. Authoring a document with a group
   c. Microblogging
   d. Posting document to share

23. Wikis are used for which action?
   a. Exchanging ideas on a specific topic with a group
   b. Authoring a document with a group
   c. Microblogging
   d. Posting document to share
24. To communicate data different visuals can be used. Which of the following is least likely to be used to display numerical data?
   a. Venn diagram
   b. Bar chart
   c. Pie chart
   d. Line graph

25. When communicating or presenting ideas, which of the following should be primary the consideration?
   a. The audience or recipient
   b. the presentation software
   c. the slide transitions
   d. the time allowed

Match the following common icons used in software and web applications to the most appropriate text label. For each Icon Group use the corresponding Answer Group on the right.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.</td>
<td>a. Reload/Refresh</td>
</tr>
<tr>
<td>27.</td>
<td>b. Share</td>
</tr>
<tr>
<td>28.</td>
<td>c. Attach</td>
</tr>
<tr>
<td>29.</td>
<td>d. Sync</td>
</tr>
<tr>
<td></td>
<td>e. Upload File</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group B</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.</td>
<td>a. Fast Forward</td>
</tr>
<tr>
<td>31.</td>
<td>b. Email</td>
</tr>
<tr>
<td>32.</td>
<td>c. Skip Next</td>
</tr>
<tr>
<td>33.</td>
<td>d. Play</td>
</tr>
<tr>
<td></td>
<td>e. Voicemail</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group C</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.</td>
<td>a. File</td>
</tr>
<tr>
<td>35.</td>
<td>b. Laptop</td>
</tr>
<tr>
<td>36.</td>
<td>c. Folder</td>
</tr>
<tr>
<td>37.</td>
<td>d. Pause</td>
</tr>
<tr>
<td></td>
<td>e. Skip Previous</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group D</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.</td>
<td>a. Ethernet</td>
</tr>
<tr>
<td>39.</td>
<td>b. Flash On</td>
</tr>
<tr>
<td>40.</td>
<td>c. Charging</td>
</tr>
<tr>
<td></td>
<td>d. Power</td>
</tr>
<tr>
<td></td>
<td>e. Connection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group E</th>
<th>Group E</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.</td>
<td>a. Cancel/Close</td>
</tr>
<tr>
<td>43.</td>
<td>b. Save</td>
</tr>
<tr>
<td>44.</td>
<td>c. File</td>
</tr>
<tr>
<td></td>
<td>d. Share</td>
</tr>
<tr>
<td></td>
<td>e. Bluetooth</td>
</tr>
</tbody>
</table>
46. The components of a URL tell us a little about the website itself. For example, the last two letters of this address, http://www.somesite.org.ca, tell us what about the website?
   a. belongs to a commercial enterprise
   b. is Canadian
   c. belongs to an organization
   d. is Californian

47. Boolean logic when used to conduct advanced Internet searches. It includes which of the following operators?
   a. AND, OR, NEAR, and NOT
   b. THE, AND, NEAR, and IS
   c. AND, NOR, NOT, and NEAR
   d. THE, AND, NEAR, and A

48. Images found on the Internet are free to use and distribute.
   a. True
   b. False

49. If you use a link on a webpage to get a file to your computer, it would be best described by which of the following?
   a. Downloading the file
   b. Loading the file
   c. Uploading the file
   d. Posting the file

50. All news sites on the Internet are required to abide by journalistic standards.
   a. True
   b. False

51. What term is used for a short notation that indicates the source of the associated document and normally includes title and authors information?
   a. Citation
   b. Blog
   c. Description
   d. Data

52. Plagiarism is best described as which of the following?
   a. The act of presenting another’s work as your own
   b. The act of preparing another’s work
   c. The act of using another’s notes from class
   d. The act of producing another’s class work

53. Which is not an example of a Periodical?
   a. Newspaper
   b. Journal
   c. Book
   d. Magazine
54. Which of the following includes Author, title, year, volume, and page number but does not include a reference to the issue?

55. Items that can be used to determine website creditability, include: (check all that apply)
   a. Date
   b. Author
   c. Layout
   d. Writing Style
   e. Information Sources

56. A U.S. government website can be identified by the following “top level domain” or TLD?
   a. .gov
   b. .org
   c. .us
   d. .usgov

57. Which of the following is NOT a secondary source?
   a. The book *To Kill a Mockingbird* by Harper Lee
   b. Books about *To Kill a Mockingbird*
   c. A dissertation focused on *To Kill a Mockingbird*
   d. Journal article by John Lanier about *To Kill a Mockingbird*

58. Choose the example of Boolean Logic that is likely yield the greatest number of results from a database search.
   a. Cars or trucks
   b. Cars and trucks
   c. Cars near trucks
   d. Cars not trucks

59. You are required to use peer-reviewed articles for your research paper. Where would you find this academic information?
   a. Journals
   b. Magazines
   c. Books
   d. Blog posts

60. What does the following citation represent?
   a. Book review
   b. Journal article
   c. Literature review
   d. Periodical
61. In the following citation, what does 46(20) represent?
   a. The volume and the number of pages in the article  
   b. The volume and issue number of the article  
   c. The year and issue of the article  
   d. The volume and starting page number of the article

62. What is the best option from the list to find a specific book?
   a. Author or title  
   b. Publisher or call number  
   c. ISBN or ISSN  
   d. Keyword or subject

63. What is the purpose of the ‘Home’ button on a typical Internet browser?
   a. To take the user back to a page viewed previously  
   b. To stop the loading of a page no longer desired  
   c. To navigate a page set by the user or default browser page  
   d. To navigate forward to the next page to be viewed in a session

64. Which best describes the purpose of a server?
   a. A computer that provides services through a network  
   b. A system for business protocols  
   c. A personal storage device  
   d. A networked device for that runs the Linux operating system

65. A EULA is a ____________________.
   a. End User License Agreement  
   b. End User Litigation Assessment  
   c. European Union License Agreement  
   d. European Union Legislation Association

66. An Ethernet cable is used for which action with a computer?
   a. Network connection  
   b. Image transmission  
   c. Connecting a monitor  
   d. Charging

67. A web browser is ________________.
   a. Software to view webpages  
   b. A file sorter  
   c. A system of web page storage  
   d. A user of the Internet

68. The files you save on a computer are stored in the ____________.
   a. RAM  
   b. Hard drive  
   c. CPU  
   d. Storage unit

69. The abbreviation OS stands for ________________.
   a. Operating system  
   b. Open software  
   c. Operating standards  
   d. Open source
70. The .MP4 file extension indicates what type of file?
   a. Image
   b. Movie
   c. Text document
   d. Multi-Part

71. Which is the best option to find where a file has been saved on computer?
   a. Use the operating system search function
   b. Use Find and Replace function
   c. Use a backup service
   d. Use the location function

72. Match the file extension with the file type/label from the appropriate group on the right.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>72. .pptx</td>
<td>75. .rtf</td>
<td>78. .pdf</td>
</tr>
<tr>
<td>73. .docx</td>
<td>76. .csv</td>
<td>79. .html</td>
</tr>
<tr>
<td>74. .mp3</td>
<td>77. .zip</td>
<td>80. .jpg</td>
</tr>
</tbody>
</table>

73. .rtf
74. .csv
75. .zip

74. .mp3
75. .rtf
76. .csv
77. .zip

78. .pdf
79. .html
80. .jpg

76. .csv
77. .zip

78. .pdf
79. .html
80. .jpg

76. .csv
77. .zip

78. .pdf
79. .html
80. .jpg

81. To open a .CSV file you could NOT use which of the following options?
   a. Plain text editor
   b. Microsoft Word
   c. Microsoft Excel
   d. Adobe Photoshop

82. Google sells advertising that is based on its ____________.
   a. Market research
   b. User’s preferences stated in Google services
   c. user’s personal data from the use Google services
   d. marketing goals

83. Specific groups of people identified for a piece of content or message by individual or organization, are known as a ____________.
   a. Target audience
   b. Narrowcasting audience
   c. Demographic response
   d. Audience poll
84. Which is the best description of censorship?
   a. When information is filtered, suppressed, or deleted to hinder freedom of speech
   b. When information is provided to support a specific opinion
   c. When someone tries to influence the opinions or behaviors of others
   d. When false and deceiving information is used to trick others

85. Because the news media monitors the political process. It also referred to as the _________.
   a. Fourth Estate
   b. Balance of Scales
   c. Watchful Eye
   d. Political Balance

86. Which phrase best describes an advertising campaign?
   a. Producing and circulating messages about a product over a specific time period with promotional goals
   b. Producing additional materials for distribution
   c. The goals associated with advertising a product
   d. The theme associated with promoting a product

87. Which is not considered in Mass Media?
   a. Education
   b. News
   c. Advertising
   d. Movies

88. Bias in media can be identified by which of the following? (all that apply)
   a. Balanced coverage
   b. Loaded language
   c. Unchallenged assumptions
   d. Stereotypes
   e. Supported sources

89. Which best describes the term Demographics?
   a. Characteristics by which people are divided into particular social categories
   b. Characteristics dividing research aspects
   c. Images used to illustrate examples
   d. Examples of groups of people in a social group

90. All blogs on the Internet are subject to journalistic standards.
   a. True
   b. False
91. This PETA (People for the Ethical Treatment of Animals) ad compares smoking to eating meat, stating that both increase heart disease and cancer. To achieve this goal, they are using types of persuasion?

a. Bandwagon (everyone is doing it)
b. Humor or Irritation
c. Fear
d. Life Enhancement
e. Rational Choice

92. This ad from the Humane Watch group is attempting to draw attention to the Humane Society’s donation distribution to increase the portion distributed to local shelters or encourage donations to local animal shelters. To achieve this goal, they are using types of persuasion?

a. Bandwagon (everyone is doing it)
b. Humor or Irritation
c. Fear
d. Life Enhancement
e. Rational Choice
Appendix G - CFA Models

4-Factor Model

Communication =~ Q02, Q01, Q03 +Q09, Q10, Q11, Q12, Q13, Q14, Q15, Q76, Q80
Media =~ Q04, Q05, Q06, Q40, Q72, Q73, Q74, Q75, Q77, Q78, Q81, Q82
InfoTech =~ Q07, Q08, Q36, Q38, Q41, Q42, Q43, Q44, Q45, Q46, Q47, Q49, Q50, Q51, Q52, Q79
Information =~ Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34, Q35, Q37, Q39, Q48, Q53, Q54, Q55, Q56, Q57, Q58, Q59, Q60, Q61, Q62, Q63, Q64, Q65, Q66, Q67, Q68, Q69, Q70, Q71'

1-factor Model (includes all items)

ICT =~ Q02, Q01, Q03, Q04, Q05, Q06, Q07, Q08, Q09, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34, Q35, Q36, Q37, Q38, Q39, Q40, Q41, Q42, Q43, Q44, Q45, Q46, Q47, Q48, Q49, Q50, Q51, Q52, Q53, Q54, Q55, Q56, Q57, Q58, Q59, Q60, Q61, Q62, Q63, Q64, Q65, Q66, Q67, Q68, Q69, Q70, Q71, Q72, Q73, Q74, Q75, Q76, Q77, Q78, Q79, Q80, Q81, Q82
4-Factor Model Graphic
1-Factor Model
## Appendix H - Sample Weighting

<table>
<thead>
<tr>
<th>Enrollment 2012</th>
<th>Population % by Gender</th>
<th>Population %</th>
<th>Sample Freq</th>
<th>Sample %</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native: Male</td>
<td>62,900</td>
<td>0.0370</td>
<td>0.00018689</td>
<td>1</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>0.0350</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Indian/Alaska Native: Female</td>
<td>94,900</td>
<td>0.0560</td>
<td>0.00028198</td>
<td>7</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>00</td>
<td></td>
<td>0.00028198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian: Male</td>
<td>479,900</td>
<td>0.0285</td>
<td>0.0142596</td>
<td>11</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian: Female</td>
<td>526,600</td>
<td>0.0313</td>
<td>0.0156472</td>
<td>19</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black/African American: Male</td>
<td>969,700</td>
<td>0.0576</td>
<td>0.0288134</td>
<td>11</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black/African American: Female</td>
<td>1,623,100</td>
<td>0.0965</td>
<td>0.0482284</td>
<td>16</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian/Pacific Islander: Male</td>
<td>25,600</td>
<td>0.0015</td>
<td>0.0007606</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian/Pacific Islander: Female</td>
<td>31,100</td>
<td>0.0018</td>
<td>0.0009240</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White: Male</td>
<td>5,744,900</td>
<td>0.3414</td>
<td>0.1707027</td>
<td>100</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Female</td>
<td>7,268,500</td>
<td>0.4319</td>
<td>0.2159747</td>
<td>122</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTALS</td>
<td>16,827,200</td>
<td>1.00</td>
<td>0.50</td>
<td>287</td>
<td>1.00</td>
</tr>
</tbody>
</table>
## Appendix I - EFA Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Variance</td>
<td>% of Variance</td>
<td>Total Variance</td>
</tr>
<tr>
<td>2</td>
<td>5.067</td>
<td>6.179</td>
<td>4.512</td>
</tr>
<tr>
<td>3</td>
<td>2.169</td>
<td>2.646</td>
<td>1.492</td>
</tr>
<tr>
<td>4</td>
<td>2.068</td>
<td>2.522</td>
<td>1.383</td>
</tr>
<tr>
<td>5</td>
<td>1.765</td>
<td>2.152</td>
<td>1.795</td>
</tr>
<tr>
<td>6</td>
<td>1.722</td>
<td>2.100</td>
<td>1.795</td>
</tr>
<tr>
<td>7</td>
<td>1.610</td>
<td>1.963</td>
<td>1.795</td>
</tr>
<tr>
<td>8</td>
<td>1.576</td>
<td>1.922</td>
<td>1.795</td>
</tr>
<tr>
<td>9</td>
<td>1.532</td>
<td>1.868</td>
<td>1.795</td>
</tr>
<tr>
<td>10</td>
<td>1.472</td>
<td>1.795</td>
<td>1.795</td>
</tr>
<tr>
<td>11</td>
<td>1.464</td>
<td>1.786</td>
<td>1.795</td>
</tr>
<tr>
<td>12</td>
<td>1.417</td>
<td>1.728</td>
<td>1.795</td>
</tr>
<tr>
<td>13</td>
<td>1.392</td>
<td>1.698</td>
<td>1.795</td>
</tr>
<tr>
<td>14</td>
<td>1.323</td>
<td>1.613</td>
<td>1.795</td>
</tr>
<tr>
<td>15</td>
<td>1.320</td>
<td>1.610</td>
<td>1.795</td>
</tr>
<tr>
<td>16</td>
<td>1.282</td>
<td>1.564</td>
<td>1.795</td>
</tr>
<tr>
<td>17</td>
<td>1.231</td>
<td>1.501</td>
<td>1.795</td>
</tr>
<tr>
<td>18</td>
<td>1.190</td>
<td>1.451</td>
<td>1.795</td>
</tr>
<tr>
<td>19</td>
<td>1.177</td>
<td>1.435</td>
<td>1.795</td>
</tr>
<tr>
<td>20</td>
<td>1.143</td>
<td>1.394</td>
<td>1.795</td>
</tr>
<tr>
<td>21</td>
<td>1.111</td>
<td>1.355</td>
<td>1.795</td>
</tr>
<tr>
<td>22</td>
<td>1.084</td>
<td>1.322</td>
<td>1.795</td>
</tr>
<tr>
<td>23</td>
<td>1.079</td>
<td>1.315</td>
<td>1.795</td>
</tr>
<tr>
<td>24</td>
<td>1.024</td>
<td>1.249</td>
<td>1.795</td>
</tr>
<tr>
<td>25</td>
<td>1.009</td>
<td>1.230</td>
<td>1.795</td>
</tr>
<tr>
<td>26</td>
<td>.990</td>
<td>1.207</td>
<td>1.795</td>
</tr>
<tr>
<td>27</td>
<td>.980</td>
<td>1.196</td>
<td>1.795</td>
</tr>
<tr>
<td>28</td>
<td>.920</td>
<td>1.122</td>
<td>1.795</td>
</tr>
<tr>
<td>29</td>
<td>.918</td>
<td>1.119</td>
<td>1.795</td>
</tr>
<tr>
<td>30</td>
<td>.891</td>
<td>1.086</td>
<td>1.795</td>
</tr>
<tr>
<td>31</td>
<td>.867</td>
<td>1.057</td>
<td>1.795</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>32</td>
<td>.860</td>
<td>1.049</td>
<td>74.034</td>
</tr>
<tr>
<td>33</td>
<td>.821</td>
<td>1.001</td>
<td>75.035</td>
</tr>
<tr>
<td>34</td>
<td>.797</td>
<td>.972</td>
<td>76.007</td>
</tr>
<tr>
<td>35</td>
<td>.779</td>
<td>.950</td>
<td>76.958</td>
</tr>
<tr>
<td>36</td>
<td>.747</td>
<td>.911</td>
<td>77.869</td>
</tr>
<tr>
<td>37</td>
<td>.729</td>
<td>.890</td>
<td>78.759</td>
</tr>
<tr>
<td>38</td>
<td>.709</td>
<td>.864</td>
<td>79.623</td>
</tr>
<tr>
<td>39</td>
<td>.693</td>
<td>.845</td>
<td>80.468</td>
</tr>
<tr>
<td>40</td>
<td>.669</td>
<td>.816</td>
<td>81.285</td>
</tr>
<tr>
<td>41</td>
<td>.657</td>
<td>.802</td>
<td>82.086</td>
</tr>
<tr>
<td>42</td>
<td>.628</td>
<td>.765</td>
<td>82.852</td>
</tr>
<tr>
<td>43</td>
<td>.614</td>
<td>.749</td>
<td>83.601</td>
</tr>
<tr>
<td>44</td>
<td>.608</td>
<td>.741</td>
<td>84.342</td>
</tr>
<tr>
<td>45</td>
<td>.600</td>
<td>.731</td>
<td>85.073</td>
</tr>
<tr>
<td>46</td>
<td>.592</td>
<td>.722</td>
<td>85.795</td>
</tr>
<tr>
<td>47</td>
<td>.583</td>
<td>.711</td>
<td>86.507</td>
</tr>
<tr>
<td>48</td>
<td>.560</td>
<td>.683</td>
<td>87.189</td>
</tr>
<tr>
<td>49</td>
<td>.518</td>
<td>.632</td>
<td>87.821</td>
</tr>
<tr>
<td>50</td>
<td>.508</td>
<td>.620</td>
<td>88.441</td>
</tr>
<tr>
<td>51</td>
<td>.497</td>
<td>.606</td>
<td>89.047</td>
</tr>
<tr>
<td>52</td>
<td>.488</td>
<td>.595</td>
<td>89.642</td>
</tr>
<tr>
<td>53</td>
<td>.485</td>
<td>.591</td>
<td>90.232</td>
</tr>
<tr>
<td>54</td>
<td>.453</td>
<td>.552</td>
<td>90.785</td>
</tr>
<tr>
<td>55</td>
<td>.447</td>
<td>.545</td>
<td>91.330</td>
</tr>
<tr>
<td>56</td>
<td>.434</td>
<td>.530</td>
<td>91.860</td>
</tr>
<tr>
<td>57</td>
<td>.419</td>
<td>.511</td>
<td>92.371</td>
</tr>
<tr>
<td>58</td>
<td>.402</td>
<td>.490</td>
<td>92.861</td>
</tr>
<tr>
<td>59</td>
<td>.398</td>
<td>.485</td>
<td>93.346</td>
</tr>
<tr>
<td>60</td>
<td>.370</td>
<td>.451</td>
<td>93.797</td>
</tr>
<tr>
<td>61</td>
<td>.356</td>
<td>.434</td>
<td>94.231</td>
</tr>
<tr>
<td>62</td>
<td>.354</td>
<td>.431</td>
<td>94.662</td>
</tr>
<tr>
<td>63</td>
<td>.339</td>
<td>.413</td>
<td>95.076</td>
</tr>
<tr>
<td>64</td>
<td>.323</td>
<td>.394</td>
<td>95.469</td>
</tr>
<tr>
<td>65</td>
<td>.297</td>
<td>.362</td>
<td>95.831</td>
</tr>
<tr>
<td>66</td>
<td>.290</td>
<td>.354</td>
<td>96.185</td>
</tr>
<tr>
<td>67</td>
<td>.282</td>
<td>.344</td>
<td>96.529</td>
</tr>
<tr>
<td>68</td>
<td>.281</td>
<td>.342</td>
<td>96.871</td>
</tr>
<tr>
<td>69</td>
<td>.260</td>
<td>.317</td>
<td>97.188</td>
</tr>
<tr>
<td>70</td>
<td>.247</td>
<td>.302</td>
<td>97.490</td>
</tr>
<tr>
<td>71</td>
<td>.242</td>
<td>.295</td>
<td>97.785</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----</td>
<td>-----</td>
<td>---------</td>
</tr>
<tr>
<td>72</td>
<td>.222</td>
<td>.271</td>
<td>98.056</td>
</tr>
<tr>
<td>73</td>
<td>.220</td>
<td>.268</td>
<td>98.324</td>
</tr>
<tr>
<td>74</td>
<td>.210</td>
<td>.256</td>
<td>98.580</td>
</tr>
<tr>
<td>75</td>
<td>.201</td>
<td>.245</td>
<td>98.825</td>
</tr>
<tr>
<td>76</td>
<td>.186</td>
<td>.227</td>
<td>99.052</td>
</tr>
<tr>
<td>77</td>
<td>.162</td>
<td>.197</td>
<td>99.249</td>
</tr>
<tr>
<td>78</td>
<td>.152</td>
<td>.185</td>
<td>99.435</td>
</tr>
<tr>
<td>79</td>
<td>.139</td>
<td>.170</td>
<td>99.605</td>
</tr>
<tr>
<td>80</td>
<td>.129</td>
<td>.157</td>
<td>99.762</td>
</tr>
<tr>
<td>81</td>
<td>.107</td>
<td>.130</td>
<td>99.892</td>
</tr>
<tr>
<td>82</td>
<td>.089</td>
<td>.108</td>
<td>100.000</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.
Appendix J - Modified ICT Assessment Instrument

Information & Communications Technology Assessment

ICT Questions

Please choose the most appropriate answer for each question. Those that have multiple answers are indicated.

1. Consider the following scenario: Your class assignment is to prepare a PowerPoint presentation. There are important guidelines that you should consider when using the PowerPoint program. General effectiveness rules for creating a presentation include: (select all that apply)
   a. Include as much text as possible for clarity
   b. Add images to emphasize the message
   c. Keep text to the point and minimal
   d. Always include your name on the slide
   e. Use complementarity colors that are not distracting

2. Social Networks (such as Facebook and Twitter) receive revenues through _________.
   a. User Fees
   b. Corporate sponsors
   c. Grants
   d. Advertising

3. Headlines of online news articles are always representative of the content of the article.
   a. True
   b. False

4. Digital Footprint refers to
   a. The data that you leave behind on the Internet
   b. The data that is contained in your Facebook profile
   c. The storage space need to save your documents
   d. The energy that you consume to use the Internet

5. News shared on social media ___________. (check all that apply)
   a. Can be biased in nature
   b. Can represent variety of topics
   c. Is always factual and accurate
   d. Is sponsored by the government
6. In which time period did all fruit sales increase?

- February to March
- January to February
- March to April
- April to May

7. Online communication methods require the same exact set considerations as face-to-face communications.
   - True
   - False

8. Online communication may be best received and understood, if you are __________.
   - clear and detailed
   - unfamiliar to the audience
   - Positive and outgoing
   - Cheerful and to the point

9. Discussion boards or forums are used for which action?
   - Exchange ideas on a specific topic with a group
   - Authoring a document with a group
   - Microbloging
   - Posting document to share

10. To communicate data different visuals can be used. Which of the following is least likely to be used to display numerical data?
    - Venn diagram
    - Bar chart
    - Pie chart
    - Line graph

11. When communicating or presenting ideas, which of the following should be primary the consideration?
    - The audience or recipient
    - the presentation software
    - the slide transitions
    - the time allowed
Match the following common icons used in software and web applications to the most appropriate text label. For each Icon Group use the corresponding Answer Group on the right.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
<th>Group E</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Icon](122x608 to 147x633)</td>
<td>![Icon](205x608 to 229x633)</td>
<td>![Icon](122x579 to 147x603)</td>
<td>![Icon](205x579 to 229x603)</td>
<td>![Icon](122x530 to 147x554)</td>
</tr>
<tr>
<td>![Icon](205x530 to 229x554)</td>
<td>![Icon](122x500 to 147x524)</td>
<td>![Icon](205x500 to 229x524)</td>
<td>![Icon](122x451 to 147x475)</td>
<td>![Icon](205x451 to 229x475)</td>
</tr>
<tr>
<td>![Icon](122x420 to 147x445)</td>
<td>![Icon](205x421 to 229x445)</td>
<td>![Icon](122x371 to 147x395)</td>
<td>![Icon](205x371 to 229x395)</td>
<td>![Icon](122x342 to 147x366)</td>
</tr>
<tr>
<td>![Icon](122x288 to 147x313)</td>
<td>![Icon](205x288 to 229x313)</td>
<td>![Icon](122x261 to 144x283)</td>
<td>![Icon](205x259 to 229x283)</td>
<td><img src="304x39" alt="Icon" /></td>
</tr>
</tbody>
</table>

Group A
-  a. Reload/Refresh
-  b. Share
-  c. Attach
-  d. Sync
-  e. Upload File

Group B
-  a. Fast Forward
-  b. Email
-  c. Skip Next
-  d. Play
-  e. Voicemail

Group C
-  a. File
-  b. Laptop
-  c. Folder
-  d. Pause
-  e. Skip Previous

Group D
-  a. Ethernet
-  b. Flash On
-  c. Charging
-  d. Power
-  e. Connection

Group E
-  a. Cancel/Close
-  b. Save
-  c. File
-  d. Share
-  e. Bluetooth
31. The components of a URL tell us a little about the website itself. For example, the last two letters of this address, http://www.somesite.org.ca, tell us what about the website?
   a. belongs to a commercial enterprise
   b. is Canadian
   c. belongs to an organization
   d. is Californian
32. Boolean logic when used to conduct advanced Internet searches. It includes which of the following operators?
   a. AND, OR, NEAR, and NOT
   b. THE, AND, NEAR, and IS
   c. AND, NOR, NOT, and NEAR
   d. THE, AND, NEAR, and A
33. Images found on the Internet are free to use and distribute.
   a. True
   b. False
34. If you use a link on a webpage to get a file to your computer, it would be best described by which of the following?
   a. Downloading the file
   b. Loading the file
   c. Uploading the file
   d. Posting the file
35. All news sites on the Internet are required to abide by journalistic standards.
   a. True
   b. False
36. What term is used for a short notation that indicates the source of the associated document and normally includes title and authors information?
   a. Citation
   b. Blog
   c. Description
   d. Data
37. Plagiarism is best described as which of the following?
   a. The act of presenting another’s work as your own
   b. The act of preparing another’s work
   c. The act of using another’s notes from class
   d. The act of producing another’s class work
38. Which is not an example of a Periodical?
   a. Newspaper
   b. Journal
   c. Book
   d. Magazine
39. A U.S. government website can be identified by the following “top level domain” or TLD?
   a. .gov
   b. .org
   c. .us
   d. .usgov

40. Which of the following is NOT a secondary source?
   a. The book To Kill a Mockingbird by Harper Lee
   b. Books about To Kill a Mockingbird
   c. A dissertation focused on To Kill a Mockingbird
   d. Journal article by John Lanier about To Kill a Mockingbird

41. You are required to use peer-reviewed articles for your research paper. Where would you find this academic information?
   a. Journals
   b. Magazines
   c. Books
   d. Blog posts

42. In the following citation, what does 46(20) represent?
   a. The volume and the number of pages in the article
   b. The volume and issue number of the article
   c. The year and issue of the article
   d. The volume and starting page number of the article

43. What is the best option from the list to find a specific book?
   a. Author or title
   b. Publisher or call number
   c. ISBN or ISSN
   d. Keyword or subject

44. What is the purpose of the ‘Home’ button on a typical Internet browser?
   a. To take the user back to a page viewed previously
   b. To stop the loading of a page no longer desired
   c. To navigate a page set by the user or default browser page
   d. To navigate forward to the next page to be viewed in a session

45. Which best describes the purpose of a server?
   a. A computer that provides services through a network
   b. A system for business protocols
   c. A personal storage device
   d. A networked device for that runs the Linux operating system

46. A EULA is a ________________.
   a. End User License Agreement
   b. End User Litigation Assessment
   c. European Union License Agreement
   d. European Union Legislation Association

47. An Ethernet cable is used for which action with a computer?
   a. Network connection
   b. Image transmission
   c. Connecting a monitor
   d. Charging
48. A web browser is ________________.
   a. Software to view webpages
   b. A file sorter
   c. A system of web page storage
   d. A user of the Internet

49. The files you save on a computer are stored in the _________.
   a. RAM
   b. Hard drive
   c. CPU
   d. Storage unit

50. The abbreviation OS stands for ____________.
   a. Operating system
   b. Open software
   c. Operating standards
   d. Open source

51. The .MP4 file extension indicates what type of file?
   a. Image
   b. Movie
   c. Text document
   d. Multi-Part

52. Which is the best option to find where a file has been saved on computer?
   a. Use the operating system search function
   b. Use Find and Replace function
   c. Use a backup service
   d. Use the location function

Match the file extension with the file type/label from the appropriate group on the right.

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>53. .pptx</td>
<td>a. Compression format</td>
<td>a. Adobe Photoshop</td>
</tr>
<tr>
<td>54. .docx</td>
<td>b. MPEG Layer 3</td>
<td>b. Adobe Portable Document Format</td>
</tr>
<tr>
<td>55. .mp3</td>
<td>c. Microsoft Publisher</td>
<td>c. Joint Photographic Experts Group</td>
</tr>
<tr>
<td></td>
<td>d. MS Office Open XML Text Document</td>
<td>d. Hypertext Markup Language</td>
</tr>
<tr>
<td></td>
<td>e. MS Office Open XML Presentation</td>
<td>e. Multimedia File Format</td>
</tr>
</tbody>
</table>
62. Google sells advertising that is based on its _____________.
   a. Market research
   b. User’s preferences stated in Google services
   c. user’s personal data from the use Google services
   d. marketing goals

63. Specific groups of people identified for a piece of content or message by individual or organization, are known as a _____________.
   a. Target audience
   b. Narrowcasting audience
   c. Demographic response
   d. Audience poll

64. Which is the best description of censorship?
   a. When information is filtered, suppressed, or deleted to hinder freedom of speech
   b. When information is provided to support a specific opinion
   c. When someone tries to influence the opinions or behaviors of others
   d. When false and deceiving information is used to trick others

65. Which phrase best describes an advertising campaign?
   a. Producing and circulating messages about a product over a specific time period with promotional goals
   b. Producing additional materials for distribution
   c. The goals associated with advertising a product
   d. The theme associated with promoting a product

66. Which is not considered in Mass Media?
   a. Education
   b. News
   c. Advertising
   d. Movies

67. Which best describes the term Demographics?
   a. Characteristics by which people are divided into particular social categories
   b. Characteristics dividing research aspects
   c. Images used to illustrate examples
   d. Examples of groups of people in a social group

68. All blogs on the Internet are subject to journalistic standards.
   a. True
   b. False
69. This PETA (People for the Ethical Treatment of Animals) ad compares smoking to eating meat, stating that both increase heart disease and cancer. To achieve this goal, they are using types of persuasion?

a. Bandwagon (everyone is doing it)
b. Humor or Irritation
c. Fear
d. Life Enhancement
e. Rational Choice