CRITICAL THINKING SKILLS AND INFORMATION LITERACY SKILLS:
DISCERNING ONLINE INFORMATION AMONG HIGH SCHOOL STUDENTS

by
Patricia Ann Flood
Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
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APPROVED BY:

Gary Kuhne, Ed.D., Committee Chair

Ralph Marino, Jr. Ed.D., Committee Member

Mark Long, Ed.D., Committee Member

Scott Watson, Ph.D., Associate Dean, Advanced Programs
ABSTRACT

This study examined the impact of discerning information accessed on the Internet that is authentic, reliable, and valid as facilitated by a 1:1 iPad program on students’ critical thinking skills and information literacy skills. Students enrolled in a Career Magnet School where each student has an iPad to receive and deliver assignments were measured on their critical thinking skills in solving real-world problems using the Test of Everyday Reasoning (TER). Their information literacy skills were measured using iSkills which is based on real-world problem solving through digital means. Students enrolled in a traditional high school with limited exposure to the Internet were tested with the same instruments. The review of literature stated that students show a gap in discerning useful information on the Internet in comparison to valid information. This study explored students’ critical thinking and information literacy skills and their ability to discern the information as valid, reliable, and authentic as accessed from the Internet. Failure to reject the null hypothesis was applied to each null hypothesis. One of the factors may have been due to the small sample size.

Keywords: critical thinking skills, information literacy skills, 1:1 iPad program, Internet, Test of Everyday Reasoning, iSkills
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# Table of Contents

ABSTRACT........................................................................................................................................3

Acknowledgments ..........................................................................................................................4

List of Tables ..................................................................................................................................9

List of Abbreviations ......................................................................................................................10

CHAPTER ONE: INTRODUCTION .................................................................................................11

Background ....................................................................................................................................11

Problem Statement .......................................................................................................................14

Purpose Statement ........................................................................................................................15

Significance of the Study ...............................................................................................................16

Research Questions .....................................................................................................................17

Null Hypotheses ..........................................................................................................................20

Definitions .....................................................................................................................................22

CHAPTER TWO: LITERATURE REVIEW .......................................................................................26

Introduction ....................................................................................................................................26

Gaps in Literature ..........................................................................................................................27

Theoretical Framework ................................................................................................................28

Characteristics of a Critical Thinker ............................................................................................29

Contributors to Critical Thinking Skills .....................................................................................30

Critical Thinking and Education ..................................................................................................32

Critical Thinking and Students ...................................................................................................33

Literacy Skills ................................................................................................................................35

Information Literacy ....................................................................................................................37
Challenges to Information Literacy ................................................................. 38
Critical Thinking Skills and Information Literacy ............................................. 40
Access to Information Via the Internet ............................................................. 41
How Current Literacy Issues Differ From 20th Century ...................................... 44
Role of Technology in Critical Thinking Skills ................................................. 45
1:1 Programs and Information Literacy Skills .................................................... 46
Framework for Maximum Learning ................................................................... 48
Assessment of Critical Thinking ....................................................................... 52
  Standardized assessments ............................................................................... 52
Assessment of Information Literacy ................................................................... 53
Summary ............................................................................................................ 54
CHAPTER THREE: METHODS ........................................................................... 56
  Design ........................................................................................................... 56
  Research Questions ....................................................................................... 57
Null Hypotheses ............................................................................................... 59
Participants and Setting .................................................................................... 62
Instrumentation ............................................................................................... 65
Procedures ....................................................................................................... 67
Data Analysis ................................................................................................... 68
CHAPTER FOUR: FINDINGS ............................................................................ 69
  Research Questions ....................................................................................... 69
Null Hypotheses ............................................................................................... 72
Descriptive Statistics ....................................................................................... 75
APPENDIX A ......................................................................................................................... 128
APPENDIX B .......................................................................................................................... 129
APPENDIX C .......................................................................................................................... 130
APPENDIX D .......................................................................................................................... 133
APPENDIX E .......................................................................................................................... 134
List of Tables

Table 1: Courses at High School and Magnet School ............................................................ 65
Table 2: Summary of Descriptive Statistics for CMS and HS Students ..................................... 75
Table 3: Results of Overall Analysis Skills of HS Students on iSkills ..................................... 79
Table 4: Results of Overall Analysis Skills of HS Students on TER .................................... 80
Table 5: Results of Analysis Subtest on TER ........................................................................ 82
Table 6: Results of Inference Subtest on TER ........................................................................ 83
Table 7: Results of Evaluate Subtest on TER ........................................................................ 85
Table 8: Results of Induction Subtest on TER ........................................................................ 86
Table 9: Results of Deduction Subtest on TER ..................................................................... 87
Table 10: Results of Define Subtest on iSkills ...................................................................... 89
Table 11: Results of Access Subtest on iSkills ..................................................................... 90
Table 12: Results of Evaluate Subtest on iSkills .................................................................. 92
Table 13: Results of Manage Subtest on iSkills ................................................................... 94
Table 14: Results of Integrate Subtest on iSkills .................................................................. 95
Table 15: Results of Create Subtest on iSkills ..................................................................... 97
Table 16: Results of Communicate Subtest on iSkills ............................................................ 99
List of Abbreviations

California Critical Thinking Skills Test (CCTST)
Career Magnet School (CMS)
Children’s Internet Protection Act (CIPA)
Cornell Critical Thinking Test (CCTT)
Information and Communication Technology (ICT)
Institutional Review Board (IRB)
Reflective Online Searching System (ROSS)
Science, Technology, Engineering, Mathematics (STEM)
Tasks in Critical Thinking (TCT)
Test of Everyday Reasoning (TER)
Watson-Glaser Critical Thinking Appraisal (WGCTA)
CHAPTER ONE: INTRODUCTION

Background

Technology has reorganized how individuals live, communicate, and learn (Tan & Guo, 2010). The information age has brought improvements in learning as well as challenges to the education environment. The volume of information that individuals must sift through is extensive. Sorting through the information for authenticity, reliability, and validity is a challenging task for mature adults no less for high school students who rely on information accessed through the Internet to complete research papers and projects. Students may have access to technology tools and be familiar with them in the context of entertainment and basic skills, but that does not necessarily mean they are adept at finding the information they need for a specific task (Gibson, 2012; Shantaram, 2012).

Critical thinking skills are coming to the forefront as students are challenged to be prepared for jobs and careers that have not yet been established. They need to be able to learn and make sense of new information and use it in a creative manner (Akyuz & Samsa, 2009). Critical thinking skills are essential for students to analyze, synthesize, evaluate, and reason through information. After going through such a process, the goal is to generalize, transfer, and apply that knowledge from one context to another (Limberg, Sundin, & Talja, 2012). Snyder and Snyder (2008) remarked that studies show students who engage in critical thinking skills bring valuable attributes to the work place. Since students are not naturally inclined to think critically, it is the task of the schools to fulfill the role of preparation and development of critical thinking skills in students (Angeli & Valanides, 2008).

To compound the challenge of developing critical thinking skills in students, the information age has brought about the need for students to acquire information literacy skills so
they can successfully navigate the plethora of information on the Internet. This information has become less controlled by experts which consequently requires students to have the ability to identify, locate, evaluate, and effectively use information accessed from the Internet (Eisenberg, McGuire, & Spitzer, 2004; Leu et al., 2011). Further, students then must make connections from one source to another (Transue, 2013).

Critical thinking skills are intertwined with information literacy skills, but information literacy skills are not a necessary component of critical thinking skills (Albitz, 2007). Information literacy promotes the development of critical thinking skills and enhances the opportunity for individuals to be more self-directed and have greater control over their learning (Shantaram, 2012). While research shows that students have an ease and familiarity with technology, it is not matched by their ability to evaluate Internet sources correctly. Exposure to technology does not automatically equate to proficiency in technology (Gibson, 2012). Studies show that students’ perceptions of their information literacy skills are inflated (Leung, 2009; Smith, 2013).

Schools are rapidly implementing 1:1 programs and other types of technology integration into their educational setting (Spector-Levy & Granot-Gilat, 2012). An assumption would be that those students involved with the programs have well-developed information literacy skills; however, this is not the case as can be seen with several studies (Gibson, 2012; Leung, 2009; Smith, 2013). Just as critical thinking skills are not innate and must be taught, information literacy skills must also be taught (Snyder & Snyder, 2008).

The purpose of this study is to add to the field of research in examining 1:1 programs and the effect they have on critical thinking and information literacy skills in regards to accessing and evaluating information from the Internet. Investigating students who are currently in a 1:1
iPad program with students who have exposure to technology in a traditional high school classroom will give a comparison of these fundamental skills and give insight into helping educators understand the present needs for each group. This chapter will present relevant background information regarding current research in critical thinking and information literacy skills as well as 1:1 programs. The problem and purpose statements, significance of the study, research questions and corresponding hypotheses, identification of variables, definitions, and research summary are also included.

The theory used in this research is the constructivist theory developed by Piaget. The premise to constructivism is that children construct knowledge from prior experiences with the learner at the center of that learning experience (M. Allen, 2008). When students process information through the Internet, they are using prior knowledge to assimilate information into existing knowledge. Undertaking this task with an abundance of information, new information is assimilated to ascertain conclusions or form judgments (M. Allen, 2008). The teacher serves as a guide through this process.

Constructivism perpetuates self-directed learning which is one of the outcomes of critical thinking and information literacy skills (Shantaram, 2012). Students ask questions about the material and are exposed to information that will expand their knowledge (Adams, 2006). The student is incorporating problem solving, self-inquiry, and personal reflection to construct knowledge and joins the common task of critical thinking skills and information literacy skills in constructing knowledge (Vogel-Walcutt, Gebrim, Bowers, Carper, & Nicholson, 2011).

As applied to my study, this theory posits that I would expect the independent variables of the 1:1 iPad program and traditional high school setting to explain the dependent variables because the learner in the iPad program is exposed to information accessed from the Internet at a
much greater rate than the learner who has access in a traditional high school program. The learner in both cases constructs knowledge from that accessed information, but they may be lacking in the ability to identify whether it is valid, reliable, and authentic. If a student is to be self-directed in his or her learning, difficulty may be encountered as he or she attempts to use viable information from the Internet where it is not processed through an editor or have gone through peer review.

**Problem Statement**

The problem is that assumptions are made concerning students’ knowledge base for evaluating information from the Internet as being valid, reliable, and authentic (Akyuz & Samsa, 2009; Bouhnik & Giat, 2009; Mackey & Johnson, 2011; Miri, David, & Uri, 2007). Accessibility or exposure does not equate to proficiency in discerning this information. Students prove to be enthusiastic about technology but do not display the skills to match (Marcus, 2009). Also, there are few studies that focus on Internet use in the K-12 classroom (Shively & VanFossen, 2009). Examining a 1:1 iPad program and measuring the critical thinking and information literacy skills of high school students can bring further insight into the effectiveness of these programs on the skills in discerning information accessed from the Internet compared to students who do not have such continuous access or exposure.

This study seeks to build and add to existing research of students’ ability to discern information as reliable, valid, and authentic as accessed from the Internet and to use it effectively. Researching whether or not exposure to technology affects those skills is also part of the study. Studies show varied results of the effectiveness of such programs on these skills and some have not allowed the program to have sufficient time for implementation (Holcomb & Gahala, 2001; Hobbs, 2011; McMahon, 2009; Spector-Levy & Granot-Gilat, 2012).
Purpose Statement

The purpose of this ex post facto study is to determine if high school students enrolled in a 1:1 iPad program demonstrated a difference in critical thinking and information literacy skills through accessing information from the Internet compared to students who are enrolled in a traditional high school program and have limited access to the Internet. The findings of such a study will assist educators in determining whether or not exposure to information from the Internet equals the ability for them to discern its reliability, validity, and authenticity. With the challenge of an overabundance of information that is questionable in quality, the solution cannot be limited to improving technology instruction, rather there needs to be an increased need for students to have stronger information literacy skills (Katz, 2008).

The findings of this study will provide empirical data to 1:1 iPad programs in regards to the significance of differences between students’ critical thinking skills and information literacy skills who are enrolled in a 1:1 program and those students enrolled in a traditional high school setting and their ability to discern information from the Internet as valid, reliable, and authentic. The results will give evidence to further studies to track such programs and evaluate their effectiveness in relation to critical thinking and information literacy skills. It will also lead to awareness that students need to be instructed to discern valid, reliable, and authentic information from the Internet.

The independent variable will be generally defined as a 1:1 iPad program where each student enrolled at the Career Magnet School (CMS) has his or her own iPad to use for educational purposes to receive, formulate, and deliver assignments (Education World, n.d.). The majority of assignments are project-based, and the students are considered to be at the center of the learning process and responsible for their learning. The traditional high school classroom
setting encompasses a mixture of lecture format and taking notes with limited access to the Internet where teachers are considered an important part of the learning process. Assignments may be project-based, but the majority are either accomplished through the means of worksheets or writing papers (Consumaster, n.d.).

The dependent variable of critical thinking skills will be generally defined as analyzing, synthesizing, evaluating, and reasoning through information with the goal to apply knowledge and transfer it to other settings (Limberg et al., 2012). The other dependent variable, information literacy skills, will be generally defined as the ability to recognize information and to locate, evaluate, manage, and use it effectively through digital means (Association of College Research Libraries, 2000).

**Significance of the Study**

Changes in society come about with the passing of time. Innovation can be a driving factor in how society responds. Technology has been one of the driving factors in rethinking literacy. It has required educational institutions to respond, cope, and change to this transition (Spektor-Levy & Granot-Gilat, 2012). Information is no longer presented as static pages with words, but rather a multitude of pages that can be opened at one time and accessed very quickly (Leu et al., 2011).

While information literacy is not a new term, it is one that has been refined, redefined, and expanded upon to include the ability to “locate, evaluate, manage, and use effectively the needed information” in the context of technology and the availability of digital tools and access to the Internet (Association of College Research Libraries, 2000, para. 1; Holum & Gahala, 2001). It has forced educators to take a closer look at gaps in skills and to teach skills that never existed before this time (Kingsley & Boone, 2009; Marcus, 2009; Shively & VanFossen, 2009;
Tan & Guo, 2010; van Deursen & van Dijk, 2010). The task of the educator is to help the learner acquire the learning skills to enable him or her to “locate the information, process it, and present new knowledge” (Spektor-Levy & Granot-Gilat, 2013, p. 84).

With the onslaught of devices being used in the educational setting, researching students’ critical thinking skills and information literacy skills is imperative if students are to benefit beyond the task of inputting information and expecting valid output without discerning the information in an intellectual manner and evaluating its reliability and validity. Placing a device in their hands does not automatically make them into skilled users of the information presented to them. Saljo (1999) stated that people react to the tools available and that their thinking practices are shaped through their interaction with the tools. If thinking is not shaped purposely and intentionally for students, they run the risk of using tools that will not effectively help their thinking skills and fall under the false impression that they have a grasp on skills that are illusive (Leung, 2009; Smith, 2013). Students in 1:1 programs may have the greater perception of being adept in these literacies due to their exposure to digital tools. By investigating existing critical thinking skills and information literacy skills in the absence and also in the presence of these tools, educated conclusions can be drawn as to how to fill in the gaps of student learning that aligns with this new way of gaining information.

**Research Questions**

**RQ1:** Is there a statistically significant difference in high school students’ critical thinking and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in 1:1 iPad programs compared to high school students’ critical thinking and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills?
**RQ2:** Is there a statistically significant difference in high school students’ analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ analysis scores on the TER who are enrolled in a traditional high school setting?

**RQ3:** Is there a statistically significant difference in high school students’ inference scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ inference scores on the TER who are enrolled in a traditional high school setting?

**RQ4:** Is there a statistically significant difference in high school students’ evaluation scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the TER who are enrolled in a traditional high school setting?

**RQ5:** Is there a statistically significant difference in high school students’ induction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ induction scores on the TER who are enrolled in a traditional high school setting?

**RQ6:** Is there a statistically significant difference in high school students’ deduction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ deduction scores on the TER who are enrolled in a traditional high school setting?

**RQ7:** Is there a statistically significant difference in high school students’ definition scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school
students’ definition scores on the iSkills assessment who are enrolled in a traditional high school setting?

RQ8: Is there a statistically significant difference in high school students’ access scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ access scores on the iSkills assessment who are enrolled in a traditional high school setting?

RQ9: Is there a statistically significant difference in high school students’ evaluation scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the iSkills assessment who are enrolled in a traditional high school setting?

RQ10: Is there a statistically significant difference in high school students’ management scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ management scores on the iSkills assessment who are enrolled in a traditional high school setting?

RQ11: Is there a statistically significant difference in high school students’ integration scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ integration scores on the iSkills assessment who are enrolled in a traditional high school setting?

RQ12: Is there a statistically significant difference in high school students’ creative scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ creative scores on the iSkills assessment who are enrolled in a traditional high school setting?
RQ13: Is there a statistically significant difference in high school students’ communication scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting?

Null Hypotheses

The null hypotheses for this study are:

H₀₁: There will not be a statistically significant difference in high school students’ information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ information literacy skills who are enrolled in a traditional high school setting as measured by iSkills.

H₀₂: There will not be a statistically significant difference in high school students’ critical thinking skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER).

H₀₃: There will not be a statistically significant difference between high school students’ critical thinking skills and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills.

H₀₄: There will not be a statistically significant difference in high school students’ analysis skills who are involved in a 1:1 iPad program compared to high school students’ analysis skills who are enrolled in a traditional high school setting as measured by the TER.
**H₀5:** There will not be a statistically significant difference in high school students’ inference skills who are involved in a 1:1 iPad program compared to high school students’ inference skills who are enrolled in a traditional high school setting as measured by the TER.

**H₀6:** There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by TER.

**H₀7:** There will not be a statistically significant difference in high school students’ induction skills who are involved in a 1:1 iPad program compared to high school students’ induction skills who are enrolled in a traditional high school setting as measured by TER.

**H₀8:** There will not be a statistically significant difference in high school students’ deduction skills who are involved in a 1:1 iPad program compared to high school students’ deduction skills who are enrolled in a traditional high school setting as measured by TER.

**H₀9:** There will not be a statistically significant difference in high school students’ definition skills who are involved in a 1:1 iPad program compared to high school students’ definition skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀10:** There will not be a statistically significant difference in high school students’ access skills who are involved in a 1:1 iPad program compared to high school students’ access skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀11:** There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by iSkills.
**H₀₁₂:** There will not be a statistically significant difference in high school students’ management skills who are involved in a 1:1 iPad program compared to high school students’ management skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀₁₃:** There will not be a statistically significant difference in high school students’ integration skills who are involved in a 1:1 iPad program compared to high school students’ integration skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀₁₄:** There will not be a statistically significant difference in high school students’ creative skills who are involved in a 1:1 iPad program compared to high school students’ creative skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀₁₅:** There will not be a statistically significant difference in high school students’ communication skills who are involved in a 1:1 iPad program compared to high school students’ communication skills who are enrolled in a traditional high school setting as measured by iSkills.

**Definitions**

1. **1:1 program**- Each student has a personal computer, laptop, handheld device or digital tablet for the purpose of educational enrichment and learning (Education World, n.d.).

2. **21st century skills**- A set of competency skills that students must reflect in order to be prepared for the life and work environment of the 21st century. These skills include creativity, innovation, critical thinking, problem solving, communication, and collaboration. It is also important that individuals are literate in information, media, and information, communication and technology (ICT) to be successful in the 21st century (Partnership for 21st Century Skills, 2009).
3. **Constructivism**- As developed by Piaget, constructivism is the theory that the learner should be placed at the center of his or her learning to construct new knowledge based on prior knowledge (M. Allen, 2008).

4. **Critical thinking skills**- There are various definitions of critical thinking skills which vary according to the researcher.

   …to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based… The ideal critical thinker is habitually inquisitive, well-informed, trustful or reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider…and persistent in seeking result which are as precise as the subject and the circumstances of inquiry permit (Facione, 1990, p. 3).

The Center for Critical Thinking defined critical thinking skills as, “the intellectually disciplines process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action” (Saadd, Morin, & Thomas, 2012, p. 2).

Other definitions of critical thinking by respected authors are:

- “thinking about thinking” originally by Flavell (1979, p. 907).
- “To deal effectively with social, scientific, and practical problems” (Shakirova, 2007, p. 42).
5. **Digital tools**- A reference to any digital medium used for communication, collaboration, or to access information to create products or to solve a problem (Partnership for 21st Century Skills, 2009).

6. **Information, Communication Technology (ICT)**- Communication and networking tools and social networks that access, manage, integrate, evaluate, and create information (Partnerships for 21st Century Skills, 2009).

7. **Information literacy skills**- Even though the term was first coined by Zurkowski (1974), the definition has broadened in the information age. The Association of Colleges and Research Libraries (2000) has defined information literacy as “a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, manage, and use effectively the needed information”.

8. **iSkills assessment**- A 75-minute exam with one hour devoted to real-world problem solving using the technology environment. It is a performance-based, interactive assessment developed by Educational Testing Services (ETS) where seven skills are measured. Students are tested on how well they evaluate the usefulness of information for a specific purpose, they create or adapt information to support a point, they communicate information to a particular audience, they define a problem and form a statement, and they synthesize information from a variety of digital sources (Somerville, Smith, & Macklin, 2008).

9. **Literacy skills**- Traditionally, the definition has been noted as the ability to read, write, and comprehend, but with the onset of technology and using digital tools to access information, the definition of literacy has been expanded to include the ability to
synthesize, evaluate data, and create new information and knowledge after determining the quality of data (Mandusic & Blaskovic, 2013).

10. *Information, Communications and Technology (ICT)* - Digital technology such as computers, tablets, media players, and GPS as well as communication and social networks to access, manage, integrate, evaluate and create information (Partnership for 21st Century Skills, 2009).

11. *Test of Everyday Reasoning (TER)* - An assessment developed by Peter Facione for individuals in grades kindergarten through college and beyond to professional workers. The TER measures analysis, inference, evaluation, induction, and deduction skills. It is a 50-minute multiple-choice test based on a five-scale score (Educational Testing Services, n.d.).

12. *Traditional classroom setting* - The teacher is at the center of learning and activities and learning are postulated through the instructor (Consumater, n.d.).
CHAPTER TWO: LITERATURE REVIEW

Introduction

Digital tools began permeating the educational realm in the 1990’s and have continued to play a significant role in learning (Williams & Rowlands, 2007). For many schools, these tools have become one of the primary modes of learning. This medium has an impact on not only how students are processing vast amounts of information siphoned from a multitude of resources, but also how they are making sense of it and drawing reasonable conclusions. Assimilating the wide array of information and being able to synthesize it into a useful product is a challenge for students in this information age (Bouhnik & Giat, 2009).

Cognitive processing skills are viewed as crucial in order to cope with a rapidly changing world. Studies have verified that high school students do not possess the skills to efficiently search for information and then critically read, analyze, and evaluate that information (Bouhnik & Giat, 2009). If these skills are a pre-existing challenge to high school students, then the problem is compounded by the volume of information accessed in a short amount of time through the Internet. Critical thinking elevates students to a more complex task of engagement in real-world problem solving which prepares them for future success (Mendelman, 2007).

Miri et al. (2007) ascertain that “as the world progresses, more and more people are required to make rational decisions based on critical thinking rather than to accept authority” (p. 356). A review of literature suggests that traits of the 21st century learner rely highly on critical thinking skills. Critical thinking skills appear to be the catalyst to the rest of the imperative skills that students must possess to be prepared for jobs that do not yet exist. Many educators believe that specific knowledge will not be as important to tomorrow's workers and citizens as the ability to learn and make sense of new information (Akyuz & Samsa, 2009). Making sense of the new
information incorporates the ability to use information literacy skills to make selective decisions regarding information accessed from the Internet. One of the obstacles to making these decisions is the mode through which information is received. Information has moved from static pages to interactive webpages where discerning the information’s validity, reliability, authorships, and authenticity further compounds the challenge (Mackey & Jacobson, 2011).

**Gaps in Literature**

As teachers encounter new technology literacies, more research is needed to understand the challenges they face as they try to implement these new literacies in the classroom (Tan & Guo, 2010). The study conducted by Tan and Guo (2010) was driven from the gap in literature between theory and practice in literary research. Their study focused on the printed text in Singapore where it is given great value. Researchers wanted to find ways of infusing new literacies into classrooms using digital media. They integrated various interactions with technology to evaluate students’ decision-making skills in using information accessed from the Internet. Though it helped students better understand their means of communication, they still depended upon the printed text (Tan & Guo, 2010).

One of the recurring themes throughout literature was that exposure to technology does not necessarily equal proficiency (Marcus, 2009). The MacArthur Foundation spearheaded studies on effective digital media skills and found that while children are enthusiastic about new technology, they often do not display the sophistication in basic communication skills to effectively use such media (Marcus, 2009). Van Deursen and van Dijk (2010) recognized that the few studies that have been conducted do not explain what the skills mean that have been measured. These researchers suggested a deeper understanding is needed of the skilled and unskilled users of the Internet.
The purpose of this review of literature is to examine how high school students’ critical thinking skills and information literacy skills are affected due to the volume of information accessed through the Internet. Saljo (1999) stated that people react in relation to the tools that are accessible. Individuals are influenced and their thinking practices are shaped through their interaction with tools, and the meaning of the tools are reshaped through repeated activities. These tools and practices are not static, but are dynamic and developing (Saljo 1999). If these ideas are true, then the changing technology and digital tools that accompany it will affect the way students are shaped; therefore, critical thinking skills and information literacy skills become even more crucial to master.

Theoretical Framework

Piaget, the father of the constructivist theory, believed new knowledge was constructed from prior experiences and that the learner is placed at the center of learning with the instructor serving as a guide (Allen, 2008). The student can “create personal meaning when new information is given to them” (Powell & Kalina, 2009, p. 241). Constructivism looks at the student constructing ideas through a personal process. Through a child’s sensory development, he or she assimilates and accommodates information to construct into a schema (Powell & Kalina, 2009). The inquiry method is used to facilitate learning.

There are other factors to consider in constructing knowledge such as the tools which define and shape thinking. When there is an abundance of knowledge, rapid evaluation of that knowledge is important to determine its worthiness (Siemens, 2004). By processing the new and unknown, critical thinking skills are implemented to conceptualize, analyze, synthesize, evaluate, and apply information so the learner can attain conclusions or form judgments (M. Allen, 2008).
The constructivist theory perpetuates self-directed learning which embraces information literacy when the student is sorting through information on the Internet to determine its value (M. Allen, 2008). The student is forced to ask questions about the material which enhances critical thinking skills. He or she is exposed to information that will expand his or her knowledge and will ask questions about the material (Adams, 2006).

Critical thinking skills are a factor in this arena because the learner is continually questioning the information being presented. After a conclusion is drawn, the learner reevaluates how they were led to that conclusion. If the conclusion is in conflict with what is actually true, the learner has to rethink the problem (M. Allen, 2008). Problem solving, self-inquiry, and personal reflection are components of constructing knowledge which also reflect critical thinking skills and information literacy (Vogel-Walcutt et al., 2011).

Education is transformed and is transforming. Constructivists believe that learning does not simply occur, but an individual makes learning happen (Adams, 2006). Technology has allowed access to information in a matter of seconds. One of the results of this transformation is the need for individuals to manage information rather than regurgitate it (Adams, 2006). Constructivism allows for the creation of a framework where each student develops skills and understanding to extend and develop their prior knowledge. It is the process of sense-making (Adams, 2006). New information can only become meaningful in relation to that which is already constructed. The growth of technology has advanced which means that the realm to deposit ideas and thoughts is ever increasing (Adams, 2006).

**Characteristics of a Critical Thinker**

While each researcher takes on a different definition of critical thinking skills, many of the definitions comprise the same basic concept of analyzing, synthesizing, evaluating, and
reasoning. The goal of acquiring critical thinking skills is to transfer and apply the knowledge learned in one context to another (Limberg et al., 2012). Abrami et al. (2008) stated that “critical thinkers have a better future as functional and contributing adults” (p. 1103). Adults have many situations where they must think independently on how to resolve the problem or situation before them. If individuals did not have these skills, they would react through emotions or impulse. Furthermore, the increased impact of critical thinking skills has an effect on students securing viable jobs and careers (Abrami et al., 2008).

Critical thinking causes students to focus on the process of learning rather than on just the facts. Though the goal of critical thinking is to have the ability to transfer information to generalizations, it does not transfer to other unrelated thinking processes. It occurs in relation to specific content. Content knowledge is needed for appropriate critical thinking in knowledge. The ability to use it depends on one’s comprehension, self-assuredness, level of maturity, and experience. Learners must create and apply new knowledge to real-world situations (Lunney, Frederickson, Spark, & McDuffie, 2008).

Even though an individual’s environment and his or her point of view affects each one personally, a skilled critical thinker can distinguish between logical reasoning and personal opinion (Saadd et al., 2012). In light of personal bias, critical thinkers analyze and compare information and construct arguments (Saadd et al., 2012). They display open-mindedness, seek to reason, have a desire to be well-informed (Ennis, 1996), display inquisitiveness, are flexible, and show a respect for and have a willingness to entertain others’ viewpoints (Facione, 1990).

**Contributors to Critical Thinking Skills**

Ennis (1996) has written several articles and books concerning critical thinking skills. Ennis defines what a critical thinker should know and should be able to do. Ennis is noted for
listing abilities and characteristics of such a learner. Ennis also claims that a critical thinker
should not only have the capability to seek reason, truth, and evidence, but also should have the
drive and tendency to do so (Popkewitz & Fendler, 1999). In one of Ennis’ articles, critical
thinking is defined as, “The emphasis on reasonableness, reflection, and the process of making
decisions” (p. 166).

Ennis (1996) goes into great detail on six dispositions of critical thinking and attempts to
simplify the list so it is more manageable. Ennis addresses cultural bias, gender bias, and subject-
specificity issues. Encompassed in this system are three broad dispositions: “getting it right” to
the closest extent possible, representing an honest and clear position, and carefully regarding
each person’s dignity and worth (Ennis, 1996).

Another contributor to critical thinking is Siegel (1999), who has criticized Ennis for
seeing critical thinking characteristics as a skill set. Siegel recognized them as more of a deep-
seated character trait (Siegel, 1999), and used an entire paper to defend the position on thinking
dispositions and disputes definitions of others as well as clarifying areas of criticism. Siegel
concluded that dispositions cannot be reduced to a list of formal rules of thought or behavior
patterns and believed students need to focus on sensitivity to situations and create conditions
where they can practice their development.

Paul (1992) is seen as a transitional figure in the two traditions of individuality and social
interactions (Popkewitz & Fendler, 1999). Paul focused on the relationship between skills and
dispositions as either having a weak-sense or strong-sense. A weak-sense is one in which the
skill has been learned and demonstrated. A strong-sense is one in which an individual
incorporates critical thinking skills into daily living where assumptions are reexamined and
questioned on an ongoing basis (Paul, 1992). Paul also embraced the perspective of others to be
Critical Thinking and Education

The role of the teacher is important in developing a positive, supportive learning environment. Of all the content taught in technology education, teaching children to use their intellectual abilities may be the most important (Sherman, Sanders, Kwon, & Pembridge, 2009). Without adapting to the innovations of technology, students are at a severe disadvantage (Saadd et al., 2012). The educator is the key in how those skills are adopted in the classroom so that maximum learning takes place that also prepares them for 21st century employment (J. Allen, 2010).

Snyder and Snyder (2008) stated that “critical thinking is not an innate ability” (p. 92). Students who are able to think critically are able to solve problems to make effective decisions. Though this is not a new concept with which to grapple, it is one with which educators have struggled for years. Engaging students in critical thinking skills is the golden ring that will bring about valuable attributes in producing well-prepared thinkers in the workplace (Snyder & Snyder, 2008). These two researchers go on to say that even naturally inquisitive children do not have the natural skills to be a critical thinker, and they need to be trained to become analytical, fair, and open-minded as they pursue knowledge. To further support this study, Angeli and Valanides (2008) also concluded that students were not automatically disposed to think critically.

The role of educators in teaching student literacy skills has changed. The American Association of School Librarians state that 21st century technologies require teachers to guide students in focusing on their information gathering skills as well as refining their decision-making skills (American Association of School Librarians, n.d.). Students are using technology
to access and present information in and out of the classroom for global display and need to refine such skills so they can be global contributors (Brown & van Tryon, 2010).

According to Marin and Halpern (2011), instruction in critical thinking skills can be accomplished either through imbedding instruction of critical thinking skills with content material or direct instruction specifically targeted to critical thinking skills. They conducted a study to investigate which method would be more effective. The research indicated that students benefit from direct instruction of learning critical thinking skills along with repeated practice. “Teaching critical thinking skills that were practical were found to be more effective…” (Marin & Halpern, 2011, p. 4). The most effective method found in communicating those skills was through real-life role-playing, the use of case studies, group discussion, and student/teacher interaction (Marin & Halpern, 2011). Similarly, three teaching strategies identified by Miri et al. (2007) as being the most effective in promoting higher order thinking skills were real-world cases, open-ended discussion, and fostering inquiry-oriented experiments.

Critical Thinking and Students

Duran and Sendag (2012) and Huang, Hung, and Cheng (2012) concurred in two different studies that in the last two decades, work environments demanded fundamental changes which have been shaped by the rapid change and transformation in the area of accessing information. The information era has brought with it life-changing conditions where critical thinking skills have gained significance. They are needed to cope with a rapidly changing world (Akyuz & Samsa, 2009). It is not enough to simply access the information; students must also have the ability to acquire and absorb knowledge efficiently and effectively (Saadd et al., 2012).

With the onslaught of information, one might assume that students would be better informed. Unfortunately, quite the opposite is happening. The plethora of information presented
to them is overwhelming to the processing system of their brains. “Humans are limited in how much information they can process at a given time and in how fast they can process the information” (Miller, 2002, p. 276). It is difficult for students to distinguish valid, factual, sound information from that which is false, fictional, and unreliable (Bouhnik & Giat, 2009).

Students are ill-equipped with critical thinking skills to “analyze and compare information, construct arguments, respect perspectives, and view phenomena from different points” (Wang, Woo, Zhao, 2009, p. 95). Traits of the 21st century learner rely heavily on critical thinking skills. If critical thinking skills are lacking, educators need to intentionally provide instruction to strengthen these skills.

According to J. Allen (2010), half of the employers surveyed stated that critical thinking skills were very important for incoming high school graduates to be successful in their job. Of those employers, 70% rated high school graduates as deficient in critical thinking (J. Allen, 2010). According to Partnership for 21st Century Skills (2009), there is a gap in practical skills acquired in schools and skills needed in the workplace.

Additionally, if students do not possess the skills required for today’s information era, their careers and contributions to society are severely limited. Bouhnik and Giat (2009) recognized this struggle by stating that “rapid changes in information technology in recent years have rendered current high school curricula unable to cope with student needs” (p. 1). Some may not want to recognize that technology is instrumental to daily lives, but it is also a phenomena that cannot be ignored. By bringing these two elements together, critical thinking skills and technology, the problem is compounded. With critical thinking skills missing the mark after many decades and with the advent of the information era impacting those skills, teachers are challenged to incorporate both to bring about an effective end product.
Even though adolescence and young adulthood have been recognized as the premium time to develop higher order thinking skills, little research has been done in this area (Marin & Halpern, 2011). Gamino, Chapman, Hull, and Lyon (2010) determined that if adequate reasoning skills are not developed during adolescence there would be a profound and lasting effect on the individual in college and throughout adulthood. They also stated that cognitive neuroscience has identified adolescence as the pivotal developmental stage for acquiring critical thinking skills (Gamino et al., 2010).

Snyder & Snyder (2008) pointed out four areas that impede the development of critical thinking skills in education: lack of training, lack of information, preconceptions, and time constraints. Teachers learn their content area and are trained in teaching methods, but little training is given to teaching critical thinking skills. Instructional material rarely provides critical thinking resources (Snyder & Snyder, 2008). Another area that blocks attainment of critical thinking skills is that of preconceptions. Teachers have biases which block them from the ability to be fair and open-minded (Snyder & Snyder, 2008). Time constraints also function as a limitation as teachers try to get the content taught in a school year. This leaves little time for extraneous activities that might enhance critical thinking skills versus a short cut to getting the material communicated through lectures (Snyder & Snyder, 2008).

**Literacy Skills**

Literacy has gained a broader definition to include not only traditional literacy, but also multiple literacies related to multimedia (Leu et al., 2011). Traditionally, literacy skills have been the ability to read, write, and comprehend, but with the onset of technology and using digital tools to access information, the definition of literacy has been expanded to include the ability to synthesize, evaluate data, and create new information and knowledge after determining
the quality of data (Mandusic & Blaskovic, 2013). The 21st Century Learning Standards (American Association of School Librarians, n.d.) stated that learners use resources and tools to draw conclusions, make informed decisions, apply knowledge to new situations, and create new knowledge. The need for literacy is changing over time, and it is more complex than 20-30 years ago and will become more complex 20-30 years from now (Mandusic & Blaskovic, 2013).

The act of reading and writing is never neutral because it is constructed through a type of lens guiding students (Gainer, 2013). Leu, Kinzer, Coiro, and Cammack (2004) saw new literacies of the Internet and other information and communication technology (ICT) for the 21st century including strategies, skills, and dispositions necessary to successfully use and adapt to the rapidly changing ICT’s. The Internet and ICT’s allow individuals to identify questions, locate information, critically evaluate information and its usefulness, synthesize the information into an answer, and communicate the answer to others (Tan & Guo, 2010). These new literacies require access, reading, and learning from multimodal texts (Turner, 2011).

Ong’s (1981) research reflected upon the changes that digital literacy has had on society. Ong’s research showed that without appropriate media education or information literacy, individuals will have a hard time comprehending information they read. With the advancement of technology and globalization, “the need for various types of literacy to interpret different media has never been more critical” (Gibson, 2012, p. 186).

Leu et al. (2011) identified three issues that have become important in literacy but have not been addressed: (1) “the meaning and nature of literacy is continuously changing, (2) effective online information use requires additional online reading comprehension practices, skills, and dispositions, and (3) misalignments in public policy, assessment, and instruction impede teachers’ ability to prepare students for effective use of online information and
communication” (p. 6). There are currently no state-mandated assessments to test online reading comprehension. Without the back-up of such policies, there is not support to reinforce these skills in the classroom (Leu et al., 2011).

As new technologies for information and communication appear, the meaning of literacy also goes through a continual and rapid change (Leu et al., 2011). Literacy has always changed, but over more substantial periods of time. Literacy today means being able to use a combination of blogs, wikis, texting, search engines, Google Docs, Skype, apps, and many other technologies that have not been anticipated. Due to these rapid changes, society must revisit the definition of literacy on a continuous basis (Leu et al., 2011).

**Information Literacy**

Zurkowski (1974) originated the term information literacy in 1974 when he wrote a report on the future needs for various competencies in work, business, and industry. He called people information literates who could learn “techniques and skills for utilizing the wide range of information tools as well as primary resources in molding information solutions to their problems” (Zurkowski, 1974, p.6). Banta and Mzumara (2004) viewed information literacy as going beyond the skills of locating and using information and extending it to gaining knowledge for interpretation and evaluation. Skills identified as making a person information literate are: accessing, locating, and recognizing information that is needed and constructing strategies for locating, comparing and evaluating, organizing, applying and communicating, and synthesizing and creating (Shantaram, 2012).

Even though information literacy is not a new concept, it is being refined and redesigned in the context of technology and the availability of digital tools and access to the Internet (Holum & Gahala, 2001). In order to interact with this information which is more abundant and less
controlled by experts, students must be literate in identifying, locating, evaluating, and effectively using it (Eisenberg et al., 2004; Leu et al., 2011). Information literacy involves creating connections among many types of resources in a rapidly evolving environment (Transue, 2013).

The question to ask is no longer if students should be allowed to access the Internet, but to conduct research asking what it takes to use the Internet to successfully teach literacy (Holum & Gahala, 2001). This teaching of literacy is more than searching the Internet for information, selecting it, and using it for a paper. It requires having an intellectual framework for understanding the information, searching valid information, and using it in an effective manner (Mandusic & Blaskovic, 2013). With the increase of digital tools and information accessibility through the Internet, information flow is fast and requires more intellectual skills than learning software or hardware (Holum & Gahala. 2001).

**Challenges to Information Literacy**

Information has remained the same, but Saljo (1999) noted that functional literacies for today are very high compared to earlier periods in history. It extends from a mechanical skill to thinking critically and challenging dominant ideologies (Limberg et al., 2012). Information literacy promotes lifelong learning because it allows an individual to be equipped to find the necessary information for the tasks or decisions set before him or her (Mandusic & Blaskovic, 2013). It is a systematic development used to define informational needs, use tools and procedures for identifying and locating reliable sources and information, analyzing information, and using the results for proper use (Mandusic & Blaskovic, 2013).

When text is presented in printed form, one can see how the content and form come together as a whole. This awareness is not so easily achieved when looking at digital print. One
can get the impression that information is floating without relation to any physical artifacts (Limberg et al., 2012). The way a web page is structured will influence the interactions with it. One of the challenges online reading presents is that the content is more diverse and commercially biased (Leu et al., 2011).

Another challenge involved with information literacy includes locating information to meet an individual’s needs, generating an effective word search, inferring useful links within search results, and scanning for relevant information within websites (Leu et al., 2011). Additionally, coordinating and synthesizing vast amounts of multiple media formats of information from an unlimited possibility of sources compounds the other skills necessary to determine if information is relevant, reliable, and authentic. Because these challenges are not being met, there is increasing evidence that online reading by adolescents is not improving (Leu et al., 2011).

Leung (2009) conducted a survey to determine individuals’ perception of being information literate dependent on the amount of time spent on the Internet. The results showed that people felt more information literate when they spent more time on the Internet; however, it has been found through several studies that people have an inflated perception of their information literacy skills (Gibson, 2012; Julien & Barker, 2009; Smith, et al., 2013; Leung, 2009). A study conducted by Isfandyari-Moghaddam and Kashi-Nahanji (2011) explored the present levels of high school students’ ability to access information efficiently and competently, evaluate it, and use it accurately and creatively. The overall information literacy levels of those students were also evaluated. Students who received instruction through technology did better than those who did not. There was also evidence that females were more information literate than males (Isfandyari-Moghaddam & Kashi-Nahanji, 2011).
Another study conducted interviews with secondary teachers to determine their understanding and perception of information literacy instruction. The answers were greatly varied with most of them not knowing what they were. Also, students had a high perception of their skills even though studies showed they lacked in these skills (Smith, 2013). The study concluded that information literacy was not occurring consistently or effectively. To remedy this situation, researchers have suggested that information literacy be part of teacher education programs. In addition, research often refers to librarians being tasked to instruct in information literacy (Smith, 2013).

Van Deursen and van Diepen (2012) conducted an observational study with secondary students to measure their Internet skills by completing assignments on the Internet. Sixty-four percent of the assignments were completed successfully. The researchers found that subjects used search queries that were too general. The authors also found that most of the subjects did not pay attention to the source of the information. Finding the answer was their only objective regardless of where the information came (van Deursen & van Diepen, 2012).

**Critical Thinking Skills and Information Literacy**

Ennis (2009) identified twelve elements of critical thinking, with some similar to those of information literacy (M. Allen, 2008). According to Albitz (2007), accomplishing critical thinking skills is dependent on the acquisition of information literacy skills. He sees critical thinking skills as an essential component of information literacy; however, information literacy is not always a component of critical thinking skills. Being information literate requires more than the ability to work analytically with information. It demands that learners know how to manage information in more creative and meaningful ways (Albitz, 2007). Breivik (2005) stated that “information literacy is a kind of critical thinking ability; often the terms are used
interchangeably, but a person who is information literate specifically uses critical thinking to negotiate our info-overloaded existence” (p. 18).

Information literacy promotes the development of critical thinking. They both help the individual become more self-directed and have greater control over their learning (Shantaram, 2012). Just as Snyder and Snyder (2008) concluded that critical thinking skills are not innate, Wilson (1994) also concluded that information-seeking behavior is learned, not innate. The latest technology cannot be put into a student’s hand and he or she be expected to use it effectively. Individuals often give up looking for information online before they find it. When they do find it, they often do not evaluate it, but rather allow the information to find them. Adults and children uncritically trust information from any source instead of verifying its validity through questions such as who is the author, what is the purpose of the message, and how was the message constructed (Hobbs, 2011).

Articles were published in 2007 stating the importance of developing critical thinking skills and developing curriculum to help students build those skills to critically examine and analyze data (Gunter, 2007). Articles found in 2012 still recognized the problem of information or data literacy skills and the breakdown with critical thinking skills. The same strategies were even suggested of integrating these skills into the already existing curriculum (Gunter, 2007).

**Access to Information Via the Internet**

Gonzalez (2004) described the challenges of “knowledge life” as rapidly diminishing. Half of what is known today was not known ten years ago. Knowledge has doubled in the past ten years and is doubling every eighteen months (Gonzalez, 2004). Formal education is no longer the trend in learning. Information education through Internet access has become a significant
aspect of the modern learning experience. This information learning is not limited to one mode. It encompasses a variety of modes such as personal and community networks (Siemens, 2004).

Research shows that students’ ease and familiarity with the mechanics of the medium are not matched by their ability to evaluate electronic sources correctly (Gibson, 2012). Students live in an information-rich world where the availability of information appears limitless and is accessed instantly. Due to the vast amount of information being generated, questions are aimed at credibility, reliability, and authenticity (Shantaram, 2012). The Internet puts massive amounts of information in front of them instantly. They are provided with the tools for accessibility, but they are not equipped with skills to evaluate and analyze the information. Information does not empower students to be successful. The process of using critical thinking skills to evaluate the information ensures success (Gibson, 2012).

The credibility of the source becomes the responsibility of the user since information can be made available to anyone by anyone. Smith et al. (2013) indicated that for college students, the reference is important but for users without academic training, the understandability of the site or the images is their basis for credibility. The 3S model was used to better understand how individuals form their judgment on the credibility of information. Determining credibility was either through semantic features where information is compared to the individual’s knowledge on a topic, factual accuracy, or domain expertise where the aesthetics of the site is taken into account. High school students did not recognize the identifying of information literacy, accuracy, authority, objectivity, currency, and coverage (Smith et al., 2013).

Julien and Barker (2009) discovered in their study that when students were tasked with finding information related to a science project, they lacked the evaluation skills to identify credible information as well as lacked search skills. They were looking for the right answer and
used superficial criteria to attain that. Students would often paste the question in the search box to Google the answer and based the credibility of the site on the site itself or the resource rather than evaluating the content answer (Julien & Barker, 2008).

Van Deurson and van Dijk (2010) stated two digital divides; one that refers to access to computers and the Internet and one related to skills using the Internet. They identified four types of digital skills related to the Internet: operational internet skills which relates to basic skills in using Internet technology, formal Internet skills which relates to skills of navigation and orientation to the Internet, information Internet skills where information needs are fulfilled, and strategic Internet skills which is the ability to use the Internet to reach particular goals. The identification of these skills allows for recognizing how the levels are distributed among various populations. Their study investigated the levels of Internet skills displayed by Dutch citizens and the determining factors of those skill levels. The two skill areas that indicated the need for improvement were the information and strategic Internet skills. The authors recognized that they did not know if these skills were also lacking in traditional media. They suggest further research to see if operational, formal, informational, and strategic skills increase the gap between individuals of different ages, educational, and occupational backgrounds (van Deurson & van Dijk, 2010).

Williams and Rowlands (2007) conducted a study comparing information seeking in pre and post electronic ages. Both groups studied faced similar problems in using strategies to find relevant information. The difficultly was finding information in the vastness of the Internet not filtered through a publisher, librarian, or teacher, but analyzed by the individual (Mandalios, 2013). Lorenzen (2007) found that high school students were using the Internet for sources and stated that they appeared to be official, but they did not give much thought to the accuracy.
Information looks credible and convincing and students are more trusting of the information they encounter. In this way, learning is self-directed, and research becomes more difficult than it was in previous times (Williams & Rowlands, 2007).

A study conducted by Wolsey and Grisham (2007) examined eighth grade students and their exposure to information on the Internet. One group actively used the Internet at home and the other group did not. Through the information gathered, it was found that students were exposed to the Internet through surfing, playing online games, using email, and using chat rooms, but they were not as adept in using it for academic purposes. This study supports findings in other studies that students have exposure and entry experience with the Internet but using it for academic tasks is lacking. A pre and post survey was done and meaningful increases in technology use were found as long as they were integrated meaningfully with what was happening in the classroom. The scaffolding process was also an important element in teaching students digital literacy skills (Wolsey & Grisham, 2007).

**How Current Literacy Issues Differ From 20th Century**

Not much has changed in human development since the 20th century other than learning new ideas and practicing new skills. One difference about the 21st century is the matter of scale in which information is available. Time, size, distance, audience, and available data are all affected. Information can be shared instantaneously through blogs and social networks. Tweets are 140 characters long, distance is not an issue with global sharing, and audience availability extends beyond the classroom. By 2011, the digital universe increased ten times that of 2006 (Gantz et al., 2008).

The net generation, individuals born between 1977 and 1997, grew up with the Internet, and they are more likely to go to the Internet for the latest information (Isfandyari-Moghaddam
A study by Valenza (2006) showed concern about the way students understand the way information is organized, the presentation of results, and the differences in search engines. Other studies share the theme of training needed to enable the effective use of digital tools because students do not adequately evaluate information online (Williams & Rolands, 2007). The concern centers on the lack of skills at being critical consumers and ethical producers of information. Assumptions have been made that this generation is quite adept at technological skills, but studies show that they rarely use technology to work together, access information for education reasons, produce a product, or exchange information (Somyurek & Coskun, 2013; Leung, 2009). The basic skills to digital competency are lacking.

**Role of Technology in Critical Thinking Skills**

Technology is often seen as the main contributor to learning. Instead, it should be viewed as a mediator or tool to facilitate and enhance students’ learning. Teachers tend to focus on digital tools as sources of knowledge rather than using them to instruct students on how to use them to create and expand their ability to acquire knowledge (Wang et al., 2009). An educator’s understanding of the role of technology is paramount before beginning effective implementation in the classroom.

For information to be perceived as contributing or relevant to students in the 21st century, it must be presented in an interactive mode (Saadd et al., 2012). One of the goals of incorporating technology into the classroom is to make students more active in the learning process. Through being active, contributing members, they are sharing information and ideas in a collaborative manner which stimulates critical thinking skills (Saadd et al., 2012).

While students may be comfortable with technology and assume they have a good working knowledge of it, they may not understand how to use it effectively for learning and
accomplishing goals (M. Allen, 2008). One study indicated that students were satisfied with their abilities to judge web-based information although they evaluated it at a superficial level. The educator must examine if technology is being used to enhance critical thinking or if it is merely a means to getting a task accomplished quickly. The latter is not necessarily beneficial to critical thinking skill development. The context in which technology is taught may have an important impact on the way children learn (Sherman et al., 2009).

The goal of learning, regardless of the mode, is thinking. The labor market is demanding that employees are able to think critically in a problem-solving manner and “demonstrate capability in using technologies” (Al-Hammadi, 2010, p. 397). Critical thinking and problem solving are two of the most needed qualities for 21st century students (Bekele, 2009). Huang et al. (2012) summarized the problem on the subject of critical thinking and technology, “The prevalence of usage in school drives the need to understand its effects on critical thinking when technology is integrated with instruction” (p. 42).

1:1 Programs and Information Literacy Skills

1:1 programs have been growing across the nation. Studies have been conducted on the effectiveness in student achievement and student engagement. There has been little study on a large-scale aimed at the impact of 1:1 programs in learning skills and information literacy (Spector-Levy & Granot-Gilat, 2012). The study by Spector-Levy and Granot-Gilat (2012) showed that students who did not have a laptop took longer to complete research, did not finish their work, and had poor computer skills limited to Word files and power point. Students who had a laptop had some technology problems, but they worked for a shorter period of time, used a variety of computer tools, and were more focused (Spector-Levy & Granot-Gilat, 2012).
Students who use iPads in 1:1 learning experienced positive outcomes such as a higher level of engagement in learning, being more reflective and active in learning, and being more involved in collaborative and project-based instruction (Holcomb, 2009). Students report that laptops help them be better organized, and it allows them to get work done more quickly and with better quality (Holcomb, 2009). There are, however, studies that indicated no difference in student achievement scores by using a laptop. A four year study in Texas that used the Texas Assessment of Knowledge and Skill showed no statistically significant effect of the laptop program. It also did not increase reading or writing skills (Holcomb, 2009). In examining these results, one has to be careful to take into consideration that achievement in learning will not be immediate. It requires time for the true impact of learning to be measured. A period of adjustment is need which can take five to eight years for an innovation to be implemented (Holcomb, 2009).

Regular engagement to online sources may bring about a better understanding of how people understand and interpret messages differently based on their social and cultural backgrounds (Hobbs, 2011). Hobbs (2011) concluded that students displayed higher order thinking skills when they received digital media instruction and produced a product that shared new knowledge. They were also found to be able to better discern the author’s purpose. Collaboration among students was a factor in improvement these skills. Higher order thinking skills can be expanded by allowing the model to require students to develop a product which shares new knowledge (Leu et al., 2011).

A study conducted by McMahon (2009) evaluated technology skills and critical thinking skills of 150 girls showed a significant correlation between students’ computer skills and their level of critical thinking skills. Tests used were the Level of Technology Implementation,
Australian Schools Computer Skills Competition, and Ennis’ Critical Thinking Essay Test. Not surprisingly, there was also a significant correlation between time spent in a technology-rich environment and their development of computer skills. The recommendation from the author was that further research should be done to develop higher order thinking skills in a technology-based environment (McMahon, 2009).

**Framework for Maximum Learning**

There are several approaches and practices that can be implemented for maximizing the use and learning of critical thinking skills in the classroom. Problem-based learning activities are among the most noted to be effective. Also, modeling critical thinking skills by having student evaluate scenarios that do not have right or wrong answers allows students to practice these skills before encountering such events (Snyder & Snyder, 2008). Designing authentic tasks shows relevance to learning critical thinking skills (Manernach, 2006). Through these various methods, teachers can provide students with individualized feedback to address areas where they can assess their thinking.

There are other frameworks which may be beneficial in teaching student how to think critically. Shakirova (2007) developed four stages to consider in shaping critical thinking: ensure the relevance of knowledge, interpret new information, and engage in reflection to shape an opinion, generalize and assess the information. Another tool that is used is an argument map (Butchart et al., 2009). It is a representation of an argument shown in logical structure that illustrates each step of an argument takes place, from the premise to the intermediate steps to the conclusion to the way they all fit together. Meanwhile, higher education institutions are implementing critical thinking classes as a more direct link to learning these skills. Learning is collaboratively constructed (Huang et al., 2012). Wang et al. (2009) postulated the importance of
interaction involving four mediums: learner-content, learner-learner, learner-instructor, and learner-interface.

With information literacy, not only do critical thinking skills need to be addressed and taught, but teachers also need to also become familiar with the meta language connected with it (Tan & Guo, 2010). Teachers have reported not only that they are unfamiliar with the meta language connected with the new literacies, but also that they are lacking in the resources and support necessary to incorporate them into the classroom (Tan and Guo, 2010). Studies conducted in Singapore have shown that teacher knowledge of new literacies was limited (Tan & Guo, 2010). These results suggest that new literacies do not spontaneously happen in the classroom. There is a need for the teacher to be familiar with these literacies and to teach them to students.

Tan and Guo’s (2010) study used pedagogy of multi literacies in English classrooms. One particular teacher worked on using intervention measures to influence pedagogical practices adopted from The New London Group in closing the gap between theory and practice. They recognized that meaning of text is influenced by social and cultural contexts. The nature of texts are not ideologically free. The assumption was that if students could interpret multimodal texts from social and cultural contexts, they would be able to apply the same literacy skills to other texts (Tan & Guo, 2010). Old skills were not used with new technology. The shift to multimodal literacy was made through gradual introduction to various forms of media such as brochures, 2D and 3D multimedia production with each shift having specific goals of shifting from a text coder to text analyst to a text producer. One of the problems that the study encountered was that the meta language was too abstract for use in the classroom, so a scaffolding framework needed to be formed. The teacher served as a co-learner with her students and scaffolded in such a manner
so that they became more text analysts and text producers. To track progress, coding sheets were used in addition to field notes of the activities that took place, lessons were videotaped (Tan & Guo, 2010).

Two turning points occurred in this study. The first one was when the teacher asked students to compare a printed brochure with a website. While the students were able to see the differences, they had more difficulty analyzing the purpose and assumption of the brochure. The second turning point was when students used Shakespeare’s Macbeth as a reading assignment and also a media production. Involving the students as text producers allowed them to have a deeper understanding of the literary work. Using a variety of media allowed for deeper understanding. The teacher designed learning opportunities so students would be able to grasp a deeper meaning of the text. The instructor jointly constructed meaning based on student interactions to multimedia texts (Tan & Guo, 2010).

Bruce, Edwards and Lupton (2006) identified six frameworks for information literacy: content frame, competency frame, learning to learn frame, personal relevance frame, social impact frame, and relational frame. The relational frame implements the use of a Reflective Online Searching System (ROSS), which is designed on students’ experiences with Internet searching. The model uses two key aspects: reflection and planning of the search process (Bruce, Edwards, Lupton, 2006). So far, there are no other tools like ROSS that allow students to reflect on the information literacy skills. Students identified differences they have noticed in search strategies and results they have achieved. Additionally, students need to have variations in their experience of learning. Those variations need to be explicit and explained to students without making assumptions (Bruce et al., 2006). Students evaluated various resources to determine their reliability.
Studies show that a collaborative approach and sharing information using interactive technology increases critical thinking skills and understanding. These skills also promote sharing information online (Mackey & Jacobson, 2011). The process of accessing information and deciding what is to be used prompts evaluation of information to take place early in the process (Mackey & Jacobson, 2011).

The studies reviewed have a common thread: teaching students information literacy is not an isolated skill; it needs to be integrated in the curriculum. The teacher needs to craft the learning activities and include interactive assessment of student learning, but the student remains the center of learning (Wolsey & Grisham, 2007). A study done in Hong Kong focused on improving information literacy skills. Students recognized the improvement in their own reflective thinking. The researchers set up three stages of learning: acquiring skills, making the skills automatic, and transferring the skills to other contexts of application. Effective pedagogy included developing learning experiences to target cognitive stages and helping students develop to the next stage (Wong, 2010).

Challenges to instruction include teachers lack of awareness of resources available and how to use them effectively and teachers taking the time to create meaningful assignments (Julien, Tan, & Merillat, 2013). To discern the reliability of information gathered through the Internet, teachers should have students consider the following about sources they encounter: bias, authorship, credibility, coverage, purpose, timeliness, and reliability. While these criteria may help students evaluate information, it is also important to include the impact of the information (Stark, 2011).
Assessment of Critical Thinking

Standardized assessments

Several tests are available to measure critical thinking skills such as the Watson-Glaser Critical Thinking Appraisal, Cornell Critical Thinking Test, California Critical Thinking Skills Test, and California Critical Thinking Disposition Inventory (Abrami et al., 2008). Other test-taking tools for critical thinking skills are tests developed and evaluated by a teacher and secondary source measures such as adopting from other sources. Assessments may also be effectively done through surveys or discussion forums (Abrami et al., 2008).

The TER was developed by Facione and his research team who also developed The California Critical Thinking Skills and The California Critical Thinking Dispositions Inventory. Facione and his team have developed several tests for individuals in kindergarten through college graduates and those in professional work (Ennis, 2009). The TER measures core reasoning skills and uses familiar topics and contexts by using progressive questioning. Students analyze or interpret information in text, charts, or images. They are tasked with drawing and evaluating inferences and explaining reasoning. The 50 minute, multiple choice assessment is based on a five-scale score and measures analysis, inference, evaluation, induction, and deduction. The test can be administered online (Insight Assessment, n.d.).

TER is normed with high school students, two year colleges, elite colleges, and pre high school students. They can also be compared to working professionals in entry level positions. The readability level, based on the Flesch-Kincaid readability level, is at the sixth grade level. The test can either be administered online or through paper and pencil. It can be delivered through several learning management systems such as Moodle or Blackboard. Companion tests recommended are the California Critical Thinking Disposition Inventory to assess the test taker’s
disposition and skills in critical thinking, or the California Measure of Mental Motivation Level 3 (CM3) depending on the students’ age. There is an option to administer the TER-N which measures numeracy skills in applying mathematical techniques to situations (Insight Assessment, n.d.).

The report of the TER includes demographic information, a summary of scores, and interpretative analysis. An overall score is included as well as categorical interpretation, norm-reference percentile ranking, and scale scores. Group descriptive statistics are available as well (Insight Assessment, n.d.).

Other potential critical thinking tests include the Watson-Glaser Critical Thinking Appraisal (WGCTA), the California Critical Thinking Skills Test (CCTST), Tasks in Critical Thinking (TCT), and the Cornell Critical Thinking Test (CCTT) (Ennis, 2009). These tests were not chosen due to either an inappropriate age level or effectiveness of the test in measuring what the researcher was looking for.

**Assessment of Information Literacy**

iSkills was developed by the Educational Testing Service (ETS) in 2003 as a response to studies that showed students can email and download music, but could not “effectively and efficiently find, use, and evaluate content to solve problems and make decisions” (Somerville, 2007, p. 160). Its development was guided by the ICT Literacy Panel’s report, *Digital Transformation: A Framework for ICT Literacy* (Somerville, 2007). The panel met for fifteen months to study the existing and emerging ICT’s and their relationships to literacy (Katz, 2008). It is based on the process known as evidence-centered design which is a systematic approach that focuses on evidence of proficiencies. It measures knowledge of technology as well as the ability
to use critical thinking skills to solve everyday problems within a technology environment (The iSkills Assessment, n.d.).

Seven skills are measured through the assessment where students: define- understand the scope of information; access-collect and/or retrieve information digitally; evaluate- judge usefulness of information by determining authority, bias, relevance; manage- organize information to find later; integrate- interpret information to synthesize, summarize, compare, and contrast; create- create a digital display after adapting, applying, and designing information; and communicate- disperse tailored information to a particular audience. Individual and group data are given through reports that include an overall ICT literacy score, a percentile score, and individual feedback on a student’s performance. The scores are available after 50 students have taken the test for reliable purposes.

Summary

Critical thinking has gone through various definitions and has been referred to in many facets. The basic foundation of the definition is that it equips individuals to have problem solving skills in order to make effective decisions (Snyder & Snyder, 2008). Miri et al. (2007) believed critical thinking skills involve identifying the source of information, analyzing credibility of information and reflecting on whether it is consistent with prior knowledge and drawing conclusions. The goal is not technology itself, but to use it as an enhancement to the learning process.

Part of the learning process is based on the capacity to find and access knowledge and apply it to problem solving. With this new paradigm of technology, information literacy, and critical thinking skills give priority to older acquisitions of gaining knowledge. Seeking and finding information, crystalizing issues, forming hypothesis, evaluating evidence, and solving
problems are at the forefront of the information and technology age. (Isfandyari-Moghaddam & Kashi-Nahanji, 2011). The primary goal of education is learning how to learn. If students become adept at learning how to sift through information offered through the Internet, they will be prepared for the work force.
CHAPTER THREE: METHODS

With the presence of technology having a more instrumental role in education, information literacy skills and critical thinking skills are at the forefront of qualities employers are seeking as they screen candidates (Abrami et al., 2008; J. Allen, 2010; Bouhnik & Giat, 2009). Availability and access to information from the Internet gives students a false sense of ability to evaluate electronic sources (Gibson, 2012). The purpose of this study was to examine the critical thinking skills and information literacy skills of high school students who are enrolled in a 1:1 iPad program in comparison to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting to establish if there is a difference in the scores between the two populations particular to their ability to identify information as authentic, reliable, and valid as accessed on the Internet. This methodology section will explain the design, pose the research questions and hypotheses, describe the participants and the setting, as well as the instrumentation, procedures, and data analysis.

Design

This exploratory study used an ex post facto design to determine if critical thinking skills and information literacy skills were influenced by educational delivery modalities. This non experimental design was a correlational study which examined the relationship between the dependent variables (Gall, Gall, & Borg, 2007).

The purpose of this study was to study the relationship of students in a 1:1 iPad program at a magnet school where they are exposed to information from the Internet on a consistent basis and students in a traditional high school program to their competencies in critical thinking skills and information literacy skills. Treatment had already occurred, and manipulation was not
possible which brought about an ex post facto approach. Randomization was not possible due to the particular program that was tested; therefore, a homogeneous purposive sample of convenience was used to select students because they were chosen from a group of students who posed a particular characteristic of interest (Gall et al., 2007). In this case it was those students who were enrolled in a 1:1 iPad program.

**Research Questions**

**RQ1:** Is there a statistically significant difference in high school students’ critical thinking and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in 1:1 iPad programs compared to high school students’ critical thinking and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills?

**RQ2:** Is there a statistically significant difference in high school students’ analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ analysis scores on the TER who are enrolled in a traditional high school setting?

**RQ3:** Is there a statistically significant difference in high school students’ inference scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ inference scores on the TER who are enrolled in a traditional high school setting?

**RQ4:** Is there a statistically significant difference in high school students’ evaluation scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the TER who are enrolled in a traditional high school setting?
**RQ5:** Is there a statistically significant difference in high school students’ induction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ induction scores on the TER who are enrolled in a traditional high school setting?

**RQ6:** Is there a statistically significant difference in high school students’ deduction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ deduction scores on the TER who are enrolled in a traditional high school setting?

**RQ7:** Is there a statistically significant difference in high school students’ definition scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ definition scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ8:** Is there a statistically significant difference in high school students’ access scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ access scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ9:** Is there a statistically significant difference in high school students’ evaluation scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ10:** Is there a statistically significant difference in high school students’ management scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school
students’ management scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ11:** Is there a statistically significant difference in high school students’ integration scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ integration scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ12:** Is there a statistically significant difference in high school students’ creative scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ creative scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ13:** Is there a statistically significant difference in high school students’ communication scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting?

**Null Hypotheses**

The null hypotheses for this study are:

**H₀₁:** There will not be a statistically significant difference in high school students’ information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ information literacy skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀₂:** There will not be a statistically significant difference in high school students’ critical thinking skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills
who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER).

**H₀³:** There will not be a statistically significant difference between high school students’ critical thinking skills and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills.

**H₀⁴:** There will not be a statistically significant difference in high school students’ analysis skills who are involved in a 1:1 iPad program compared to high school students’ analysis skills who are enrolled in a traditional high school setting as measured by the TER.

**H₀⁵:** There will not be a statistically significant difference in high school students’ inference skills who are involved in a 1:1 iPad program compared to high school students’ inference skills who are enrolled in a traditional high school setting as measured by the TER.

**H₀⁶:** There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by TER.

**H₀⁷:** There will not be a statistically significant difference in high school students’ induction skills who are involved in a 1:1 iPad program compared to high school students’ induction skills who are enrolled in a traditional high school setting as measured by TER.

**H₀⁸:** There will not be a statistically significant difference in high school students’ deduction skills who are involved in a 1:1 iPad program compared to high school students’ deduction skills who are enrolled in a traditional high school setting as measured by TER.
**H₀9:** There will not be a statistically significant difference in high school students’ definition skills who are involved in a 1:1 iPad program compared to high school students’ definition skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀10:** There will not be a statistically significant difference in high school students’ access skills who are involved in a 1:1 iPad program compared to high school students’ access skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀11:** There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀12:** There will not be a statistically significant difference in high school students’ management skills who are involved in a 1:1 iPad program compared to high school students’ management skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀13:** There will not be a statistically significant difference in high school students’ integration skills who are involved in a 1:1 iPad program compared to high school students’ integration skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀14:** There will not be a statistically significant difference in high school students’ creative skills who are involved in a 1:1 iPad program compared to high school students’ creative skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀15:** There will not be a statistically significant difference in high school students’ communication skills who are involved in a 1:1 iPad program compared to high school students’ communication skills who are enrolled in a traditional high school setting as measured by iSkills.
Participants and Setting

Two groups were examined in this study. One group attended CMS and the other group attended the traditional local high school. Students from CMS had been enrolled in the 1:1 iPad program since the construction of the school in 2012. They must apply for acceptance which is based upon application completion, grades, and recommendations. The students selected had been enrolled in the 1:1 program since 2012. Students selected from the traditional high school classroom were chosen based on attendance at the high school since 2012. The participants were derived from a homogeneous, purposive sample of convenience because the research focused specifically on students in a 1:1 iPad program, and they needed to fit a particular profile (Gall et al., 2007). The high school students in a traditional high school setting were also selected through a homogeneous, purposive sample of convenience since they needed to have a homogeneous, purposive sample of convenience to the students in the 1:1 program. Students were identified through random numbers.

This research study was conducted at a CMS and a traditional high school in rural, south central Pennsylvania. The school district is composed of 13 elementary schools, two middle schools, one high school, and one CMS along with a virtual academy. It also participates in a county technical education center. The district serves approximately 8,337 students (Pennsylvania Department of Education, n.d.).

CMS serves students in grades 9-12. It has an emphasis on technology, career exploration, and acceleration to graduate early. Students at CMS range in ages fifteen to eighteen with the majority between the ages of sixteen and eighteen. There are 399 students at the school with 48 percent being female and 52 percent being male. Eighty-two percent of the students are Caucasian, 10% are Hispanic, 5% are African-American, and 3% are multi-racial. Thirty-three
percent come under the category of economically disadvantaged, and 22% are in special education. One principal, one guidance counselor, one secretary, and one nurse serve the school (Pennsylvania Department of Education, n.d.).

This is the third year of the school using a 1:1 iPad program with technology-based homework, tests, and projects. Students must apply to attend this school. Each student is issued an iPad upon enrollment at the school. Grades must be a C or higher, and students must show initiative in learning through the interview questions.

The high school consists of 2,035 students in grades 9-12. Fifty-two percent are female and 48% are male. Seventy-three percent are Caucasian, 13% are Hispanic, 10% are African-American, 2% are Asian, and 2% are multi-racial. Thirty-five percent of the students enrolled are economically disadvantaged and 10% are in special education. There are 13 advanced placement courses offered along with an early to college program.

Students in grades 9-12 are required to have 23.5 credits to graduate that must be in major subject areas. Additionally, they need to take .50 credits in information technology, 2.00 credits in wellness and fitness, participate in a junior project, and show proficiency on the Keystone exams. Both samples of students have experienced the same curriculum until they reach ninth grade, where they separate to either the high school or magnet school.

Students are required to take an ICT course which teaches them about valid sites on the Internet as well as digital citizenship. The school district follows Children’s Internet Protection Act (CIPA) by incorporating 21st century learning skills into the curriculum and understanding their digital footprint. They also have the option to take classes through the local community college as well as take advantage of Advanced Placement courses. Early to college programs, internships, and early to work programs are also in place.
CMS was added to the district’s program in Fall 2012. Students at the CMS are required to take the same courses as the high school students, but there are additional options and requirements, such as each ninth grade student being required to take a science, technology, engineering, mathematics (STEM) exploratory elective. Students are issued an iPad and use it as their primary means of communication and production. One of the goals is for students to perpetuate their own learning experience through a nontraditional school setting. CMS is equipped with Apple TV’s, makes use of iTunes U, and uses applications as part of its daily practice. Students have a wide variety of flexibility of taking courses online that are not offered at the high school. STEM is integrated throughout all subject areas.

In addition to the differences listed below, another major difference between the curriculum at CMS and the high school is that students at CMS are expected to use their device at all times whereas traditional high school students use laptop and iPad carts at the teacher’s discretion. Students may only use what is provided by the school. Approximately 20 out of 125 teachers at the high school deliver courses through blended learning. Blackboard is used by some teachers. While CMS has fewer electives and fewer AP courses, they also have more opportunities to take courses through various online entities. At CMS, technology integration is required in contrast to no expectation for technology integration at the high school where it is based on teacher choice.

The similarities in the two programs exist in the fact that all the students must take the major courses of study in English, math, social studies, and science. All eighth grade students must take an eLearning course as well as an information literacy course which explores valid resources and digital citizenship.
### Table 1

*Courses at High School and Magnet School*

<table>
<thead>
<tr>
<th>Year/Course</th>
<th>High School</th>
<th>CMS</th>
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</thead>
<tbody>
<tr>
<td>9th grade</td>
<td>American Literature 1</td>
<td>American Literature 1</td>
</tr>
<tr>
<td></td>
<td>Biology</td>
<td>Honors Conceptual Physics</td>
</tr>
<tr>
<td></td>
<td>Algebra I, II</td>
<td>Algebra I, II</td>
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<tr>
<td></td>
<td>Geometry</td>
<td>Geometry</td>
</tr>
<tr>
<td></td>
<td>Early American History</td>
<td>Early American History</td>
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<tr>
<td></td>
<td>Information Literacy</td>
<td>Information Literacy</td>
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<tr>
<td></td>
<td>Health</td>
<td>Health</td>
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<tr>
<td></td>
<td>STEM Exploratory Elective</td>
<td>STEM Exploratory Elective</td>
</tr>
<tr>
<td>10th grade</td>
<td>American Literature 2</td>
<td>American Literature 2</td>
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<tr>
<td></td>
<td>Biology II</td>
<td>Biology</td>
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<tr>
<td></td>
<td>Physics</td>
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<td></td>
<td>Algebra 2</td>
<td>Algebra 2</td>
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<tr>
<td></td>
<td>Geometry</td>
<td>Geometry</td>
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<tr>
<td></td>
<td>Pre-Calculus</td>
<td>Pre-Calculus</td>
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<tr>
<td></td>
<td>Modern American History</td>
<td>World History</td>
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<tr>
<td></td>
<td>Information Literacy</td>
<td>Information Literacy</td>
</tr>
<tr>
<td>11th grade</td>
<td>World Literature</td>
<td>World Literature</td>
</tr>
<tr>
<td></td>
<td>Variety of science electives</td>
<td>Chemistry</td>
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<td></td>
<td>such as Physics, Chemistry,</td>
<td>Physics</td>
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<td></td>
<td>Organic Chemistry,</td>
<td>Environmental Studies</td>
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<tr>
<td></td>
<td>Anatomy and Physiology</td>
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<td></td>
<td>Geometry</td>
<td>Calculus</td>
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<tr>
<td></td>
<td>Pre-Calculus</td>
<td></td>
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<tr>
<td></td>
<td>Variety of electives such as</td>
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<tr>
<td></td>
<td>Trigonometry, Statistics, Calculus</td>
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<tr>
<td></td>
<td>World History</td>
<td>World History</td>
</tr>
<tr>
<td></td>
<td>Information Literacy</td>
<td>Information Literacy</td>
</tr>
</tbody>
</table>

**Instrumentation**

The TER was used to measure the independent variable of critical thinking skills of high school students. There are core reasoning skills that the TER measures by using familiar topics and contexts through progressive questioning. Information is presented to the students to analyze...
or interpret information in text, charts, or images. The 50 minute, 35 multiple choice assessment is based on a five-scale score and measures analysis, inference, evaluation, induction, and deduction. The test can be administered online (Facione, 2001).

TER is normed with high school students, two-year colleges, and elite college pre high school students. They can also be compared to working professionals in entry-level positions. The readability level, based on the Flesch-Kincaid Readability Level, is at the sixth grade level. TER is strongly correlated to the California Critical Thinking Skills Test (CCTST) with 0.766 construct validity. There are four separate Kuder-Richardson 20 coefficients presented for internal consistency from four samples ranging from 0.72 to 0.89 (Facione, 2001).

The results of the TER includes demographic information, a summary of scores, and interpretative analysis. An overall score is included as well as categorical interpretation, norm-reference percentile ranking, and scale scores. Group descriptive statistics are available as well (Insight Assessment, n.d.).

iSkills assessment was used to measure high school students’ information literacy skills. It is based on a systemic approach known as evidence-centered design which focuses on evidence of proficiencies. Administered online, it measures knowledge of technology as well as the ability to use critical thinking skills to solved everyday problems within a technology environment through seven performance areas.

Individual and group data were given through reports that included an overall ICT literacy score, a percentile score, and individual feedback on a student’s performance. The scores are available after 50 students have taken the test for reliability purposes. The estimated reliability is .88 with the Cronbach alpha. The evidence-centered design is drawn from a panel of experts who connected their view with information literacy, evidence of student performance,
design of the tasks, and the means for scoring the assessment. In 2005, a panel of experts reviewed the questions and endorsed 26 of the 30 tasks. which were then revised (Katz, 2008).

**Procedures**

Approval was received from the Institutional Review Board (IRB) from Liberty University (see Appendix A) as well as the school district superintendent (see Appendix B). Initial contact with the principals was through email, conversations on the phone, and visitations regarding their willingness to participate. Parental consent forms (see Appendix C) and invitation letters (see Appendix D) were sent home to gain permission for their child to participate. No monetary incentive was offered to complete the study.

The initial response to the study did not meet the minimum requirement of 20 students from each school. The researcher received approval from IRB to offer a $10 gift card to local stores to add incentive (see Appendix E). After approval, an email was sent to parents and students from each principal informing them of the incentive. This procured more students which resulted in 20 students from the high school and 25 students from CMS to participate.

The researcher and proctor were trained in how to set up the assessments and the procedure involved through conference calls with each company. The representative of each company shared the website address for students to enter and the code for the assessment. The principal of the CMS proctored each school in taking the tests. Additionally, there were manuals for each assessment.

In April, CMS students traveled to the high school to take both assessments. At the same time, the high school students went to the testing room and took the assessments. Students went online using the given website and code to access the assessments. Each assessment took approximately 45-50 minutes. Not all students showed up on the first testing date due to school
meetings and absences. Another date was set in May to complete testing with the rest of the students.

**Data Analysis**

This correlational study with an ex post design was utilized for this quantitative study to determine if there was a difference in high school students’ critical thinking skills and information literacy skills in critically analyzing information accessed from the Internet with students who are enrolled in a 1:1 iPad program compared to students enrolled in a traditional high school setting with limited access to the Internet. There were two assessments used with each group, TER and iSkills. To analyze the differences between scores, inferential statistics was applied using an independent *t*-test. SPSS statistical software was used to study the scores between the two groups to determine if there were statistically significant differences between the two independent variables.
CHAPTER FOUR: FINDINGS

The purpose of this study was to examine the critical thinking skills and information literacy skills of high school students who are enrolled in a 1:1 iPad program in comparison to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting to establish if there is a difference in the scores between the two populations particular to their ability to identify information as authentic, reliable, and valid as accessed on the Internet. There were two schools involved with this study; one was a CMS and the other was a traditional high school. The schools are located approximately 3.5 miles apart in rural, south central Pennsylvania. CMS has been in existence since 2012. Students at both schools took the same courses with CMS adding courses related to STEM. Additionally, CMS students are issued an iPad and are expected to use it for classes and projects. The iPad is the fundamental tool used for project-based learning.

The sample group was taken from the current junior class at each school. In order to participate in the study, juniors had to attend CMS or the high school since 2012 so there was alignment in their curriculum for three consecutive years. There were 184 students at CMS and 383 students at the high school. Two testing sessions took place because there were not enough participants during the first draft. The researcher secured permission from the IRB to offer a $10 gift card. This procured more students yet still produced a small sample size. There were 25 participants from CMS and 20 from the high school.

Research Questions

RQ1: Is there a statistically significant difference in high school students’ critical thinking and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in 1:1 iPad programs compared to high school students’
critical thinking and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills?

**RQ2**: Is there a statistically significant difference in high school students’ analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ analysis scores on the TER who are enrolled in a traditional high school setting?

**RQ3**: Is there a statistically significant difference in high school students’ inference scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ inference scores on the TER who are enrolled in a traditional high school setting?

**RQ4**: Is there a statistically significant difference in high school students’ evaluation scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the TER who are enrolled in a traditional high school setting?

**RQ5**: Is there a statistically significant difference in high school students’ induction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ induction scores on the TER who are enrolled in a traditional high school setting?

**RQ6**: Is there a statistically significant difference in high school students’ deduction scores on the Test of Everyday Reasoning (TER) assessment who are involved in a 1:1 iPad program compared to high school students’ deduction scores on the TER who are enrolled in a traditional high school setting?
**RQ7:** Is there a statistically significant difference in high school students’ definition scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ definition scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ8:** Is there a statistically significant difference in high school students’ access scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ access scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ9:** Is there a statistically significant difference in high school students’ evaluation scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ evaluation scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ10:** Is there a statistically significant difference in high school students’ management scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ management scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ11:** Is there a statistically significant difference in high school students’ integration scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ integration scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ12:** Is there a statistically significant difference in high school students’ creative scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school
students’ creative scores on the iSkills assessment who are enrolled in a traditional high school setting?

**RQ13:** Is there a statistically significant difference in high school students’ communication scores on the iSkills assessment who are involved in a 1:1 iPad program compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting?

**Null Hypotheses**

The null hypotheses for this study are:

**H$_{01}$:** There will not be a statistically significant difference in high school students’ information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ information literacy skills who are enrolled in a traditional high school setting as measured by iSkills.

**H$_{02}$:** There will not be a statistically significant difference in high school students’ critical thinking skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER).

**H$_{03}$:** There will not be a statistically significant difference between high school students’ critical thinking skills and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills.
**H₀⁴:** There will not be a statistically significant difference in high school students’ analysis skills who are involved in a 1:1 iPad program compared to high school students’ analysis skills who are enrolled in a traditional high school setting as measured by the TER.

**H₀⁵:** There will not be a statistically significant difference in high school students’ inference skills who are involved in a 1:1 iPad program compared to high school students’ inference skills who are enrolled in a traditional high school setting as measured by the TER.

**H₀⁶:** There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by TER.

**H₀⁷:** There will not be a statistically significant difference in high school students’ induction skills who are involved in a 1:1 iPad program compared to high school students’ induction skills who are enrolled in a traditional high school setting as measured by TER.

**H₀⁸:** There will not be a statistically significant difference in high school students’ deduction skills who are involved in a 1:1 iPad program compared to high school students’ deduction skills who are enrolled in a traditional high school setting as measured by TER.

**H₀⁹:** There will not be a statistically significant difference in high school students’ definition skills who are involved in a 1:1 iPad program compared to high school students’ definition skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀¹⁰:** There will not be a statistically significant difference in high school students’ access skills who are involved in a 1:1 iPad program compared to high school students’ access skills who are enrolled in a traditional high school setting as measured by iSkills.
H₀₁₁: There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by iSkills.

H₀₁₂: There will not be a statistically significant difference in high school students’ management skills who are involved in a 1:1 iPad program compared to high school students’ management skills who are enrolled in a traditional high school setting as measured by iSkills.

H₀₁₃: There will not be a statistically significant difference in high school students’ integration skills who are involved in a 1:1 iPad program compared to high school students’ integration skills who are enrolled in a traditional high school setting as measured by iSkills.

H₀₁₄: There will not be a statistically significant difference in high school students’ creative skills who are involved in a 1:1 iPad program compared to high school students’ creative skills who are enrolled in a traditional high school setting as measured by iSkills.

H₀₁₅: There will not be a statistically significant difference in high school students’ communication skills who are involved in a 1:1 iPad program compared to high school students’ communication skills who are enrolled in a traditional high school setting as measured by iSkills.
## Descriptive Statistics

Table 2

*Summary of Descriptive Statistics for CMS and HS Students*

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Mean CMS</th>
<th>Mean HS</th>
<th>SD CMS</th>
<th>SD HS</th>
<th>Median CMS</th>
<th>Median HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>iSkills overall</td>
<td>234.62</td>
<td>218.42</td>
<td>69.47</td>
<td>60.85</td>
<td>227.78</td>
<td>210.00</td>
</tr>
<tr>
<td>Access</td>
<td>61.07</td>
<td>55.17</td>
<td>14.39</td>
<td>15.50</td>
<td>65.00</td>
<td>56.00</td>
</tr>
<tr>
<td>Comm.</td>
<td>61.78</td>
<td>59.56</td>
<td>10.95</td>
<td>12.59</td>
<td>64.00</td>
<td>61.50</td>
</tr>
<tr>
<td>Create</td>
<td>60.22</td>
<td>55.56</td>
<td>18.00</td>
<td>14.56</td>
<td>60.00</td>
<td>55.00</td>
</tr>
<tr>
<td>Define</td>
<td>58.89</td>
<td>55.28</td>
<td>15.64</td>
<td>15.31</td>
<td>63.00</td>
<td>55.00</td>
</tr>
<tr>
<td>Evaluate</td>
<td>64.11</td>
<td>61.94</td>
<td>18.32</td>
<td>15.59</td>
<td>62.00</td>
<td>55.00</td>
</tr>
<tr>
<td>Integrate</td>
<td>56.30</td>
<td>56.72</td>
<td>11.16</td>
<td>12.95</td>
<td>59.00</td>
<td>55.00</td>
</tr>
<tr>
<td>Manage</td>
<td>61.44</td>
<td>57.44</td>
<td>14.59</td>
<td>16.59</td>
<td>64.00</td>
<td>60.50</td>
</tr>
<tr>
<td>TER overall</td>
<td>21.08</td>
<td>18.89</td>
<td>4.90</td>
<td>5.12</td>
<td>20.00</td>
<td>19.00</td>
</tr>
<tr>
<td>Analysis</td>
<td>5.46</td>
<td>5.37</td>
<td>1.68</td>
<td>1.86</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Inference</td>
<td>9.31</td>
<td>8.16</td>
<td>2.78</td>
<td>2.46</td>
<td>9.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Induction</td>
<td>10.35</td>
<td>9.26</td>
<td>2.31</td>
<td>2.13</td>
<td>10.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Deduction</td>
<td>10.73</td>
<td>9.63</td>
<td>3.10</td>
<td>3.52</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Evaluation</td>
<td>6.31</td>
<td>5.37</td>
<td>1.95</td>
<td>1.83</td>
<td>6.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Table 2 provides descriptive statistics through SPSS for CMS and high school students on the various assessments in iSkills and TER. The overall scores on the iSkills assessment for 25 CMS students (\(M=234.62, SD=69.47, Mdn=227.78\)) and 20 HS students (\(M=218.42, SD=60.85, Mdn=210.00\)) suggest the results were not greatly skewed but there was variability in
The scores on the Access subtest of the iSkills assessment for 25 CMS students 
\((M=61.07, SD=14.39, Mdn=65.00)\) and 20 HS students \((M=55.17, SD=15.50, Mdn=56.00)\) 
suggest the results were not greatly skewed but there was variability in the scores.

The scores on the Communicate subtests on the iSkills assessment for 25 CMS students 
\((M=61.78, SD=10.95, Mdn=64.00)\) and 20 HS students \((M=59.56, SD=12.59, Mdn=61.50)\) 
suggest the results were not greatly skewed but there was variability in the scores.

The scores on the Create subtest of the iSkills assessment for 25 CMS students 
\((M=60.22, SD=18.00, Mdn=60.00)\) and 20 HS students \((M=55.56, SD=14.56, Mdn=55.00)\) 
suggest the results were not greatly skewed but there was variability in the scores.

The scores on the Define subtest on the iSkills assessment for 25 CMS students 
\((M=58.89, SD=15.64, Mdn=63.00)\) and 20 HS students \((M=55.28, SD=15.31, Mdn=55.00)\) 
suggest the results were not greatly skewed, but there was variability in the scores.

The scores on the Evaluate subtest of the iSkills assessment for 25 CMS students 
\((M=64.11, SD=18.32, Mdn=62.00)\) and 20 HS students \((M=61.94, SD=15.59, Mdn=55.00)\) 
suggest the results were not greatly skewed but there was variability in the scores.

The scores on the Integrate subtest of the iSkills assessment for 25 CMS students 
\((M=56.30, SD=11.16, Mdn=59.00)\) and 20 HS students \((M=56.72, SD=12.95, Mdn=55.00)\) 
suggests the results were not greatly skewed, but there was variability in the scores.

The scores on the Manage subtest of the iSkills assessment for 25 CMS students 
\((M=61.44, SD=14.59, Mdn=64.00)\) and 20 HS students \((M=57.44, SD=16.59, Mdn=60.50)\) 
suggest the results were not greatly skewed but there was variability in the scores.
The overall scores on the TER assessment for 25 CMS students ($M=21.08$, $SD=4.90$, $Mdn=20.00$) and 20 HS students ($M=18.89$, $SD=5.12$, $Mdn=19.00$) suggest the results were not greatly skewed but there was variability in the scores.

The Analysis subtest scores on the TER assessment for 25 CMS students ($M=5.46$, $SD=1.68$, $Mdn=5.00$) and 20 HS students ($M=5.37$, $SD=1.86$, $Mdn=5.00$) suggest the results were not greatly skewed but there was variability in the scores.

The Inference subtest scores on the TER assessment for 25 CMS students ($M=9.31$, $SD=2.78$, $Mdn=9.00$) and 20 HS students ($M=8.16$, $SD=2.46$, $Mdn=8.00$) suggest the results were not greatly skewed but there was variability in the scores.

The Induction subtest scores on the TER assessment for 25 CMS students ($M=10.35$, $SD=2.31$, $Mdn=10.00$) and 20 HS students ($M=9.26$, $SD=2.13$, $Mdn=9.00$) suggest the results were not greatly skewed but there was variability in the scores.

The Deduction subtest scores on the TER assessment for 25 CMS students ($M=10.73$, $SD=3.19$, $Mdn=10.00$) and 20 HS students ($M=9.63$, $SD=3.52$, $Mdn=10.00$) suggest the results were not greatly skewed but there was variability in the scores.

The Evaluation subtest scores on the TER assessment for 25 CMS students ($M=6.31$, $SD=1.95$, $Mdn=6.00$) and 20 HS students ($M=5.37$, $SD=1.83$, $Mdn=5.00$) suggest the results were not greatly skewed but there was variability in the scores.

**Results**

SPSS was used to run an independent samples $t$-test for each of the assessments. A summary of the results from each test and subtest are listed below.
Null Hypothesis One

The first research question attempted to ascertain whether or not there was a significant difference between high school students’ critical thinking and information literacy skills who were enrolled in a 1:1 iPad program at a magnet school and those who were in a traditional high school setting as measured by the iSkills assessments and TER. $H_0$ stated: There will not be a statistically significant difference in high school students’ information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ information literacy skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean iSkills overall score differed between CMS students involved in an iPad program ($M=234.62$, $SD=69.47$) and those in a traditional high school program ($M=218.42$, $SD=60.85$); $t(45)=.81$, $p=.42$; therefore, there is a failure to reject the null hypothesis.
Table 3

Results of Overall Analysis Skills of HS Students on iSkills

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>25</td>
<td>234.62</td>
<td>69.468</td>
<td>13.624</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>218.42</td>
<td>60.852</td>
<td>13.960</td>
</tr>
</tbody>
</table>

Independent Samples Test

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
</tbody>
</table>

Null Hypothesis Two

\( H_0 \) 2 to the first research question stated: There will not be a statistically significant difference in high school students’ critical thinking skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER).

For each data point, an independent samples \( t \)-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean TER overall score differed between CMS students involved in an iPad program (\( M=21.08, SD=4.90 \)) and those in a traditional high school program (\( M=18.89, SD=5.12 \)); \( t \) (45)=1.45, \( p=.16 \); therefore, there is a failure to reject the null hypothesis.
Table 4

Results of Overall Analysis Skills of HS Students on TER

**Group Statistics**

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>45</td>
<td>21.0769</td>
<td>4.89835</td>
<td>.96065</td>
</tr>
<tr>
<td>CMS</td>
<td>25</td>
<td>21.0769</td>
<td>4.89835</td>
<td>.96065</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>18.8947</td>
<td>5.11962</td>
<td>1.17452</td>
</tr>
</tbody>
</table>

**Independent Samples 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>Overall</td>
<td>.001</td>
<td>.975</td>
</tr>
</tbody>
</table>

**Null Hypothesis Three**

$H_0$: to the first research question stated: There will not be a statistically significant difference between high school students’ critical thinking skills and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills.

For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the overall mean of the iSkills assessment differed between CMS students involved in an iPad
program ($M=218.42$, $SD=60.85$) and those in a traditional high school program ($M=234.62$, $SD=69.47$); $t(45)=1.45$, $p=.16$. There was also not significant evidence in the scores to show that the overall mean of the TER differed between CMS students involved in an iPad program ($M=18.89$, $SD=5.12$) and those in a traditional high school program ($M=21.08$, $SD=4.90$); $t(45)=.81$, $p=.42$; therefore, there is failure to reject the null hypothesis for both groups in both assessments.

**Null Hypothesis Four**

The second research question attempted to ascertain whether or not there was a significant difference in high school students’ analysis scores on the TER who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. $H_0$ stated: There will not be a statistically significant difference in high school students’ analysis skills who are involved in a 1:1 iPad program compared to high school students’ analysis skills who are enrolled in a traditional high school setting as measured by the TER.

For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean TER analysis score differed between CMS students involved in an iPad program ($M=5.46$, $SD=1.68$) and those in a traditional high school program ($M=5.37$, $SD=1.86$); $t(45)=-18$, $p=.86$; therefore, there is a failure to reject the null hypothesis.
Table 5

Results of Analysis Subtest on TER

**Group Statistics**

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>25</td>
<td>5.4615</td>
<td>1.6783</td>
<td>.32925</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>5.3684</td>
<td>1.8622</td>
<td>.42722</td>
</tr>
</tbody>
</table>

**Independent Samples 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>Analysis</td>
<td>.212</td>
<td>.647</td>
</tr>
</tbody>
</table>

**Null Hypothesis Five**

The third research question attempted to ascertain whether or not there was a significant difference in high school students’ inference scores on the TER who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. H₀5 stated: There will not be a statistically significant difference in high school students’ inference skills who are involved in a 1:1 iPad program compared to high school students’ inference skills who are enrolled in a traditional high school setting as measured by TER.

For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean TER inference score differed between CMS students involved in an iPad program...
\((M=9.31, SD=2.78)\) and those in a traditional high school program \((M=8.16, SD=2.78)\); \(t(45)=1.44, p=.16\); therefore, there is a failure to reject the null hypothesis.

Table 6

*Results of Inference Subtest on TER*

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inference</td>
<td>CMS</td>
<td>25</td>
<td>9.3077</td>
<td>2.78236</td>
</tr>
<tr>
<td></td>
<td>CASHS</td>
<td>20</td>
<td>8.1579</td>
<td>2.45545</td>
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</table>

**Independent Samples Test**

<table>
<thead>
<tr>
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<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>Inference</td>
<td>.846</td>
<td>.363</td>
</tr>
</tbody>
</table>

**Null Hypothesis Six**

The fourth research question attempted to ascertain whether or not there was a significant difference in high school students’ evaluation scores on the TER who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. \(H_0\) stated: There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by TER.
For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean TER evaluate subtest score differed between CMS students involved in an iPad program ($M=6.31$, $SD=1.95$) and those in a traditional high school program ($M=5.37$, $SD=1.83$); $t(45)=1.63$, $p=.11$; therefore, there is a failure to reject the null hypothesis.
Table 7

*Result of Evaluation Subtest on TER*

**Group Statistics**

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation</td>
<td>CMS</td>
<td>25</td>
<td>6.3077</td>
<td>1.95488</td>
</tr>
<tr>
<td></td>
<td>CASHS</td>
<td>20</td>
<td>5.3684</td>
<td>1.83214</td>
</tr>
</tbody>
</table>

**Independent Samples 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>Evaluation</td>
<td>.074</td>
<td>.787</td>
</tr>
</tbody>
</table>

**Null Hypothesis Seven**

The fifth research question attempted to ascertain whether or not there was a significant difference in high school students’ induction scores on the TER who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. \( H_07 \) stated: There will not be a statistically significant difference in high school students’ induction skills who are involved in a 1:1 iPad program compared to high school students’ induction skills who are enrolled in a traditional high school setting as measured by TER.

For each data point, an independent samples \( t \)-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean iSkills induction subtest scores differed between CMS students involved in an iPad
program ($M=10.35$, $SD=2.31$) and those in a traditional high school program ($M=9.26$, $SD=2.31$); $t(45)=1.60$, $p=.12$; therefore, there is a failure to reject the null hypothesis.

Table 8

*Results of Induction Subtest on TER*

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>25</td>
<td>10.362</td>
<td>2.31417</td>
<td>.45385</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>9.263</td>
<td>2.13026</td>
<td>.48872</td>
</tr>
</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>1.000</td>
<td>.987</td>
</tr>
<tr>
<td>1.603</td>
<td>.116</td>
</tr>
<tr>
<td>45</td>
<td>.012</td>
</tr>
</tbody>
</table>

95% Confidence Interval of the Difference

<table>
<thead>
<tr>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>-.27983</td>
<td>2.44582</td>
</tr>
</tbody>
</table>

**Null Hypothesis Eight**

The sixth research question attempted to ascertain whether or not there was a significant difference in high school students’ deduction scores on the TER who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. $H_08$ stated: There will not be a statistically significant difference in high school students’ deduction skills who are involved in a 1:1 iPad program compared to high school students’ deduction skills who are enrolled in a traditional high school setting as measured by iSkills.
For each data point, an independent samples \( t \)-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean iSkills deduction subtest scores differed between CMS students involved in an iPad program \((M=10.73, SD=3.19)\) and those in a traditional high school program \((M=9.63, SD=3.52)\); \(t(45)=1.09, p=.28\); therefore, there is a failure to reject the null hypothesis.

Table 9

*Results Deduction Subtest on TER*

**Group Statistics**

<table>
<thead>
<tr>
<th>Categories</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMS</td>
<td>25</td>
<td>10.7308</td>
<td>3.19447</td>
<td>.62649</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>9.6316</td>
<td>3.51521</td>
<td>.80645</td>
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</table>

**Independent Samples 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>Deduction</td>
<td>.078</td>
<td>.782</td>
</tr>
</tbody>
</table>

**Null Hypothesis Nine**

The seventh research question attempted to ascertain whether or not there was a significant difference in high school students’ definition scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. \(H_09\) stated:

There will not be a statistically significant difference in high school students’ definition skills.
who are involved in a 1:1 iPad program compared to high school students’ definition skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the mean iSkills define subtest scores differed between CMS students involved in an iPad program ($M=58.89$, $SD=15.64$) and those in a traditional high school program ($M=55.28$, $SD=15.32$); $t(45)=.77$, $p=.45$; therefore, there is a failure to reject the null hypothesis.
Table 10

Results of Define Subtest on iSkills Assessment

Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define CMS</td>
<td>25</td>
<td>58.8889</td>
<td>15.63609</td>
<td>3.00917</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>55.2778</td>
<td>15.31937</td>
<td>3.61081</td>
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</tbody>
</table>

Independent Samples Test

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Define</td>
<td>.135</td>
<td>.715</td>
</tr>
</tbody>
</table>

Null Hypothesis Ten

The eighth research question attempted to ascertain whether or not there was a significant difference in high school students’ access scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. H₀₁₀ stated: There will not be a statistically significant difference in high school students’ access skills who are involved in a 1:1 iPad program compared to high school students’ access skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the access subtest iSkills scores differed between CMS students involved in an iPad program
(\(M=61.07, SD=14.39\)) and those in a traditional high school program (\(M=55.17, SD=15.50\)); 
\(t(45)=1.31, p=.20\); therefore, there is a failure to reject the null hypothesis.

Table 11

*Results of Access Subtest on iSkills*

**Group Statistics**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>25</td>
<td>61.0741</td>
<td>14.39264</td>
<td>2.76987</td>
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<tr>
<td>CASHS</td>
<td>20</td>
<td>55.1667</td>
<td>15.50047</td>
<td>3.65350</td>
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</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Equality of Variances</td>
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<td>Mean Difference</td>
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<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Access</td>
<td>.204</td>
<td>.654</td>
<td>1.308</td>
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</tbody>
</table>

**Null Hypothesis Eleven**

The ninth research question attempted to ascertain whether or not there was a significant difference in high school students’ evaluation scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. \(H_{011}\) stated: There will not be a statistically significant difference in high school students’ evaluation skills who are involved in a 1:1 iPad program compared to high school students’ evaluation skills who are enrolled in a traditional high school setting as measured by iSkills.
For each data point, an independent samples $t$-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the evaluate subtest iSkills scores differed between CMS students involved in an iPad program ($M=64.11, SD=18.32$) and those in a traditional high school program ($M=61.94, SD=15.59$); $t(45)=.41, p=.68$; therefore, there is a failure to reject the null hypothesis.
Table 12

*Results of Evaluate Subtest on iSkills*

### Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>25</td>
<td>64.1111</td>
<td>18.32051</td>
<td>3.52578</td>
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<td>CASHS</td>
<td>20</td>
<td>61.9444</td>
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<td>3.67421</td>
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### Independent Samples Test

<table>
<thead>
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</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Evaluate</td>
<td>.395</td>
<td>.533</td>
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### Null Hypothesis Twelve

The tenth research question attempted to ascertain whether or not there was a significant difference in high school students’ management scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. H₀₁₂ stated: There will not be a statistically significant difference in high school students’ management skills who are involved in a 1:1 iPad program compared to high school students’ management skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that
the manage subtest iSkills scores differed between CMS students involved in an iPad program (M=61.44, SD=14.59) and those in a traditional high school program (M=57.44, SD=16.59); t(45)=.853 p=.40; therefore, there is a failure to reject the null hypothesis.
Table 13

Results of Manage Subtest on iSkills

### Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
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<td>61.4444</td>
<td>14.59276</td>
<td>2.80838</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>57.4444</td>
<td>16.59278</td>
<td>3.91096</td>
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### Independent Samples Test

<table>
<thead>
<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Manage</td>
<td>.581</td>
<td>.450</td>
</tr>
</tbody>
</table>

**Null Hypothesis Thirteen**

The eleventh research question attempted to ascertain whether or not there was a significant difference in high school students’ integration scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. H$_{013}$ stated: There will not be a statistically significant difference in high school students’ integration skills who are involved in a 1:1 iPad program compared to high school students’ integration skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the integrate subtest of iSkills scores differed between CMS students involved in an iPad
program \((M=56.30, SD=11.16)\) and those in a traditional high school program \((M=56.72, SD=12.95)\); \(t(45)=-.12, p=.91\); therefore, there is a failure to reject the null hypothesis.

Table 14

Results of Integrate Subtest on iSkills

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrate</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMS</td>
<td>25</td>
<td>56.2963</td>
<td>11.15904</td>
<td>2.14756</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>56.7222</td>
<td>12.94698</td>
<td>3.05163</td>
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</tbody>
</table>

Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Integrate</td>
<td>.892</td>
<td>.350</td>
<td>-.118</td>
</tr>
</tbody>
</table>

Null Hypothesis Fourteen

The twelfth research question attempted to ascertain whether or not there was a significant difference in high school students’ creative scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. The \(H_{014}\) stated: There will not be a statistically significant difference in high school students’ creative skills who are involved in a 1:1 iPad program compared to high school students’ creative skills who are enrolled in a traditional high school setting as measured by iSkills.
For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that the create subtest of iSkills scores differed between CMS students involved in an iPad program ($M=60.22, SD=18.01$) and those in a traditional high school program ($M=55.56, SD=14.56$); $t(45)=.92, p=.36$; therefore, there is a failure to reject the null hypothesis.
Table 15

*Results of Create Subtest on iSkills*

### Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
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<td>60.2222</td>
<td>18.00712</td>
<td>3.46547</td>
</tr>
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<td>CMS</td>
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<td>55.5556</td>
<td>14.55708</td>
<td>3.43114</td>
</tr>
<tr>
<td>CASHS</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Independent Samples Test

<table>
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<tr>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>Create</td>
<td>4.317</td>
</tr>
</tbody>
</table>

### Null Hypothesis Fifteen

The thirteenth research question attempted to ascertain whether or not there was a significant difference in high school students’ communication scores on the iSkills who were enrolled in the 1:1 iPad program compared to students in a traditional high school setting. The H₀₁₅ stated: There will not be a statistically significant difference in high school students’ communication skills who are involved in a 1:1 iPad program compared to high school students’ communication skills who are enrolled in a traditional high school setting as measured by iSkills.

For each data point, an independent samples t-test was used to compare the means with an alpha level of .05 significance. There was not significant evidence in the scores to show that
the communicate subtest iSkills scores differed between CMS students involved in an iPad program \( (M=61.78, \text{SD}=10.95) \) and those in a traditional high school program \( (M=59.56, \text{SD}=12.59) \); \( t(45)=.63, \quad p=.53 \); therefore, there is a failure to reject the null hypothesis.
Table 16

*Results of Communicate Subtest on iSkills*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMS</td>
<td>25</td>
<td>61.7778</td>
<td>10.94860</td>
<td>2.10706</td>
</tr>
<tr>
<td>CASHS</td>
<td>20</td>
<td>59.5556</td>
<td>12.58955</td>
<td>2.96739</td>
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**Independent Samples Test**

<table>
<thead>
<tr>
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<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Sig.</td>
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<tr>
<td>Communication</td>
<td>.567</td>
<td>.455</td>
</tr>
</tbody>
</table>

**Summary**

Descriptive and inferential statistics were used to explore each of the thirteen research questions. There were overall research questions that incorporated the entire assessment as well as subtest scores. The scores reflected on all accounts that there was a failure to reject the null hypothesis due to the elevated $p$ value that was over 0.05. Additionally, variability was also noted with many of the assessments, yet the median score closely related to the mean and did not exceed the standard deviation. Chapter five will delve further into the discussion of these scores.
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

One of the basic foundations of learning is critical thinking skills. As students build knowledge, they must be able to generalize, transfer, and apply that knowledge from one context to another (Limberg et al., 2012). Since critical thinking skills are not a natural inclination, schools are accountable to fulfill that role (Angeli & Valanides, 2009). Snyder and Snyder (2008) stated that even naturally inquisitive children do not have the natural skills to become a critical thinker. With the information age moving rapidly forward, critical thinking skills are imperative in the work force as employers expect their workers to be creative and adaptable to learning so that innovation can take place within their companies. Studies show that students are ill-equipped with critical thinking skills (Wang et al., 2009).

Alongside critical thinking skills are issues related to the rapid development of technology. Schools are implementing various devices and laptops into their curriculum as well as applications and databases. While this change has brought about improvements in learning, it has also brought about challenges to the education environment in not only trying to keep up with technology advances, but to also allow the integration to be meaningful to students (Bouhick & Giat, 2009). To be information literate, a person should possess the following skills in regards to information: recognize what is needed; distinguish how to address the gap; and construct strategies for location, accessing, comparing and evaluating, organizing, applying, communicating, synthesizing and creating. Information literacy inadvertently encompasses teaching students critical thinking skills (Shantaram, 2012).

Students have increased exposure to digital tools and may be familiar with them, but this has not transitioned into their adeptness at securing the skills they need for a specific task.
Internet sources are unrestricted and can include partial, biased, or distorting information. With this abundance of information, the assumption could be taken that better informed students are being produced, when actually students are impeded in their ability to distinguish factual information from false, identify underlying motives or reaching sound and reasoned opinions (Bouhick & Giat, 2009; Shantaram, 2012).

The partnership of critical thinking skills and information literacy skills cannot be ignored as students are forced to filter through the magnitude of material provided for them via the Internet. Discerning authentic, reliable, and valid information is now their responsibility. While the information in and of itself does not allow a student to be successful, the process of using critical thinking skills to evaluate the material produces success (Gibson, 2012).

Even though students may be comfortable with the technology afforded them, it may be mistakenly assumed they also have a solid working knowledge of it (M.Allen, 2008). Therefore, students may not understand their need for critical thinking skills and further may not understand how to form the necessary questions to filter material. Their false sense of ability to evaluate material could inherently work as a handicap.

Quantitative research was used to gain insight into critical thinking skills and information literacy skills among high school students who attended a 1:1 iPad program and those who attended a traditional high school. This study was conducted in two sessions in the spring of 2015. Permission was received to conduct the study from the superintendent of the school district as well as securing cooperation from each principal. Permission was subsequently secured from the students’ parents. Students were identified through numbers that were assigned by each assessment. There was one custom question at the end of each assessment that asked if the student attended CMS or high school. They chose either 1 (CMS) or 2 (CASHS).
The assessments were taken online at the high school during the students’ activity period or club time. The principal from CMS proctored the assessments. There were no incidences reported during the assessments.

The overall research question asked if there is a statistically significant difference in high school students’ critical thinking and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in 1:1 iPad programs compared to high school students’ critical thinking and information literacy skills who are enrolled in a traditional high school setting as measured by TER and iSkills.

**H₀₁**: There is no statistically significant difference in high school students’ information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ information literacy skills who are enrolled in a traditional high school setting as measured by iSkills.

**H₀₂**: There is no statistically significant difference in high school students’ critical thinking skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ critical thinking skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER).

**H₀₃**: There is no statistically significant difference between high school students’ critical thinking skills and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in a 1:1 iPad program compared to high school students’ who are enrolled in a traditional high school setting as measured by TER and iSkills.

Research question two asked if there is a statistically significant difference in high school students’ analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved
in 1:1 iPad programs compared to high school students’ analysis scores on the TER who are enrolled in a traditional high school setting.

**H04:** There is no statistically significant difference in high school students’ information analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ analysis scores on the TER who are enrolled in a traditional high school setting.

Research question three asked if there is a statistically significant difference in high school students’ inference scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ inference scores on the TER who are enrolled in a traditional high school setting.

**H05:** There is no statistically significant difference in high school students’ inference scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ inference scores on the TER who are enrolled in a traditional high school setting.

Research question four asked if there is a statistically significant difference in high school students’ evaluation scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ evaluation scores on the TER who are enrolled in a traditional high school setting.

**H06:** There is no statistically significant difference in high school students’ evaluation scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ evaluation scores on the TER who are enrolled in a traditional high school setting.
Research question five asked if there is a statistically significant difference in high school students’ induction scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ induction scores on the TER who are enrolled in a traditional high school setting.

**H_{07}:** There is no statistically significant difference in high school students’ information induction scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ induction scores on the TER who are enrolled in a traditional high school setting.

Research question six asked if there is a statistically significant difference in high school students’ deduction scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ deduction scores on the TER who are enrolled in a traditional high school setting.

**H_{08}:** There is no statistically significant difference in high school students’ deduction analysis scores on the Test of Everyday Reasoning (TER) assessment who are involved in 1:1 iPad programs compared to high school students’ deduction scores on the TER who are enrolled in a traditional high school setting.

Research question seven asked if there is a statistically significant difference in high school students’ definition scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ definition scores on the iSkills assessment who are enrolled in a traditional high school setting.

**H_{09}:** There is no statistically significant difference in high school students’ definition scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school
students’ definition scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question eight asked if there is a statistically significant difference in high school students’ access scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ access scores on the iSkills assessment who are enrolled in a traditional high school setting.

\textbf{H_{010}}: There is no statistically significant difference in high school students’ access scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ access scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question nine asked if there is a statistically significant difference in high school students’ evaluation scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ evaluation scores on the iSkills assessment who are enrolled in a traditional high school setting.

\textbf{H_{011}}: There is no statistically significant difference in high school students’ evaluation scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ evaluation scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question ten asked if there is a statistically significant difference in high school students’ management scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ management scores on the iSkills assessment who are enrolled in a traditional high school setting.
**H₀₁₂**: There is no statistically significant difference in high school students’ management scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ management scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question eleven asked if there is a statistically significant difference in high school students’ integration scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ integration scores on the iSkills assessment who are enrolled in a traditional high school setting.

**H₀₁₃**: There is no statistically significant difference in high school students’ integration scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ integration scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question twelve asked if there is a statistically significant difference in high school students’ creative scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ creative scores on the iSkills assessment who are enrolled in a traditional high school setting.

**H₀₁₄**: There is no statistically significant difference in high school students’ creative scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ creative scores on the iSkills assessment who are enrolled in a traditional high school setting.

Research question thirteen asked if there is a statistically significant difference in high school students’ communication scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting.
programs compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting.

**H₀15**: There is no statistically significant difference in high school students’ communication scores on the iSkills assessment who are involved in 1:1 iPad programs compared to high school students’ communication scores on the iSkills assessment who are enrolled in a traditional high school setting.

The high associated p values for each of these tests and subtests indicate that no statistically significant difference existed between students’ information literacy skills and critical thinking skills who were enrolled in either the 1:1 iPad program or those who were enrolled in a traditional high school setting. Consequently, the null hypothesis for each research question failed to be rejected. This suggests that students who are enrolled in 1:1 iPad programs do not score higher on information literacy skills or critical thinking skills than those enrolled in the traditional high school setting. However, consideration must be given to variability in the scores as indicated by the confidence levels and standard deviations with additional consideration being given to the small sample size. This variability could be due to the small sample sizes as well as the iSkills subtests having fewer than 50 participants which reduces the validity and reliability of those scores.

**Conclusions**

A recurring theme through literature has been that exposure to technology does not equal proficiency (Marcus, 2009). Van Duersen and van Dijk (2010) highlighted the fact that few studies have been conducted and do not delve into specific skills that have been measured and therefore, a deeper understanding is needed of the skills of an Internet user. Tan and Guo (2010) agreed that in efforts to investigate the expanse of digital literacy, it has, in some cases, made the
picture more complex due to various resources schools have, training of teachers, training of students, and differing opinions of educators. Since this study failed to reject the null hypothesis, it is difficult to make conclusions as to the effectiveness of the iPad program versus limited technology in a traditional high school. A higher sample study might have brought about a more conclusive deduction. Ongoing investigation into the effectiveness of a 1:1 iPad program on students’ critical thinking skills and information literacy skills would be helpful to educate students further. Intentionally teaching these skills should be a consideration as schools implement curriculum planning.

Critical thinking skills are the foundation for thinking beyond the concrete. Investigating the importance of these skills is of increasing need due to the rising demand from employers (Snyder & Snyder, 2008). The effect of technology on critical thinking skills captured this researchers’ interest as the two are tied together with analyzing, synthesizing, evaluating, and reasoning through information that is posed on the Internet (Limberg et al., 2012). Information literacy skills are clearly linked with critical thinking skills in that students cannot discern the information intelligently without the tools of critical thinking. Since this is not a natural inclination, then educators are tasked with how to educate students appropriately on these skills (Angeli & Valanides, 2009).

The scores on TER and iSkills do not reflect notable difference between traditional high school students and magnet school students. This would suggest that the 1:1 iPad program does not show a great effect on students’ critical thinking or information literacy skills. Exposure does not simply appear to be enough to create these skills in students. Part of the plan for any educational institution would not to simply implement technology, but to also train students in how to think about technology and how to discern what they are being exposed to on the
Internet. These are skills that should be taught to students no matter the context, but the educational system may not have been as aggressive in teaching these skills as needed. Additionally, when these skills are taught, they may be taught in isolation and not connected to the task at hand. Connecting critical thinking skills and information literacy skills to assigned projects could enhance student learning in those areas.

Even though it was not significant, scores for CMS students were slightly increased over traditional high school student’s scores. This indicates that immersion in technology does not hinder student learning. The ICT course could have been a factor in these increased scores.

The further expanse of generalizing, transferring, and applying the knowledge gained from one context to another would be the next step after using critical thinking skills and information literacy skills in the present context (Limberg et al., 2012). Making sense of new information and using it in a creative manner is the goal that will mark students as being successful in the workplace as well as successful in discerning information presented to them through various media as being authentic, reliable, and valid (Akyuz & Samsa, 2009). Educators need to push beyond the basic skills of reading, writing, and math to more complex strategies using critical thinking and information literacy skills based on real world problem solving.

Education is unfortunately one of the areas that lag in keeping up with real world advances. These advances force educators to respond, cope, and change, but the response may not be aligning with success for students (Spektor-Levy & Granot-Gilat, 2012). Gaps that have not existed before are widening rapidly as educators grapple with how to keep technology relevant and affordable in light of the constant availability of various devices.

The responsibility of adapting students to the innovations of technology falls on the educator (J. Allen, 2010). If this responsibility is not taken, students are at a disadvantage once
they reach the working world (Saad et al., 2012). While the role of the teacher has changed from being an up front lecturer to coming along beside the student, using methods of instruction embedded in content material can better target critical thinking skills. Intentional teaching of these skills through real-world cases and open-ended discussions and fostering inquiry-based experiments will benefit students especially if repeated (Marin & Halpern, 2011).

Adolescence and young adulthood is the premium time to develop higher order thinking skills (Marin & Halpern, 2011). If those skills are not developed, there can be lasting effects through adulthood (Gamino et al., 2010). The high school years are a pivotal stage to have higher order thinking skills understood and refined.

One of the major factors in the gap is that students have the false perception that they are adept at using technology because they are exposed to it and use it often (Leung, 2009; Smith, 2013). This perception can inhibit their willingness to learn how to sift through the information and learn that critical thinking skills and information literacy skills are needed to sort through the information presented to them. Exposure has not necessarily translated to proficiency in identifying helpful information as the scores between the high school students and magnet school students are not very different. There are gaps in research on specific skills needed to be prolific in critical thinking and information literacy. Studies are lacking and more need to be conducted in order to add to the base of how to promote student learning (van Deursen and van Dijik, 2010). A deeper understanding is needed of skilled and unskilled users of the Internet so there can be advances in learning instead of adding technology and devices. Student needs in those areas are widening as they are not being addressed.

If there are skills unexplored that students are lacking, their success rate will not increase. Construction has to be based on something that they understand. If they have false understanding
based on a false principle that they understand information presented to them from the Internet, false conclusions and concepts will be formed upon which they base their assumptions. Constructivism is based on students constructing ideas through a personal process with the information being assimilated and accommodated to construct into schema (Powell & Kalina, 2009). Making sense of that schema through new information becomes instrumental as students attempt to discern information they encounter on the Internet. They must become their own editors. Based on the above discussion, students construct ideas through a personal process by using information with which they have come in contact.

The constructivist theory promotes self-learning which aligns itself with the information age. But, students have to know the correct questions to ask while sorting through the material as an individual (M. Allen, 2008). This theory takes into account that an individual makes learning happen (Adams, 2006). There is an increase in the necessity for students to be critical thinkers in not only interacting with information assessed from the Internet, but also engaging with the world around them.

Self-learning requires questioning. The Internet brings an abundance of knowledge that is rapid and changing (Siemens, 2004). This brings about a new dynamic for students. They not only have to go through the knowledge they encounter on the Internet, but they must also assess it rapidly to determine its worthiness (Siemens, 2004). Forming those judgments is part of the learning that happens within the student. Without the appropriate critical thinking and information literacy skills in place to filter that judgment, students can steer in the wrong direction of learning. The teacher, acting as a guide, is important in this so that the real life circumstance can be addressed together in discerning the information.
The definition of literacy has expanded to include multimedia (Leu et al., 2011). This has forced educators to adapt, change, and innovate their teaching methods and delivery. Technology has added to the complexity of developing literacy skills competent for 21st century learning. This complexity has grown and will continue to grow which will have educators continually refining methods of delivery. The foundational skills of critical thinking and information literacy allow students to close the gap of reading information and generalizing it to other concepts. Using appropriate contexts, aids in these skills (Sherman et al., 2009). The key is educators and administration realizing that students have to be taught these skills with intentionality.

**Implications**

This study adds to the existing body of knowledge by reporting scores in two critical areas of education: critical thinking skills and information literacy skills. Although the results are limiting in making generalizations, this study can be a catalyst to other studies to investigate the effectiveness of technology in these two important areas. Research is needed to understand the challenges educators face as they try to implement new literacies in the classroom (Tan & Guo, 2010).

Educators may find this information useful as they plan curriculum so students are being taught critical thinking skills and information literacy skills. The ever changing world of technology will continue to challenge teachers to educate students in navigating information they encounter on the Internet for educational purposes. Assumptions can no longer be made that because students are savvy users of technology, they are also savvy users of the information presented through that technology (Gibson 2012; Shantaram, 2012).

Research directed at trying to understand the relationship of technology and information literacy skills and critical thinking may need to be further evaluated to see if there is a significant
influence in the way these skills are developed. Research points to the probability that there is an impact on critical thinking skills and information literacy skills if they are directly taught (Shantaram, 2012; Mandusic & Blaskovic, 2013; Gibson, 2012); however, because of the limitations of this study, the ability to validate or not validate was not attainable.

In regards to the length of time students were immersed in the 1:1 iPad program, a longitudinal study that tracks students through a number of years would be beneficial. Over time individuals continue to adapt and develop mental processing skills. Having exposure to learning over a longer period of time could bear more accurate results on how these programs influence learners.

**Limitations**

There were several limitations that contributed to this study. One of the limitations was the narrowness of the requirements for participation in the study. Students had to attend their school for all three years and only one class (juniors) was targeted. Having a broader range of participants could have expanded the sample base. Students in grades 10-12 could have been recruited who attended their school for at least one year. Expansion could have also taken place by offering this opportunity to other 1:1 high schools as well as traditional high schools.

Recruitment was one of the difficulties of this study. While there was strong support from the principal of one school, the support from the other principal was not as high. The researcher was at the mercy of the principals to recruit students. If a principal does not fulfill that due to time factors or lack of support for the study, the participant involvement is limited. The first attempt to recruit students was very limited with an average of 5-10 students from each school showing interest. Adjustments were made to offer a gift card and interest increased which resulted in another testing date, but it was not at the level that would create a robust sample size.
This was one of the most limiting factors in this study.

Another limitation was the timing of the study. Though the intention was to have the study administered in the fall, other factors slowed down this process such as approval from IRB, communication and approval with administration at the school district, and sensitivity to each school’s calendar in terms of semester changes and state testing. The TER and iSkills were performed in April and May when there tends to be many activities. Finding a mutually satisfying date for both schools was challenging. The first testing date was impeded because of clubs being scheduled at the same time. The second testing date was the last week of May which is close to the end of the school year, and students are typically ready for school to end.

Because of the small sample size, iSkills would not release subtest scores if less than 50 students took the test. In communicating with the creator of the assessment, this was due to the fact that the subtests are highly correlated with each other and with the main score. The sub scores are based on relatively few items, and consequently, do not have good reliability with small sample sizes. The researcher made an exception for this study due to it being based on research for a dissertation. This caused another limitation that the subtest scores for iSkills were not reliable even though they were reported in this paper.

The time period to expect students in the 1:1 iPad program to have a noticeable difference could also have been a factor. Students were immersed in a 1:1 iPad program for a period of 3 years. More time in a program such as this could render higher testing scores.

**Recommendations for Future Research**

Even though the $p$ value was too high to make a decisive conclusion on students’ ability to discern information from the Internet, there was value in analyzing the scores and observing the similarities between the groups. Further research would be helpful to continue investigation
into this field. Technology and using the resources that accompany it will continue to grow in educational settings. Finding out how to best use these tools is imperative as educators not only need to help students through their academics, but they also need to help them navigate the digital world and discern authentic, reliable, and valid information.

Broadening the study sample would give potential to an increased sample size. Including other 1:1 schools and traditional high schools who have similar demographics would be one factor to contribute to a more successful recruitment. Limiting to one school district restricted the participants as well as the value of the scores.

Focusing on a particular content area such as social studies between a 1:1 school and traditional high school would produce a more concentrated set of scores on specific skills. Coordination between the schools in teaching the same unit, through different means would pose a challenge, but the results could be useful for future planning of educational venues.

Consideration could be given to administering different assessments. The assessments used for this study were satisfactory, but investigation into other tests could meet the criteria for high school students in a more productive manner. These assessments were geared for upper level high school and college students.

A possibility of the slightly higher scores on TER and iSkills for CMS students could be attributed to the ICT course available at the school. Measuring student efficacy in critical thinking skills and information literacy skills in light of ICT training could give further insight into the difference in scores between two groups who did and did not experience this course.

The only customized questions asked in these tests were if students attended CMS or CASHS. For future research, more questions should be asked so that more information is gained as needed for processing the results. Examples of possible questions to consider are: students’
GPA, time spent on the Internet for entertainment versus academics, scores in state assessments, attitude toward researching on the Internet, and student interest level in participating in the study.
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January 13, 2015

Patricia Flood
IRB Exemption 2060.011315: Information Literacy Skills and Critical Thinking Skills: Discerning Online Information among High School Students

Dear Patricia,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:
(i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation.

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

Fernando Garzon, Psy.D.
Professor, IRB Chair
Counseling

(434) 592-4054
October 15, 2014

Mrs. Patty Flood
Shalom Christian Academy
126 Social Island Road
Chambersburg PA 17202

To Whom It May Concern:

I have given Mrs. Flood approval to do research related to her dissertation within the Chambersburg Area School District.

Dr. Mark Long and Brad Ocker will assist her with research as it relates to providing each student with an approximately 45 minute assessment.

If you have any questions please feel free to contact me.

Cc: Dr. Mark Long
    Brad Ocker
APPENDIX C

The Liberty University Institutional Review Board has approved this document for use from 1/13/15 to 1/13/16
Protocol # 2069.011315

CONSENT FORM

INFORMATION LITERACY SKILLS AND CRITICAL THINKING SKILLS: DISCERNING ONLINE INFORMATION AMONG HIGH SCHOOL STUDENTS
Patricia Flood
Liberty University
Education Department

INTRODUCTION: Your child/student is being asked to take part in a research study of how well students can discern information accessed from the Internet as authentic, reliable, and valid and how critical thinking skills and information literacy are affected based on their exposure to using the Internet for educational purposes. He or she is being asked to take part because he or she is part of the class that had the opportunity to enroll in the Career Magnet School in its first year and he or she either enrolled in that school or opted to enroll in the traditional high school setting. The results of this study will help educators recommend pedagogical practices that will enhance critical thinking and information literacy skills pertaining to online learning.

This study is being conducted by Patricia Flood, a doctoral student at Liberty University.

Background Information:

The purpose of this study is to answer the following question which was developed from related literature and frames the investigation: Is there a statistically significant difference in high school students’ critical thinking and information literacy skills in analyzing information from the Internet as authentic, reliable, and valid who are involved in 1:1 iPad programs compared to high school students’ critical thinking and information literacy skills who are enrolled in a traditional high school setting as measured by the Test of Everyday Reasoning (TER) and iSkills?

Procedures:

If you agree that your child may participate in this study, he or she will be asked to do the following things:
Your child will be asked to participate in two testing sessions. They will both take place online and during a study hall. Test of Everyday Reasoning Skills will be given as well as the iSkills assessment. They will be given within two weeks of each other. Each test will take approximately 45 minutes.

Risks and Benefits of being in the Study:

I do not anticipate any risks to your child participating in this study other than those encountered in day-to-day life. Names will not be assigned to data collection.
The benefits to participation are:

1. It will provide information to educators on how well students discern information they encounter on the Internet as being authentic, reliable, and valid based upon their educational time spent on the Internet in a 1:1 iPad program.

2. It will provide information to educators on how well developed students’ information literacy skills are based on their enrollment in a 1:1 iPad program.

3. It will serve as a catalyst to other studies to research strategies that can strengthen students’ critical thinking and information literacy skills.

Compensation:

Participants will not be compensated.

Confidentiality:

The records of this study will be kept private. In any report I make public I will not include information that will make it possible to identify your child. Research records will be kept in a locked file; only the researcher will have access to the records. The identity of the school is referred to as a Magnet School and a traditional high school with a general location in south central Pennsylvania. All participants will be given a four-digit code as an identifier. All data will be stored on flash drives in a locked storage drawer and protected for the duration of three years and the researcher will have sole access to the files. Files will also be kept on the researcher’s laptop with a secure password. The only persons having access are the researcher and the committee.

Voluntary Nature of the Study:

Taking part in this study is voluntary. If your child decides not to take part, it will not affect his or her current or future relationship with Liberty University. If your child decides to take part, he or she is free to withdraw at any time. There is the possibility that your child may not be selected for this study based on the number of applicant responses.

Contacts and Questions:

The researcher conducting this study is Patricia Flood. If you have questions, you are encouraged to contact her at [redacted] or paflight@liberty.edu. You may also contact her advisor, Dr. Gary Kuhn at [redacted] or garykuhn@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24515 or email at irbs@liberty.edu.
Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: ____________________________ Date: ________________

Signature of parent or guardian: ____________________________ Date: ________________

Signature of Investigator: ____________________________ Date: ________________
APPENDIX D

Letter of Invitation to Participant

Dear Potential Participant,

I am a doctoral student at Liberty University in Lynchburg, Virginia. I am inviting you to participate in a research study that I am conducting for partial fulfillment of the requirements of my degree program.

The focus of my study is how well students using the Internet discern information as valid, reliable, and authentic and how it affects their information literacy skills as well as their critical thinking skills. You have been identified as a potential participant. If you agree to be in this study, you will be asked to participate in two testing sessions. The first one will be an online test called Test of Everyday Reasoning. This will measure critical thinking skills. Two weeks later, you will take a test, iSkills which will measure your information literacy skills or how well you discern and interact with information found on the Internet. Each test takes about 45-60 minutes.

These tasks will take place during the school hours at your institution. If you are interested in participating in this study, please sign and send the attached consent form. You will obtain a copy of the consent form for your records at the time of your test in the fall.

If you have any questions or concerns, about this research project, please feel free to call me at [number] or email me at paflood@liberty.edu.

Thank you for your consideration,

Sincerely,

Patricia Flood
APPENDIX E

IRB Change in Protocol Approval: IRB Exemption 2060.011315: Information Literacy Skills and Critical Thinking Skills: Discerning Online Information among High School Students

Good Evening Patricia,

This email is to inform you that your request to offer a $10 Sheetz or Target gift card to compensate research participants has been approved.

Thank you for complying with the IRB’s requirements for making changes to your approved study. Please do not hesitate to contact us with any questions.

We wish you well as you continue with your research.

Best,

G. Michele Baker, MA, CIP

Institutional Review Board Coordinator

The Graduate School

(434) 592-5530